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Giving Form to Feedback: Craft and Technology, circa 1968-1974

DISSERTATION

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by

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ABSTRACT OF THE DISSERTATION

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Professor Cécile Whiting, Chair

In the American postwar era, artistic engagement with technology has been characterized by deep ambivalence in favor of conceptual practice. This project examines how craftspeople challenge this history through their engagement with digital technology. Given their object-centered practice, craftspeople were primed to give material form to abstract "Systems Era" concepts. I approach this project through three case studies: biological feedback in Mary Ann Scherr's jewelry, human-computer feedback designed by IBM programmer and weaver Janice Lourie, and ecological feedback in woodworker Wendell Castle's immersive spaces. These craftspeople provide a vibrant precedent to contemporary personal fabrication, and offer insight into the role gender played in the domestication of technology.

INTRODUCTION

"Giving Form to Feedback: Craft and Technology" examines how and why American craftspeople (circa 1968-1974) embraced technological innovation.[1] Since the American importation of the British Arts and Crafts movement in the late 19th century, "craft" has generally been described as a reaction against industrialization. Subsequently, craftspeople have been romanticized as anachronistic, working with the objects and processes of previous eras in order to provide a social corrective to the ills of the industrial workplace. Recent scholarship challenges this pervasive narrative, countering that "craft" is itself a product of modernity and the Industrial Revolution. To support their argument, these scholars focus on moments when craftspeople collaborated with industry, most notably those associated with the Bauhaus, as well as Cold War era "designer craftsmen" such as Charles and Ray Eames. In this new scholarship, the late 1960s and early 1970s represent the end of the designer craftsman era, as craftspeople embraced their own sentimental mythos, abandoned their collaborations with industry, and reverted to antiquated ways of making, encouraged by the popularity of countercultural tenets of individualism and anti-consumerism. In my dissertation, I retain the core insight of contemporary craft scholarship—that craft must be understood within the context of industry and mechanization—but focus on a subset of craftspeople from this era whose legacy challenges the assumption that a dismissal of industry necessitates a rejection of technological tools.

Understanding craft's changing relationship to industry and technology requires an appreciation of how America's "Machine Age" (circa, 1880-1940) gave way to an "Information

[1] The issue of gendered nouns and pronouns deserves attention. Every woman I write about describes her activities as those of a "craftsman," or even uses the pronoun "he." I maintain this convention to reflect how they saw themselves, and how they were expected to speak and write about themselves. When writing about contemporary issues, I employ the term "craftsperson."

Age," in which complex machinery (such as computers) capable of solving a wide array of problems replaced devices built to solve specific problems (such as steam engines and radar dishes). Subsequently, the mastery of technology became less focused on how machines were built, and more focused on how integrated systems could be controlled to handle specific issues. In 1948, Norbert Wiener—a philosopher, mathematician, and pioneer of systems theory—declared "the thought of every age is reflected in its technique ... If the seventeenth and early eighteenth centuries are the age of clocks, and the later eighteenth and nineteenth centuries constitute the age of steam engines, the present time is the age of communication and control."[2] Wiener and other Information Age theorists proposed that "feedback loops" regulated communication and control between systems. These feedback loops were not only essential to technological progress, but could be applied to a range of problems, including biological concepts of homeostasis, ecological food webs, and economic theories of markets. If recent scholarship has firmly positioned craft in concert with mechanized production, then my project grapples with discerning how craftspeople positioned themselves in relation to Information Age conceptions of feedback loops and increasingly complicated technological systems. I argue that they understood their object-centered engagement with "hands on" making as lending material form to abstract concepts and systems.

Craft and the Lens of Social Reform

In contrast to this project's thesis, in the 1960s and 70s the term "craftsman" conjured pastoral imagery. A 1966 article from *Life* magazine on the "craft revival" [Fig. 1] exemplifies this perspective: "[T]he whole movement runs startling counter to the drift of our times. Working

[2] Norbert Wiener, *Cybernetics or Control and Communication in the Animal and the Machine.* (Cambridge: MIT Press, 1965.), 39.

with the simplest of tools (no electronics), using the oldest of materials (no plastics), tending all the work himself from design to execution".[3] While my dissertation will dispute each one of *Life's* claims, it is instructive to understand how craft was framed in the popular press. it is instructive to understand how craft was framed in the popular press. In this quote craft is presented as a "movement," suggesting a shared goal of social reform. Secondly, it is clear that this movement of craftspeople is oriented towards the past; in addition to the denial of electronics or plastics, the mode of working in utter isolation seems shockingly anachronistic for the mid 1960s. The *Life* article exemplifies how a focus on social reform and a romanticized past has oversimplified the discourse surrounding craft.

This romantic view is frequently traced to the British designer and social critic William Morris, whose socialist philosophical outlook was yoked to the decorative arts in an appeal to create both a more beautiful environment for the consumer and better living conditions for the laborer. For Morris, both goals could be reached through a more thoughtful approach to working conditions and processes that largely rejected the industrial labor practice of his time in favor of the guild of the Middle-Ages. Importantly, Morris' writings do not prohibit an engagement with new and mechanical forms of production, nor do they simplistically idealize the medieval past; rather his ideas have been largely misinterpreted to assume these meanings.[4]

Scholars writing about the history of craft in the United States begin with the importation of British ideas into what became known as the "Arts and Crafts Movement." In her book *Art and Labor*, historian Eileen Boris traces what she terms the "craftsman ideal" as " a reaction against industrialization, urbanization, modernization—against what we can more precisely call

[3] "The Old Crafts Find New Hands," *Life*, July 29, 1966.
[4] Edward S. Cooke Jr., "Modern Craft and the American Experience", *American Art* 21, no. 1 (2007): 2-9.

the growth of a bureaucratized corporate structure in the context of capitalist social relations."[5] For Boris, Morris' focus on social reform through an appeal to an imagined past became easily perverted within an American context, as Arts and Crafts figures such as Gustav Stickley discouraged worker unionization through an appeal to the romanticized guild of the Middle Ages, claiming that the unions' demand for equal wages would kill the motivation for quality and excellence in workmanship for its own sake. As this particular case study suggests, in Borris' final analysis the Arts and Crafts movement is something of a failure, judged primarily by the goal of social reform and defined by what it stands in opposition to.[6]

Craft would again function as a panacea during the transition into the "post-Fordist" economy of the late 1960s. Fordism came into prominence in the early 20th century, and describes a system of mass production built around maximizing worker productivity by breaking production into small, discrete tasks. In broad strokes, post-Fordism describes the economic shift from mass production to a more agile—or "just enough and just in time"—creation of inventory.[7] This change allowed companies to embrace more diffuse production models, with centers of manufacturing dispersed over larger geographic distances to take advantage of regions with less unionization. Labor historian Jefferson Cowie has shown that while the Post-Fordist deindustrialization of America—with its associated wage stagnation, massive layoffs, and crippled unions—had not fully materialized by the early 1970s, the plight of the Industrial worker was still marked by dissatisfaction.[8] Interestingly, prominent media coverage of the

[5] Eileen Boris, *Art and labor: Ruskin, Morris, and the craftsman ideal in America*, (Philadelphia: Temple University Press, 1986), xi.
[6] Boris, xiv.
[7] David Harvey, *A Brief History of Neoliberalism,* (Oxford: Oxford University Press, 2007).
[8] Jefferson Coiwe, *Stayin' Alive: the 1970s and the Last Days of the Working Class* (New York: The New Press, 2010)

"blue collar blues" emphasized dissatisfaction not with pay scale or a diminishing labor market, but with quality of life issues. For example, the highly visible 1972 labor strike of General Motors (GM) in Lordstown, Ohio, pivoted on issues of workmanship and the quality of working conditions. Prior to the strike, GM had greatly increased the pace of production at the Lordstown plant to better compete with foreign manufactures. Workers rebelled, claiming that the new pace of work was alienating and dehumanizing. GM's response to their employees' grievances was to celebrate the skill of the GM factory worker, likening him to the "Old World Craftsman."[9] Similar to Stickley, GM lauded the values of "craftsmanship" were again lauded to discourage any substantive changes to industrial working conditions.

Studio craftspeople of the early 1970s engaged with such corporate appropriations of their profession by evolving, adopting ideas from the corporate and technological sector to fashion a face of craft consistent with their views: highly skilled, individualist, and progressive. Looking at my historical moment through a lens of social reform, I might, like Boris, deem the period something of a failure; the social promotion of small and decentralized technology has, quite arguably, been usurped by even more complex and omnipresent technological systems. However, recent writings in craft theory provide other perspectives. Instead of viewing craft as a failed project of social reform, I wish to turn to theorists who help us understand craft as elucidating a more complex cultural history.

Craft as Technique

I am not the first to grapple with the relationship between craft and mechanization. Craft historian and theorist Glenn Adamson argues that the common conception of "craft" is itself a

[9] For a detailed discussion of this phenomenon see: Natasha Zaretsky, *No Direction Home: the American Family and the Fear of National Decline, 1968-1980*, (Chapel Hill: UNC Press, 2007), 122-137.

product of the Industrial Revolution, and not a vestigial remainder of a pre-industrial past.[10] He demonstrates that during the height of the British Industrial Revolution, the divide was not between hand and machine, but between conception and execution. In fact, it was culturally common to liken the skilled craftsman to the machine; unlike the artist who was seen as expressing emotion, or the engineer whose works relied on intellect, the craftsman, according to Adamson, was seen as dependent on manual knowledge. Adamson contends that this made craftsmen seem more machine-like, in that they manually reproduced without much thought towards their process. This conception yielded two responses: one of craftsman uplift—involving greater education of design processes and better working conditions—and the other of romanticizing the craftsman. Although uplift is an important theme in 20th century American craft discourse, for my purposes it is the romanticization of craft that is central to the pastoralist narrative. Objects made by craftspeople were to be valued because as expressions of the whims and desires of the craftsman that provided a link to primal and unmediated humanity.

If for Morris the machine remained a tool to be ever-watchful of, and for later writers it was craft's greatest foil, in my chosen period the "Machine Age" was overshadowed by the "Information Age." Historian James Beniger has argued that the roots of our Information Age can be found well before the creation of what we might now think of as information technology, such as computers. Instead, Beniger argues that the increased speed of manufacturing and transportation during the Industrial Revolution required new means for accounting and directing people and goods. In such a complex scenario, control is established by directing information through depersonalized systems, rather than through the judgments of individuals.[11] In this view,

[10] Glenn Adamson, *The Invention of Craft*, (London: Bloomsbury, 2013)
[11] James Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society*, (Cambridge: Harvard University Press, 1986), 11-15.

the driving force of the Information Age was not technological objects, but the rise of concepts necessary to regulate information: "control," "feedback," and "information processing."

Concomitant with the rise in information theory came discussions of "technology" as opposed to "machines." Historians agree that the term "technology" was not widely used in American thought until the 1930s, and entered common parlance after WWII.[12] Historian and cultural theorist Leo Marx has been instrumental in distinguishing technology from the machine, noting that while machines are seen as discrete objects, technology is discussed in terms of disembodied systems. As Marx has noted, this disembodiment led to a blurring of our understanding of labor and materiality:

> … a prominent feature of these complex, ad hoc systems is the blurring of the borderlines between their constituent elements—notably the boundary separating the artifactual equipment (the machinery or hardware) and all the rest: the reservoir of technical—scientific—knowledge; the specially trained workforce; the financial apparatus; and the means of acquiring raw materials[13]

In Marx's view, such blurring serves practical social ends by distancing the negative associations of the material and mechanical from the lofty social goals of the Information Age:

> …the term mechanic (or industrial, or practical) arts calls to mind men with soiled hands tinkering at workbenches, technology conjures clean, well-educated, white male technicians in control booths watching dials, instrument panels, or computer monitors. Whereas the mechanic arts belong to the mundane world of work, physicality, and practicality— of humdrum handicrafts and artisanal skills—technology belongs on the higher social and intellectual plane of book learning, scientific research, and the university. This dispassionate word, with its synthetic patina, its lack of a physical or sensory referent, its aura of sanitized, bloodless—indeed, disembodied—cerebration and precision, has eased the induction of what had been the mechanic arts—now

[12] Thomas P. Hughes, *Human-Built World: How to Think about Technology and Culture*, (Chicago, University of Chicago Press, 2004), 2.
[13] Leo Marx, "Technology: The emergence of a hazardous concept." *Technology and Culture* 51.3 (2010): 568.

> practiced by engineers—into the precincts of the finer arts and higher learning.[14]

As I will discuss later, my dissertation might be seen as restoring materiality back into discussions of the technological. However, this complex and disembodied aspect of technology as an "artform" can be seen as a root cause for the public's fasciation and anxiety during the postwar period.

The joining of technology with Information Age concepts of feedback and control came into intellectual vogue in the late 1940s. Norbert Wiener's *Cybernetics or Control and Communication in the Animal and the Machine* (1948) was a best-seller and wildly popular for a scientific text.[15] Part of the appeal of cybernetics and its cornerstone concepts of "feedback" and "control" was how it could present a unified understanding of the world. As Historian Ronald R. Kline writes, cybernetics "could bridge the physical, biological, and social sciences. The allure of cybernetics rested on its promise to model mathematically the purposeful behavior of all organisms, as well as inanimate systems."[16] In addition top providing a unified paradigm, Wiener's text introduced many readers to ongoing research into computers—the only machines capable of processing the complex information cybernetics attempted to describe. The advent of computers meant that technology was catching up with the concepts of control, spurring the rise of the Information Age.

Although the universality of cybernetics fed its popularity, it also led to a growing anxiety about the consequences of information technology for society. A central theme of Wiener's text was that humans could be likened to machines through the shared process of

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[14] Marx, 574.
[15] Ronald R. Kline, *The Cybernetics Moment: Or Why We Call Our Age the Information Age*, (Baltimore: Johns Hopkins University Press, 2015), 4.
[16] Kline, 68.

feedback. This comparison was taken to dire conclusions by Wiener, who in the popular press frequently alluded to a potential "second industrial revolution" in which humans would be put out of work by computer counterparts.[17] Kline has argued that part of the widespread fascination with cybernetics resulted from a mounting unease regarding human's reducibility to mechanical counterparts. For example, in the winter of 1951 *Time* magazine contained a feature on the Information Age, with a cover image of Harvard's Mark III computer anthropomorphized as a navy admiral. [Fig. 2] With a wary eye, the Mark III examines data on tickertape, while a thin and painfully dexterous hands input more information into a typewriter Such anthropomorphized attributes only serve to highlight the uncanny inhumanity of the computer. This anxiety only deepened over the next decade. The early 1960s represents a time when infatuation with engineers and technologists as rational social leaders became overshadowed by a mounting suspicion of overarching and invisible systems.[18] Intellectuals such as sociologist C. Wright Mills and cultural critic Lewis Mumford lent an increasingly wary tone to discussions of technologically ordered societies. Their core critique was that in an increasingly complicated and obfuscated, yet highly bureaucratic, technological society, individuals were becoming progressively regimented and machine-like, with little understanding of their roles or the systems their work supported. In the words of C. Wright Mills the Information Age worked had become the "cheerful robot."[19] With these ideas as a touchstone, standard narratives of American youth culture during the mid to late 1960s cite a rise of mistrust and hostility towards technological

[17] Harry M. Davis, "An Interview with Norbert Wiener", *the New York Times*, April 10, 1949.
[18] Thomas P. Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm, 1870-1970*, (Chicago: University of Chicago Press, 2004), 467-472.
[19] This term originates from Mills' study of middle-class Americans; see: C. Wright. Mills, *White Collar: The American Middle Classes*, (New York: Oxford University Press, 1969), 223-225.

systems. Concomitant to *Life's* portrayal of mid-60s craftspeople mentioned previously, the counterculture and back-to-the-land movements were similarly discussed as a purposeful turning back and retreat from contemporary technology and systems.

More recent histories, such as those put forth by Fred Turner, are instrumental in tempering these claims of regressive technophobia; a distrust of technological bureaucratic systems did not equate to a rejection of technological objects or systems thinking.[20] To support his, Turner studied the "new communalists," who "turned away from political action and toward technology and the transformation of consciousness as the primary sources of social change."[21] These new communalists provide a useful model for my case studies, as the group included considerable—though by no means complete—overlap with studio craftspeople of the period. Turner points out that those in the communalist back-to-the-land movement "often embraced the collaborative social practices, the celebration of technology, and the cybernetic rhetoric of mainstream military-industrial-academic research."[22] The use of systems theory and collaborative modes discussed by Turner will be instrumental in understanding the role of technology in relation to the craftspeople of my period.

A significant segment of the craft community in the late 1960s and early 1970s wrote, exhibited, and made objects using contemporaneous technological systems. Craftspeople transitioning from traditional materials to rubber, aluminum, and plastics were celebrated within

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[20] In the last few years there has been a rush of scholarship highlighting the use of technology by those who opposed widespread technological systems. For some examples, see the essays in the exhibition catalogue: Greg Castillo and Esther. *Hippie Modernism: The Struggle for Utopia*. Edited by Andrew Blauvelt. (Minneapolis: Walker Art Center, 2015)

[21] Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*, (Chicago: University of Chicago Press, 2010), 33.

[22] Turner, 33.

the pages of prominent publications such as *Craft Horizons*.[23] Synthetic materials diverged from being the purview of the designer craftsman, or what arts critic Lawrence Alloway termed a "post-Bauhaus pilgrim's progress towards the envisioned target of an ideal material," and instead became part of the rightful toolkit of craftspeople creating unique objects.[24] The metamorphosis from machines to technological systems was significant enough that multiple shows on the subject were produced by major art institutions. In his review of the 1969 exhibition *The Machine as Seen at the End of the Mechanical Age* at the Museum of Modern Art (New York), John Lahr directly engages with Norbert Wiener to reflect on the craftperson's advance into the systems age; he states, "[the craftsperson] has had to acknowledge the machine, and now the computer. If the world is drastically reformed by invention, art must absorb the force or dwindle into a beautiful anachronism". Lahr suggests that "[a]s the machine is phased out for a more complex technology, artists are trying to find a way into the labyrinth of modern science. Some of the most important innovators in art are evolving from a scientific background."[25] Examples such as these demonstrate the prevalence of the integration of technology into the craft community.

Craft as Cultural History

A central thread of critical craft inquiry places craft alongside—instead of in opposition to—modernity. The infrastructure of studio craft in the 1960s and 70s had surprisingly cosmopolitan roots. This dissertation primarily focuses on the craftspeople, discourses and exhibitions that emerged from the American Craft Council (ACC), which was based in New

[23] Gary Bower, "Clayton Bailey", *Craft Horizons*, Vol.XXVIII No. 1, (January/February 1968), 24.
[24] Lawrence Alloway, "The Plastic Reliefs of Nicholas Vergette", *Craft Horizons, Vol.XXVIII*
[25] John Lahr, "Reflections on the Machine", *Craft Horizons*, Vol.XXIX No. 1, (January/February 1969), 50.

York. While there were other vital areas of craft practice during the period, the ACC explicitly grappled with defining "craft," and had both the resources and reach to become a base for intellectual exchange and lasting canonization.[26] Aileen Osborn Webb, founder of the ACC in 1939, represented a segment of New Deal-era philanthropists.[27] A New York native, Webb was firmly embedded in a world of wealth and the arts. She was the daughter of William Church Osborn, who eventually became president of the Metropolitan Museum of Art, and was married to Vanderbilt Webb, a member of the well-known Vanderbilt family who had ties to the Whitney Museum of American Art. Far from romanticized, pastoral individualists, craft as defined by the ACC was embedded in a rarefied network connected to individuals of wealth and power in American visual culture.

Webb's biography reveals that 20th century studio craft was deeply embedded in both the world of the fine arts and the marketplace. The very address of the ACC's Museum of Contemporary Craft—29 West 53rd Street—supports this fact; it is mere doors down from the Museum of Modern Art. Webb bought the building for the Museum of Contemporary Craft (MCC) in 1953 on the advice of René d'Harnoncourt, then director of the Museum of Modern Art, and one of her close friends and confidants.[28] Additionally, the infrastructure of studio craft was always, at least in part, a commercial endeavor that sought to cultivate a mainstream audience and consumer base.[29] The ACC began as a depression-era philanthropic organization;

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[26] California was another site of vibrant experimentation into craft during this period of time. For various essays chronicling craft on the west Coast, see: Elissa Auther and Adam Lerner, eds. *West of Center: Art and the Counterculture Experiment in America, 1965-1977*, (Minneapolis: U of Minnesota Press, 2012)

[27] Ellen Paul Denker, "Aileen Osborn Webb and the Origins of Craft's Infrastructure", *The Journal of Modern Craft* 6, no. 1 (2013): 11-34.

[28] Denker, 25.

[29] The marketing of craft extended beyond the activities of the ACC. Historian Jane Becker, for instance, considers the imbrication of craft and industry in her study of the development of the

Webb believed that for craft to be viable in 20th century society, it had to produce desired objects. She put no small amount of effort into cultivating a studio craft world that could aid craftspeople in both understanding contemporary tastes and marketing their products.[30] The magazine *House Beautiful* frequently ran articles featuring ACC members, encouraging the primary audience of middle-class woman to bring craft objects into their homes. [Fig. 3] One memorable issue from the winter of 1965 includes a long feature with Webb and then-director of the Metropolitan Museum of Art, James Rorimer. Their dialogue is framed in terms of restoration:

> … a paradox of this wondrously automated era is the rebirth of respect for the work of the human hand. Realizing their own native talent for crafts. Americans have a growing appreciation for the one-of-a-kind beauty created by professional artist-craftsman, and astonishing numbers are becoming leisure-time craftsmen themselves.[31]

In summation, the image of craft as restorative was in many ways a self-conscious affectation, a savvy positioning of craft to the broader public.

While Webb gave the ACC its foundation in the world of postwar "good taste," MCC director Paul Smith helped craft adapt to the changing tastes and values of the 1960s. Smith's interest in youth culture informed his exhibitions at the MCC; shows on medium or region began to be replaced with thematic exhibitions on topics as wide ranging as fantasy and sound. In interviews from the period, Smith suggested a natural connection between studio craft and

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folk culture in Appalachia. *Selling tradition: Appalachia and the construction of an American folk, 1930-1940* (1998) traces how market forces influenced design and labor practices. In Becker's analysis, such forces were joined with conceptions of craft's rural past to make objects that were appealing to American consumers in the 1930s. Thus, modern "tasteful" designs were disseminated through advertising techniques that sold the idea of timeless and simple craft, which the country desperately needed in the wake of the Great Depression.

[30] Denker, 13-14.

[31] "The American Genius for Crafts," *House Beautiful*, (February, 1965)

shifting cultural values:

> [the youth's] way of living is more casual and individualistic. Young people often want the unique object, the handmade article, as an expression of their personalities …We want to simplify what we own and not be tied down to possessions. This way of living tends to make us very selective about certain objects.[32]

As he slips from the third-person to the first—aligning himself with the youth culture he describes—Smith frames craft as in keeping with the times.

The "young" that Smith alludes to were largely shaped by the burgeoning idea of a "counterculture;" a topic that will be reoccur throughout my case studies. From the inception of the term, "counterculture" had ties to youth culture. In his research on youth and delinquency, sociologist J. Milton Yinger distinguished between traditional "subcultures," or smaller social groups within a society, and what he termed the "contraculture," which defined itself in opposition to mainstream societal beliefs. [33] Yinger emphasized the combative nature of this "contraculture," describing its values as "emergent norms of a group caught in a frustrating and conflict-laden situation."[34] Historian Theodore Roszak built on Yinger's definition to describe the "counterculture" as a widespread shift in youth values that occurred during the 1960s.[35] To Roszak, the mainstream values that the counterculture was fighting against was the

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[32] Dorothea M. Brooks, "Handcrafted Furnishing Preferred by Homemakers", *Chicago Tribune*, January 30, 1971

[33] The etymology of the term "counterculture" is given in Elissa Auther's and Adam Lerner's "Introduction" in *West of Center: Art and the Counterculture Experiment in America, 1965-1977*, (Minneapolis: U of Minnesota Press, 2012), xix.

[34] J. Milton Yinger, "Contraculture and subculture", *American Sociological Review* (1960): 625-635.

[35] Theodore Roszak, *The Making of a Counter Culture: Reflections on the Technocratic Society and Its Youthful Opposition*, (New York: Anchor Books, 1969) Importantly, Roszak would prefigure the realization of some social critics in the 1970s—such as Christopher Lasch —noting that the definition of "youth" became prolonged during this period. For example, student protest leader Mario Salvo was in his late 20s with a wife and child, while he led student protests at UC Berkeley.

"technocracy," which was alluded to in my earlier discussion on cybernetics. Roszak viewed the technocracy as a faith that a focus on productivity and efficiency would ensure the most social good:

> [Technocracy is a] social form in which an industrial society reaches the peak of its organizational integration. It is the ideal men usually have in mind when they speak of modernizing, up-dating, rationalizing, planning. Drawing upon such unquestionable imperatives as the demand for efficiency, for social security, for large-scale co-ordination of men and resources, for ever higher levels of affluence and ever more impressive manifestations of collective human power, the technocracy works to knit together the anachronistic gaps and fissures of the industrial society.[36]

In order to counter this system, which permeated so many aspects of daily life, Roszak argued that the counterculture offered a holistic change in self-perception and personal desires.[37] This opposition to the technocracy led the counterculture to experiment with consciousness-altering psychedelics, self-sufficient living with the natural world, and new forms of familial and community structures.

While some sectors of society in the United States reacted with outright hostility towards the youth culture, many were eager to adopt values or aesthetic markers of self-transformation into their daily life. By 1967 there was a rush of articles and guides for the "square," who was not part of the counterculture but wanted to understand it better, and perhaps use some of its teachings to enhance her own life. These guides ranged from *The New York Time's* "The Intelligent Square's Guide To Hippieland," to the *Ladies Home Journal's* "A Square Woman's Guide to Hippie World", the latter of which included a glossary of of key words and phrases to

[36] Roszak, 5.
[37] Roszak contrasts this to a traditional political movement or the activities of the "New Left;" see: Roszak, 49.

help one “groove” nestled amongst advertisements for canned vegetables and diet cereal. [38] Research by sociologist Daniel Yankelovich demonstrated that countercultural ideas continued to gain popularity even after the high-water mark of counterculture visibility in the late-1960s. For example, polls of college students in 1968 found that 56% of students found the possibility of working under the authority of a "boss" acceptable, while that number dropped to 36% in 1971.[39] By the 1970s, many countercultural values had permeated the culture to which it was opposed.

The craftspeople I study would likely qualify as "squares," yet they all helped spread countercultural values into mainstream culture. My dissertation seeks to illuminate how the aesthetics and values of the counterculture permeated more culturally conservative environs. A major means by which this occurred was through consumption.[40] As mentioned previously, studio craft always had at least a foot in the consumer marketplace. Consumerism and the counterculture stood in a vexed relationship from the latter’s very inception. As Roszak argued, the counterculture was driven by postwar affluent youths who grew up with a sense of personal entitlement, empowered by their sway and influence in the marketplace, and the child rearing principles of Dr. Spock.[41] However, the counterculture was predicated on a pronounced distrust in corporate America, and there was a fear within the community that its aesthetic would be absorbed into mainstream consumerism. Yet with its focus on lifestyle rather than politics, it is difficult to disentangle consumption from the counterculture. This dissertation takes seriously the

[38] June Bingham, “The Intelligent Square's Guide to Hippieland”, *the New York Times*, September 24, 1967; "A Square Woman's Guide to Hippie World", *the Ladies Home Journal*, October, 1967

[39] Daniel Yankelovich, *The Changing Values on Campus*, (New York: Bantam, 1972), 28.

[40] For one account of the role of advertising in spreading the values of the counterculture, see: Thomas Frank, *The Conquest of Cool: Business Culture, Counterculture, and the Rise of Hip Consumerism*, (Chicago: University of Chicago Press, 1998)

[41] Roszak, 27-31.

role of consumerism as a powerful force in spreading the values of the counterculture, even if consumerism might have been abhorrent to the intellectual proponents of the counterculture

The Historization of Art and Technology in Visual Culture

While the role of technology in craft is both under-theorized and under-historicized, the role of technology in the fine arts has been the subject of more rigorous scholarship. The use of technologically new materials or techniques by artists during this period has largely been received in moralistic terms. On the national stage, this attitude can be attributed to a growing public suspicion regarding the alleged neutrality of technology as described previously. Paramount in this history is the Los Angeles County Museum of Art's *Art and Technology* (1965-1971) exhibition, which sought to pair contemporary artists with local technologically based industries. Art historian Anne Collins Goodyear has used this exhibition to trace what she cites as a post-war "technophilia" to a Vietnam-era "technophobia." When the exhibition opened in 1971, it was largely denounced as a failure; feminist groups criticized the show for inviting no female artists to participate, and even the conservative art critic Hilton Kramer damned the show on largely formal terms. For Collins Goodyear, the failure of *Art and Technology* cannot be understood outside the growing mistrust of technology tied to anti-war sentiment, as public awareness of the involvement of the Jet Propulsion Laboratory (JPL) and the RAND Corporation in the atrocities of the Vietnam War came increasingly into the forefront.[42] Additionally, as art historian Pamela Lee has argued, there was a growing perception that, as opposed to the exhibition offering technology as a "tool" for the artist, art was being used as a "tool" for technology, as companies hoped to counter negative public associations with the good press of

[42] Anne Collins Goodyear, "From Technophilia to Technophobia: The Impact of the Vietnam War on the Reception of "Art and Technology"." *Leonardo* 41, no. 2 (2008): 169-173.

participating in the arts.[43] For Goodyear, it became simply untenable for artists to partner with industry during this period due to a mounting technophobia, and it is with this legacy in mind that the author argues that art historical discourse since this period shows a marked rejection of works that engage with technologically innovative processes and materials.

While such histories are useful in describing general cultural trends, other modes are available that offer more complex understandings. Art historian Cécile Whiting's discussion of artist Vija Celmins' detailed hand-drawn depictions of NASA photographs provides an example of how the embrace of new technological forms can be situated within a complex field of relations.[44] Celmins' source photographs of lunar landscapes were from the NASA program, which as Whiting points out, can best be understood as an example of a "cyborg" melding of the human subject and technology, as the use of advanced cameras allowed NASA scientists to extend their vision and capture images of the moon. In examining Celmins' painstakingly hand reproduced depictions of these images, Whiting notes—via the theory of Laura Marks—how these pieces elicit a haptic gaze, a mode of seeing that engages with the sensual properties of touch. For Marks and for many other theorists, this haptic gaze is connected to many feminists' embrace of craft practices, such as embroidery, during the postwar period. However, Whiting makes a generative intervention by not privileging the handmade or haptic aspects of Celmins' works over the technologically derived nature of the source images. Instead, these works are allowed to exist in a hybrid zone between the handmade and the technologically created. There is little scholarship that attempts to view craft history through such a hybrid model. Ultimately, my project will seek to fill this gap by historicizing craft of the late 1960s and early 1970s not as a

[43] Pamela M. Lee, *Chronophobia: On Time in the Art of the 1960's*, (Cambridge: MIT Press, 2004), 30.
[44] Cécile Whiting, "It's Only a Paper Moon", *American Art* 23, no. 1 (2009): 36-55

rejection of technological systems, but as a field developing its objects and discourses in tandem with it.

Following intellectual historians my methodological approach in this dissertation views craft objects in a reflexive relationship with ideas. This method is directly informed by art historian George Kubler, whose *The Shape of Time* was wildly influential during the 1960s and whose work stands as a lasting influence on those who wish to incorporate material culture into their scholarship. Kubler's notion of "a history of things" brings together intellectual history, process, and the objects themselves:

> the 'history of things' is intended to reunite ideas and objects under the rubric of visual forms: the term includes both artifacts and works of art, both replicas and unique examples, both tools and expressions-in short all materials worked by human hands under the guidance of connected ideas developed in temporal sequence.[45]

This method is instructive to the field of craft studies, in which tools, processes, and the creation of multiples prove more influential than the creation of unique objects. Within the field of craft history this view has been articulated by historian Edward S. Cooke Jr., who discusses craft as an "embedded object," claiming "every object is an embedded social product in which formal complexity or technical expression is not simply a reflection of values but is often an active agent in articulating relationships or attitudes."[46] In Cooke's and Kubler's texts a robust method emerges that views objects and ideas as informing one another.

One aspect not touched on in the above methodology is the craftperson's process. The question of how one makes a given object, and how that making is communicated to the public is

[45] George Kubler, *The Shape of Time: Remarks on the History of Things*. (New Haven: Yale University Press, 1970), 9.
[46] Cooke, 7.

of the utmost importance.[47] Craft theorist Ann-Sophie Lehmann's "Showing Making" (2012) launches into the problems and usages of process in historical methodology. Lehmann employs contemporary theory that considers objects as potential social actors, but offers an important refinement in stressing that this methodology only examines the object once it is fully formed. As Lehmann states, theorists such as Bruno Latour or Alfred Gell have worked to overcome the subject/object dichotomy, but have perhaps remained within a biological framework that likens objects to living organisms, and thus only views them once they are fully developed. Lehmann usefully outlines the risks of such thinking when she claims, "if the analysis of things ignores processes of production, it fails to acknowledge how the complex interaction between humans, materials, tools, and technologies shapes the possible meanings and usages of the resulting artifact."[48] In her discussion of methodologies that would attend an inclusion of process, Lehman emphasizes her approach of studying the visual documentation of making. Lehman stresses that this documentation should not be treated as transparent or objective representations, but rather "the approach proposed here is that it aims to turn images into an analytical tool to investigate making by addressing not only what is shown, but how it is shown, how the image acquires the agency to show making and how its own materiality relates to the material process depicted."[49] Lehman negotiates between the ways in which the photos of making might be "staged"—for example, a frontal composition or the use of props—and the fact that even within this setting the artisans may well be practicing their craft. This is a useful point, as it acknowledges the construction behind the image, yet still takes its depiction seriously.

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[47] For an example of this method within the fine arts see Caroline Jones, *Machine in the Studio: Constructing the Postwar American Artist*, (Chicago: University of Chicago Press, 1998)
[48] Ann-Sophie Lehmann, "Showing Making: On Visual Documentation and Creative Practice." *The Journal of Modern Craft* 5.1 (2012), 10.
[49] Lehmann, 12.

Giving Form to Feedback: Three Case Studies

This dissertation consists of three chapters that demonstrate how craft practice gave form to disembodied technological systems, and thus helped individuals come to terms with the Information Age. If, as Fred Turner suggests, this was a period in which "young Americans encountered a cybernetic vision of the world, one in which material reality could be imagined as an information system," I would argue that the inverse was also true, that information systems could be given material form.[50] My case studies form a series of concentric rings, starting with the individual, moving outwards to computer-human relationships, and finally to human-environment interactions. Shaken by the social implications of the Information Age as well as the resulting counterculture, many in the United States experienced anxiety regarding the pervasiveness of systems they felt helplessly enmeshed in. The craftspeople I study gave form to these systems, in some cases enabling individuals to make better decisions about their personal health and the world they lived in. In other cases, they enabled corporate bureaucracies to develop a hip public image and more effectively market their goods and services. Rather than judge these various projects, I want to demonstrate how craft and its object-centered engagement interacted with a profound desire for stability during the time. In this way, we again consider how craft functioned as "restorative," but not within a romanticized, pastoral cultural context.

In addition to the primary thesis, I have chosen my case studies to illustrate several ideas about craft and technology that many will find counterintuitive. Two of my three case studies focus on women. While computer science and engineering are currently gendered as male fields, this has not always been true. I demonstrate the important role women played in shaping contemporary views on computers and technology and reintroduce them into a history where

[50] Turner, 4-5.

their contributions rarely have been recognized. Secondly, I have chosen to focus on objects that support my contention that the rise in digital fabrication has historical roots in the craft community of the 1960s and 1970s. While popular scholarship continues to see craft of this time as antithetical to technology, my case studies focus on craftspeople who embraced burgeoning technologies to make personalized objects. Many of the objects and ideas embraced by the people in my case studies directly prefigure the contemporary rise of 3D printing, laser etching, and diffuse manufacturing.

Chapter one studies how jeweler Mary Ann Scherr integrated technology into her objects to visualize feedback systems within the body. Craft was deeply in touch with the counterculture movement; a key legacy of which was the growing importance of bodily supervision. As historians such as Sam Binkley have shown, the counterculture produced a mainstream interest in getting in touch with the rhythms and processes of one's own body.[51] Publications such as *Our Bodies, Ourselves* (1969) alongside the growing popularity of massage and yoga were united through the belief that one's body was a complex system, which could be better managed through increased information and purposeful manipulation. Given its connections to countercultural thought, craft similarly reconsidered its relationship to the body.

This emphasis on craft monitoring the body finds its strongest expression through an examination of Scherr's "body monitoring" jewelry. Scherr, no stranger to working with industry and emergent materials, was commissioned by the United States Steel Company to create a series of stainless steel jewelry pieces that would travel the country in the late 1960s, highlighting the beauty of the material. In the early 1970s, Scherr began creating her body

[51] Sam Binkley, *Getting Loose: Lifestyle Consumption in the 1970s*, (Durham: Duke University Press, 2007)

monitoring line of jewelry, which performed a variety of functions, such as tracking the wearer's pulse. What is particularly remarkable about Scherr's work is how it marries precise functionality with florid design. Her "Heart-Pulse Sensor Bracelet" (1973) is adorned with incredibly elaborate metal work and incised decoration. While the current aesthetics of wearable technology, such as the Fitbit, is dominated by streamlined designs devoid of ornamentation, Scherr's objects marry technology and the decorative, and thus offer a radical reimaging of the form body extensions can take.

Chapter two historicizes the landscape of digital technology and craft practice through an examination of IBM computer programmer and weaver Janice Lourie. In the mid-1960s, Lourie developed computer assisted design (CAD) software for mechanical looms, which she termed "Textile Graphics." Lourie's CAD system utilized a computer monitor that allowed for manipulation of data through touching the screen with a light pen—similar to today's touch screen devices—enabling users to rapidly visualize and explore varied designs and weaving patterns. Lourie envisioned Textile Graphics as a conversation between computer and maker, with each party providing both constraints and solutions in progress towards a final product. Her conversational and iterative philosophy separates Lourie from many others computer scientists of her time, and connects her work to the contemporary landscape of CAD and craft.

During the period Lourie was developing her software, the neutrality of technology was routinely being challenged in mainstream thought. IBM therefore used Lourie in various public relations campaigns to counter this growing technophobia. A study of Lourie subsequently offers a vantage of how computers were domesticated in the popular imagination. Despite IBM's embrace of Lourie and the textile graphics system, her work actually complicates the neutral, hierarchical paradigm of technology IBM was promoting. Instead, Lourie encourages a

symbiotic approach to melding craft and technology that is far more nuanced than either a naïve belief in technological neutrality or, on the other extreme, a rejection of technological systems.

Chapter three engages with woodworker Wendell Castle, who produced handmade stack-laminated pieces in the 1960s that were celebrated for their curved, biomorphic form. Through a study of Castle's archival papers alongside those of his representative, Lee Nordness, I examine the cultural utility of Castle's work during the mid-60s, and how this narrative moves into contemporary discussions of digital production. The key to my argument is that Castle's work engages and re-engages the Information-Age rhetoric of middle-class and corporate culture. Castle's mid-60s pieces were embraced by corporations in the name of public relations, coinciding with a period wherein corporations no longer saw design simply as a tool to encourage public consumption, but as essential to the maintenance of corporate identity, and to give material structure to their logic and systems. In a similar tenor, economists such as Jeremy Rifkin have lauded "additive" manufacturing techniques currently employed by Castle, noting their economy of materials as a preferred method for agile and cost-effective production. In this way, technology has caught up to the rhetoric underlying Castle's earlier pieces, offering a case study on how the rhetoric and aesthetics of late-1960's craft prefigured and shaped current digital production.

Chapter 1
Of Astronauts and Gas Masks: Mary Ann Scherr's Body Monitoring Jewelry

[Fig. 1] Painted nails close lightly over an oxygen mask as the wearer looks up with surprising serenity. Tubing and electronic wires attach the mask to an ornate silver pendant. Hidden inside the pendant's large central compartment, left open for our examination, is the stuff of contemporary technology—liquid-crystal displays, sensors to detect particulates in the air, and a small cylinder of oxygen. This is no ordinary necklace, but one designed to save lives. Mary Ann Scherr's "Electronic Oxygen Mask Pendant" (1973) was displayed widely in museums and periodicals during the early 1970s. This necklace is part of Scherr's larger collection of "body monitoring" jewelry; a project that includes objects made as early as 1970 and as recently as 2016 (shortly before Scherr's death). In our current historical moment wearable technology has become a common sight; devices such as the FitBit and Apple Watch are so ubiquitous that they have become unremarkable. An understanding of Scherr's jewelry not only places the rise of wearable technology within a longer perspective, but also highlights a historical moment when technology was being profoundly shaped by changing cultural ideas about one's relationship to one's body.

The inspiration for Scherr's collection came as she watched the 1969 Apollo 11 moon landing, while creating a space-themed costume for Miss Ohio in that year's Miss USA competition.[52] [Fig. 2] As she watched the news transmit an electrocardiogram of astronaut Neil Armstrong's heartbeat, she thought about the potential of the garment in front of her. If it was possible to broadcast the heartbeat of a man on the moon, she reasoned, surely technology could

[52] Oral history interview with Mary Ann Scherr, 2001 April 6-7, Archives of American Art, Smithsonian Institution

do more to aid individuals on earth. These ideas were refined and directed by a photograph she saw in a newspaper, which showed, in her words, a "march in New York City where people wore gas masks to demonstrate that the air is rotten and that someone must do something about it."[53] The inspiration for Scherr's jewelry—the space suit and gas mask—offer two conflicting yet succinct examples regarding the hope and fear associated with personal technological devices. Scherr's jewelry tells a story of bodies—particularly female bodies—and the use of technology to achieve safety and a holistic sense of self.

I begin this chapter by examining Scherr's early training, highlighting how she leveraged her femininity and industrial design background to create jewelry that emphasized utility and innovation. Scherr's jewelry will then be placed in conversation with the space suit that inspired her, in order to illustrate 1960s ideas on how technology could generate personal empowerment through greater information about one's self and environment. I will give particular attention to two of Scherr's "body monitor" jewelry pieces, highlighting how they provided their wearers important information about their bodies while embracing the aesthetics of technology in their design. Scherr's jewelry utilized technology to bridge the opposing views of sensuality and functionalism that arose from the interplay between counterculture and the studio craft world. I will use her liquid crystal-based jewelry to illustrate the hopes associated with technology (that it could create a new field of "biofeedback"), and then her gas mask to focus on the fears (particularly environmental degradation). In both of these case studies, the types of bodies that are considered worthy of hopes and fears are often narrow. I conclude this chapter with Scherr's interest in assistive technology for people with disabilities, and explore the ways she was and

[53] "Body Jewelry Can Be Helpful to Your Health", July 23, 1972, M-86 *Portable World* (October 5, 1973 - January 1, 1974) Museum of Contemporary Crafts - Main Gallery Exhibitions, American Craft Council Archives

was not able to push conventional boundaries. This project shows how Scherr's jewelry weaves together conceptions of gender, the counterculture, ecology, and notions of ableism that developed alongside technology in the 1960s and 70s.

Scherr's Early Training

Scherr's professional trajectory—like many contemporaneous American craftspeople—began with highly pragmatic training in industrial design and eventually lead to more eccentric and individualistic projects. Scherr was born Mary Ann Weckman on August 3, 1921 in Akron, Ohio, and began her undergraduate training in art at the Cleveland Institute of Art in 1939. Her education was interrupted by the emergence of the Second World War, and in 1942 she left school to work for the Goodyear Tire (and later Goodyear Aircraft) Corporation, where she created cartographic and graphic visualizations of management systems for the US Navy. After the war, she briefly reentered the Cleveland Institute of Art and studied industrial design. Weckman was hired in 1946 as one of the first female designers at Ford Motor Company, where she worked on interiors and accessories. [Fig. 3] Ford's employment of Weckman was strategic, as the company wanted to capture women as a growing segment of their consumer base. Many promotional pieces from this period emphasize Weckman's role in feminizing cars for Ford; she is quoted in a local Akron newspaper as saying "[w]omen want their interiors more colorful. They want their fabrics more pleasing in lighter and softer colors. Some of them would even like to have the interiors quite flashy in appearance. But we always have to compromise with the men, too."[54] Scherr's positioning as a designer who can appeal to traditional feminine taste is a tendency that recurs through the bulk of Scherr's career.

[54] Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

Weckman married fellow industrial designer Sam Scherr, who was then an accessories designer at General Motors. Quickly afterwards, Sam Scherr started his own design firm, Scherr & McDermott Inc., of which Mary Ann was an active participant. Married life brought career challenges to Scherr, and in 1949 she stopped work to have her first child. She soon began to feel a sense of boredom and frustration as she stayed at home with her young son; perhaps more urgently, Scherr lamented "that her career had abandoned her."[55] To rectify this, she began taking night classes at a local community college in metalworking. Scherr eagerly began teaching herself various techniques and experimenting in different media. By 1950, the nearby Kent State University offered her a teaching position in product design. A year later, Scherr also began to teach metals (despite her relative lack of experience). Similar to her experience at Ford, this period demonstrates Scherr's savvy ability to circumvent social constraints and turn them into more advantageous situations.

Scherr received prizes at local craft shows while teaching at Kent State, and received national recognition in 1961 when she was commissioned by the United States Steel Corporation to create jewelry that highlighted the metal's beauty and strength. This commission came out of a call from President Kennedy's administration for different material industries to pitch themselves to the United States government as a substitute coinage.[56] Creating jewelry out of stainless steel was difficult due to the material's strength; tools and techniques adapted for softer metals such as silver or gold proved ill-suited for steel. But once Scherr adapted to the material, she was able to use the intrinsic strength of steel to create unusually long and continuous forms. Mirroring the

[55] Oral history interview with Mary Ann Scherr, 2001 April 6-7, Archives of American Art, Smithsonian Institution
[56] Oral history interview with Mary Ann Scherr, 2001 April 6-7, Archives of American Art, Smithsonian Institution

media attention that accompanied her career at Ford, newspapers' began referring to Scherr as the "most glamorous steel worker," while detailing the technical challenge of creating wearable and delicate designs in stainless steel.[57] [Fig. 4]

Scherr's stainless steel jewelry was first exhibited in a solo show at the Museum of Contemporary Crafts (MCC) (New York, NY) in the summer of 1963. The MCC was the main museum of the American Crafts Council (ACC) and along with the council's periodical, *Craft Horizons*, it would form one of the most vital and generative voices in the American craft scene in the latter half of the 20th century. A major initiative of the ACC was to advocate for the "designer-craftsmen," who partnered with industry to create a sense of beauty and style in everyday objects. Scherr's training in industrial design not only reflects this interest, but her stance on jewelry design reflects a longer trend towards embracing utilitarian and non-precious materials.

Scherr's background gave her a unique approach to post-war jewelry that focused on innovation in materials. Her contribution to the intersection of industrial design and studio craft can be understood through a comparison with the Museum of Modern Art's (MOMA) 1946 landmark exhibition *Modern Handmade Jewelry*. This exhibition focused on "junk jewelry," or pieces that eschewed traditional precious metals and gems in favor of quotidian materials.[58] Anni Alber's now iconic geometric sunburst necklace made from a drain cover and paper clips was shown at the exhibit, as were works by Margaret de Patta, who utilized everyday materials and serial production to make her jewelry more affordable to a larger audience.[59] Scherr engaged

[57] Garnette Jones, "Steelworker Creates Jewelry", *The Pittsburgh Press*, (July 16, 1965)
[58] "Modern Handmade Jewelry", Museum of Modern Art press release, September 11, 1946.
[59] Toni Greenbaum and Pat Kirkham, "Women Jewelry Designers" in *Women Designers in the United States*, ed. Pat Kirkham, (New Haven: Yale University Press, 2001), 205-207.

with this history of modernist jewelry, but used her connections to industry to adapt these avant-garde efforts into American industrial design. In a promotional brochure from the MCC, Scherr cast her work within this trend of democratizing jewelry: "[t]his strong and stubborn material [stainless steel] defies all traditional craft techniques, and demands a discipline not encountered in other materials. I believe I have found the precious qualities of stainless steel. I see this architectural-utilitarian material transformed into a new dimension of beauty."[60] In linking together industry, innovation, and adornment, Scherr set her path for the body monitor jewelry that would follow. Similar to how Scherr's training followed post-war trends in American craft, her later body monitoring jewelry (which concerns the rest this chapter) likewise reflects a shifting focus towards technology-driven individualism and counterculture ideology.

The body in the space race

While Scherr's monitors were inspired by the moon landing, what she couldn't have realized is what historians have later come to elucidate, that the Apollo space suit tells the story of radically shifting concepts of control and the body.[61] Space program proposals from the early 1960s focused on turning astronauts into "cyborgs," whose biochemistry and physiology should be adapted for space travel. Research team Nathan Kline and Manfred Clynes launched the idea of the cyborg into popular culture, and the term entered mainstream print in The New York Times article "Spaceman is Seen as Man-Machine".[62] A blend of the terms "cybernetic" and "organism," the cyborg was a man who, through chemical and mechanical manipulation, could survive in environments that the unaided human could not.[63] The cyborg was conceived within

[60] "Stainless Steel Jewelry/Mary Ann Scherr" brochure, Museum of Contemporary Crafts, May 24-Sept 8, 1963, American Craft Council Library
[61] Nicholas De Monchaux, *Spacesuit: Fashioning Apollo*, (Cambridge: MIT press, 2011)
[62] "Spaceman is Seen as Man-Machine", *New York Times*, May 22, 1960
[63] Ibid

the context of the space race, though Clynes also made clear that these ideas had Earthbound potential as well.[64]

The development of space suits to enable exploration of space opened up the possibility that humans on Earth could be refashioned by technology. The melding of the human and technology is, of course, an old idea; many histories of the cyborg trace the idea back to Mary Shelley's Frankenstein's monster or Frank Baum's Tin Woodman.[65] But in the 1960s this fictional concept suddenly seemed to be a medical possibility. Mid-sixties popular news coverage envisioned a future civilian that was profoundly altered by medical technology. *Life* magazine ran a four-part series entitled "Control of Life" that asked what the future of technologically-enhanced bodies would be.[66] The third installment considered "rebuilt people" and focused on manufactured and transplanted organs. [Fig. 5] The article opens with an image of a woman with over twenty synthetic modifications; her body is only visualized as a rough outline, suggesting she is a collection of individual parts and possibilities. According to the article, readers could expect robotic bladders in the not-to-distant future, and synthetic implantable hearts by 1970. One possible design for a synthetic heart is laid out cleanly on a bright red background, separating it from the messiness of the human body and taking on an almost formal purity that focuses the eye on its mechanical form. This particular issue of *Life* also included images of the Earth from the lofty vantage of the Gemini 5 spaceflight. Flipping through the pages, the outlines and contours of the continents visually associate the advances of the space race with the new frontier of advances of technology in the human body.

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[64] Ibid.
[65] Chris Hables Gray, Heidi J. Figueroa-Sarriera, and Steven Mentor, "Cyborgology: Constructing the Knowledge of Cybernetic Organisms" in *The Cyborg Handbook*, (New York: Routledge, 1995), 5.
[66] The "Control of Life" series ran in *Life from* September 10, 1965 to October 1, 1965

Despite such utopic visions, scientific research on the human body increasingly demonstrated its physiological limitations. NASA abandoned the idea of modifying humans into cyborgs, and instead embraced the idea of a "spacesuit" that could protect the astronaut's fragile form. The spacesuit that was ultimately chosen was developed by International Latex Corporation (the consumer brand of which was Playtex) which gave its astronauts an earth-like environment inside a soft and flexible shell.[67] This "cyborg-to-spacesuit" transition is one of many examples representing a movement away from post-war conceptions of absolute control, towards a framework of technological empowerment granted through a greater understanding of one's body and surroundings.

Scherr's Body Monitoring Jewelry and Changing Conceptions of the Technological Body

With her extensive training in industrial design and personal network of engineers, Scherr was uniquely positioned to give material form to burgeoning ideas regarding the body's empowerment through technology. Between 1969 and 1973 Scherr produced seven "body monitor" prototypes, each utilizing diverse technology to visualize internal bodily systems and/or the ambient environment. These pieces were meant to give the wearer information upon which to act, and change their surrounding or behavior to ensure bodily safety. Scherr's two most iconic pieces from this period—her "Electronic Oxygen Belt Pendant" (1972) and "Heart Beat Sensor Bracelet" (1972)—not only assist the wearer, but also embrace the visual aspects of technology in their ornamentation. The rhetoric of visibility and transparency is a seductive force in these two pieces; as the rhythms of the heart given a visual force, so too are the hidden structure of technology, turned into a visual motif in gold and silver.

[67] de Monchaux, 3.

The first body monitor Scherr completed was her "Electronic Oxygen Belt Pendant," [Fig. 6] made of elaborate incised silver and containing an oxygen mask, with a five-minute supply of oxygen, and an air quality monitor. This necklace was made in collaboration with the Ohio-based electronic engineer Harry L. Hosterman, who was able to fit the circuitry board into a then-impressively compact space. Scherr's initial design for this monitor [Fig. 7], incorporates technological features into the core of her design aesthetic. The finished necklace houses three circuitry compartments: the topmost small rectangular bar contains air intake valves and a row of small circular photocells to monitor the air quality; below this is the largest compartment, which contains a small cylinder of oxygen with mask, off/on circuitry, and the battery; the base contains a rectangular compartment from which hangs a round speaker to alert the wearer of any danger**.** Taken as a whole, Scherr's design choices engage with, rather than mask, the technological elements of her pendant. Etched around the top of the intake valves is a row of circular shapes reminiscent of the photocells housed inside. Likewise, the circular bottom speaker is flanked on either side by bright yellow amber stones, which lend a greater sense of balance to the largely rectangular necklace, both in its component pieces and its overall shape on the body. In this piece we can see how Scherr is gamely engaging with the technology of her body monitors; a tendency that only increases with her later pieces.

Scherr and Hosterman collaborated again on their "Heart Beat Sensor Bracelet" (1972) [Fig. 8], which used electric circuits that respond to physical pressure when placed over a pulse point (this process was awarded a patent in 1975). The references to technology in the design of Scherr's first body monitor is even more pronounced in this piece. The object is a hefty cuff, a reassuring or oppressive weight given one's own physical connection to the piece. At the top of the wrist lies a central compartment with three vertically placed hinged doors, each with a small

latch to ensure a closed position. The doors open to reveal the internal workings of the monitor. [Fig. 9] Included in the wiring of this piece are three subcircuits: respectively controlling a sensor and amplifier, a heartbeat rate detector, and an oscillator and alarm circuit. By leaving only certain doors opened, one can see both the interior circuitry and Scherr's detailed, curving, geometric abstractions. The circuits and small squares of soldered bronze echo one another; the curving lines of incised silver similarly echo the small electronic wires that connect the subcircuits, blending passages of neat geometry in a sea of curved lines. Seen from this vantage, the decoration of the bracelet not only echoes the interior circuitry, it continues it, creating visual symmetry between interior and exterior. The wearer could glance at the outside of the bracelet and be reminded of the interior workings, offering a sense of how the beating of their heart moved through an interior maze of wires and circuits. In the closed position, a small light emitting diode is present, which is intended to blink in unison with the wearer's pulse. This bracelet brings together the body and technology in new ways. It boldly places the inner workings of the technology on display, just as it similarly makes the rhythms of the body visible, putting the body and its assistive technology on the same visual field.

Scherr's combined focus on information and adornment reflect her relationship with both industry and studio craft. As she once stated, if people want devices that help control their bodies, "then we should wear a 'control' that becomes a visual pleasure."[68] In fact, Sherr was part of a growing trend of studio crafters who were interested in using technology to think about the body, and were influenced by the way that the counterculture seeped into mainstream culture. Understanding what Scherr found to be a "visual pleasure" ultimately requires an understanding of how studio craft was adapting to changing societal tastes in the late 1960s.

[68] Associated Press, February 1973, American Craft Council Library

Craft and the Counterculture Body

Studio craft in the late-sixties, like the counterculture, was invested in cultivating sensual experience. The general overlap between mainstream American craft and the counterculture was considerable; many craft historians have discussed this overlap by romanticizing simplicity and pointing to the ways in which craftspeople abandoned mass-consumer culture.[69] While these qualities were certainly present, there remains vital veins of similarities between craft and counterculture yet to be explored. I argue that changing conceptions of the body—both in terms of a growing emphasis on sensual experience and an emphasis on obtaining a greater knowledge of one's body—offers one such vein. As historians such as Sam Binkley have shown, the counterculture ultimately had an impact on mainstream culture by encouraging interest in the holistic management of the body. The growing popularity of massage, yoga, and health foods were united through the belief that the body was a complex system. As a system, the body could accordingly be better regulated through increased information and purposeful manipulation. Alongside a growing emphasis on personal freedom through sensual experience, Binkley suggests that a holistic management of the body was a means to correct a sense of alienation and inauthenticity:

> … the body was the foundation of psychic well-being, a vessel of personal meaning heretofore suppressed and unjustly restrained. The mind and the body remained tragically divorced under the regimes of modern work, consumption, and everyday life, and the overcoming of such a rending of the whole self into (sensual) body and (abstract) mind promised delivery from deep personal, spiritual, and social pathologies.[70]

[69] For an example, Elissa Auther, "Craft and the Handmade at Paolo Soleri's Communal Settlement" in *West of Center: Art and the Counterculture Experiment in America, 1965-1977.*
[70] Sam Binkley, *Getting Loose: Lifestyle Consumption in the1970s*, (Durham: Duke University Press, 2007), 211-212.

While the rhetoric of this cultural trend emphasized "freedom" and "looseness," there were highly mediated and prescribed routes to pursue these ends. Additionally, while the goal of mending this "divorce" of mind and body appeared to entail a rejection of mass-consumerism, there was a whole range of consumer goods aimed at this market.

Through its emphasis on the physicality of craft practice as well as the goods it produced, the studio craft community—dominated by the ACC—took part in this interest in the body. The 1968 exhibition *Body Covering* at the MCC eagerly tied craft to synthetic materials in opposition to the organic materials of fiber, clay, and wood, which continue to dominate a romanticized view of craft. As the exhibition displayed the awe inspiring technological prowess of the Block II Apollo suit alongside a vinyl mini-dress, the MCC sought to explore clothing both as a means of survival and purposeful personal expression. Museum director Paul Smith endeavored to show how new materials and craft know-how could create garments that advantageously situated the wearer in difficult environments—from the unknown regions of outer space to the crowded city sidewalk—by maintaining a level of physical and psychic stasis. The exhibition's catalogue cover featured a cutout silhouette of a naked human figure from which emanates concentric rings in shocking neon green and orange. [Fig. 10] While the rings that surround the body visualize the systems in which the body is enmeshed, the quality of the cutouts renders the body transparent, allowing recognition of the systems within.

By the end of the 1960s, the focus on the sensual potential of craft was fully embraced by the MCC. This emphasis may have been inspired in part by Smith's interest in yoga and transcendental mediation.[71] The MCC exhibition *Feel It* (1969) was in perfect accordance with the emerging counterculture orthodoxy of releasing oneself fully into the moment of experience.

[71] Glenn Adamson and Paul Smith Interview 12-1-17

Organized by Gustaf Clason and Eric Sorling—two Swedish designers affiliated with the Swedish Institute for Cultural Relations with Other Countries—*Feel It* prioritized touch over the standard visual encounter with a work of art. Clason's and Sorling's describe this priority in the exhibition catalogue through sentiments that could have come straight from Binkley's historical study:

> Our way of life dulls our senses and inhibits our communications with one another. Our conventionalism demonstrably produces negative effects and reduces human qualities. Our sensibility is threatened, suppressed, impaired. *Feel it* has come about as a test room for sensual experiences and emotional states, or as an exercise instrument for making use of human creative resources regardless of mental handicaps. The human being cannot and will not allow himself to be forever represented and manipulated. Passivity and vicarious experiences within the area of emotional communication work against individual qualities and thus against our development. *Feel it* should be seen as a means of expression without limitations in space, with the human beings participation and movements as prerequisites, where experiences and knowledges directly and totaly [sic] transfers to the participant.[72]

The exhibition consisted of a series of installations designed to inspire visitors to engage in a tactile manner with the art on display. One example is Bertil Vallien's "A7/B10 Pathway," a physical pathway coated with nylon fibers, glass, wood and iron. As the catalogue puts it, it is meant to act as an "artificial landscape for your feet."[73] [Fig. 11] Signaling that one might get a tad disheveled, the back cover for the catalogue features a pink fine-tooth comb and pack of Scandinavian Airlines tissues with the accompanying text "[b]ecause of the character and the arrangement of Feel it you might afterwards have use for these articles." The message is clear and not without humor; this exhibition is to here to shake you up, not just in what you imagine

[72] Gustaf Clason and Eric Sorling, "Feel It", Museum of Contemporary Craft, (New York, 1969), 3.
[73] "Feel It", Museum of Contemporary Craft, (New York, 1969).

contemporary craft to be, but to the level of your very person. Don't worry though, the comb and tissues seem to suggest, it's nothing you can't bounce back from.

This emphasis on the tactile and sensual was a major focus for years to come. Other exhibitions such as *Fur and Feathers* (1971) at the MCC encouraged visitors to explore the museum via their sense of touch. The exhibition, which highlighted synthetic or recycled fur as a nod to environmental thought, invited visitors to touch at the very point of entrance by covering their doors with green faux-fur.[74] One image from the exhibition reproduced in *The Washington Post* features a young woman pushing her entire body through the sculpture "Environmental Heaven" by Jacques Kaplan. It was made of lamb's wool, and the article included a quote from the visitor stating that experiencing this piece is "like having a house suddenly fall in love with you."[75] Another example was the three part series *ACTS: A Series of Participatory Exhibition/Events for Total Involvement*, which ran during the spring of 1971 at the MCC. This show equated "participation" with physical interaction. In one article on the series, Smith states "I merely want to bring people to a greater sense of awareness ... This is a push-button era. Less and less people are using their hands to make things. Our body has become pulled apart. We merely want to create a place where people can come to appreciate their senses through art-forms."[76] Smith's descriptive image of a body "pulled apart" demonstrates the depth with which craft was in touch with countercultural views, where sensual experience was a means to achieving physic wholeness in a fractured culture.

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[74] Rita Reif, "Show with Touch of Its Own", *The New York Times*, January, 23, 1971.
[75] David Saul, "The Sensual Exhibit: Craftsmanship with Furs, Feathers and Fun", *The Washington Post*, March 14, 1971.
[76] Jon P. Kraushar, "A Museum Where the Signs All Say: 'Please Touch' ", The Washington Post, May, 16, 1971

With this embrace of sensuality and tactile experience, jewelry began to move from ornamenting a small space of the body to become an expansive "second skin." Design historian Pat Kirkham has written about this transition towards *body sculpture*, "which reflected the undulating shapes and forms of women's bodies and the 'energy-charged' relationships of solids and voids in space. It belonged to the movement to claim jewelry as 'art' and was born out of a new awareness and pride of the human body."[77] Some of the most illustrative jewelry highlighting this tendency was made by the California based jeweler Arline Fisch. Fisch's work was a keystone piece in the iconic craft and design exhibition *Objects: USA* (1969), which was first exhibited at the Smithsonian and traveled throughout the country for the next five years, further cultivating a renewed interest in craft. Fisch frequently credited her work's intimacy and creativity to the burgeoning counterculture, going as far as to say "I credit the hippies for the renaissance in body ornamentation. They in turn influenced non-hippie young people, resulting in the wide-spread acceptance of plastic and papier mache [sic] jewelry. Cheap stuff, but nonetheless, exciting and imaginative."[78] [Fig. 12] Fisch's jewelry was used in many fashion editorials, including a 1969 issue of *Vogue* that equated the elaborate ornamentation of the body with increased self-confidence and a nebulous concept of sexual freedom. In the photo, a model poses wearing a silver bikini top with hanging silver chains by Fisch. With her face obscured by her upstretched arms, the long and sinuous line of her torso is echoed by the curve of the top of her hand; both of which seem to mimic the biomorphic, flame-like design that makes up the bikini top. The dangling chains lie on her torso and serve to elongate her figure even further. The text accompanying the photo reads: "[t]he skin around you and what's around it... a silver harness

[77] Toni Greenbaum and Pat Kirkham, "Women Jewelry Designers" in *Women Designers in the United States*, ed. Pat Kirkham, (New Haven: Yale University Press, 2001), 211.
[78] Archives of American Art, Arline M. Fisch papers, 1950-2003, bulk.

hung with chains. Moving with the body. Allowing it to reach, free and lissome, for the stars. Body ornament—the new silvery freedom—designed by Arline Fisch."[79] While the sheer size and harness-like design of the piece may suggest a cumbersome or oppressive experience, the caption and photo come together to defy this expectation. Instead, they proclaim new freedoms; the blending of skin and metal to form a second skin in which ornamentation is not something you wear, but something you are.

Of course, not all bodies were seen as fit for taking part in such celebrations of human flesh and sensual freedom. Numerous articles on Fisch's jewelry—and indeed comments made by Fisch herself—pointed out that her jewelry was intended for the young, slender, and beautiful. One article in the *Los Angeles Times* illustrates the thin line between a pleasure in the body and a narrowing of what such bodies should look like, "[t]he activists among young fashion designers believe that body covering of the future will be simply a matter of decoration. They envision human bodies so healthy and beautiful that the amount of clothing worn will be minuscule."[80] Logic that equates health and beauty ought to give pause. The article goes on to discuss another [male] designer who values "freedom of choice for women" and claims "I value the feelings of the woman I dress and feel it is my duty to help her express them." What do the designs that accompany such freedom consist of? The answer, "a micro-mini skirt in body-clinging crepe with a high-rise bra top."[81] This ethos of extreme health, youth, and vitality comes together in the work of Rudi Gernreich, one of the most noted avant-garde fashion designers of the 1960s. Gernreich, who made waves in design circles and the popular press with his 1964 topless monokini (incidentally featured in the MCC *Body Covering* exhibition), offered his sartorial

[79] "Forecast: 1969", *Vogue*, February*, 1969*
[80] "Young Designers Reach to the Future", *Los Angeles Times*, March 2, 1969,
[81] Ibid

predictions for the new decade in a two-part issue of *Life* magazine. [Fig. 13—*Life* Gernreich spread] Gernreich echoed the historical moment's discourse on fashion by declaring "[t]he esthetics [sic] of fashion are going to involve the body itself. We will train the body to grow beautifully rather than cover it to produce beauty."[82]

Gernreich offers an immature vision of personal technology, one which acknowledges utility, but is so divorced from the capabilities of the technology that he fails to envision the bodies that need such devices. The *Life* magazine article listed a dire collection of coming social problems—extreme traffic, pollution, decreasing animals to provide natural fibers—and enlisted fashion as an ameliorative force that had to bend to, what Gernreich termed, the "utility principle."[83] The sketches that accompany the article envision a future populated by hairless and elongated bodies, nearly nude in warm weather and covered in skintight synthetic knits when cold. Gender dimorphism is absent in these forms, instead an aesthetic of high-functionalism is on display. Jewelry in particular has taken on the role of device for pragmatic use; Gernreich calls this out specifically "[j]ewelry will exist only as a utility-that is, to hold something up or together, like a belt, or for information, like a combination wristwatch, weather indicator, compass and radio."[84] In Gernreich sketches these devices are of unknown utility, but they announce their presence as bulky objects on their wearer's wrist. While Gernreich's nebulous designs and predictions give us a sense of popular views on bodies and technology at the time, Scherr's prototypes allows us to see how these ideas actually took shape. And while Gernreich's devices were little more than black boxes, Scherr continued to search out and integrate novel technologies into her line of body monitor jewelry.

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[82] "Fashion for the '70s", *Life*, January 9, 1970, 117.
[83] Ibid.
[84] Ibid.

In conclusion, jewelry in the late-1960s and early-70s was being shaped by two guiding principles: that it ought to provide functional value beyond its traditional role as ornament, and that it ought to be sensual, to communicate that its wearer takes pleasure in bodily experience. Both of these aims connect to countercultural views of the body as a system, which could be manipulated to achieve a sense of physical and physic wholeness. Technology was oddly positioned in this world view; there was still a lingering faith in science and technology as a means to create healthy and beautiful bodies, which paradoxically live in a world that technology has made perilous. Moreover, it is technology made small and personal that can save these bodies, as if each person walks through the Earth in her own domesticated space suit disguised as jewelry. A major part of Scherr's success was her ability to integrate themes of sensuality, functionality, and the fear and faith present in technology

Liquid Crystals and the Surrounding Environment

Scherr's liquid crystal body monitors offer one of the best examples of a romanticized negotiation of countercultural and technological ideas; these pieces also proved to be an intellectual precursor to one of the most popular trends in jewelry during the period. After her initial body monitors, Scherr began to collaborate with Kent State's Liquid Crystal Institute, which was started in 1965 by chemistry professor Glenn H. Brown. Her "Body/Air Sensor Belt" (1973) [Fig. 14], visualizes changes in the surrounding air through color changes on the liquid crystal discs that ornament its surface. Similarly, her "Heartbeat Sensor Necklace" (1973) [Fig. 15] uses an electrode to monitor the wearer's heartbeat, and then transmit that information to a liquid crystal screen to visualize it in the form of a pulsing bull's-eye. A "liquid crystal" is a form of matter that shares properties of both solids and liquids, and generally looks like a cloudy

or nearly-opaque liquid to the naked eye.[85] Certain "thermotropic" liquid crystals are highly responsive to their surrounding environments, particularly changes in temperature. When exposed to changes in the ambient environment these liquid crystals change slowly in color; like the tide or a drop of dye moving through water, the color spreads slowly and organically. All of Scherr's liquid crystal pieces make strategic use of this feature to help visualize the air around the wearer.

Scherr's liquid crystal jewelry indulged in the fashion of science fiction as seen in television and movies. A photograph of her "Body/Air Sensor Belt" depicts a young woman in apricot colored tights and body suit, with Scherr's belt cinched to an impressive snugness around her waist [Fig. 16]. The belt is imposingly wide, occupying the woman's torso from the top of her hips to her chest. Its gleaming stainless steel is unornamented with the exception of five large liquid crystal discs that occupy the front of the belt. This image exemplifies why Scherr's objects were sometimes referred to in the press as "2001 jewelry" (a reference to the 1968 science fiction film *2001: A Space Odyssey*). The young woman, with her fists held up and her back arched back, looks ready to take on any number of hostile space creatures single-handed. In fact, the press commonly misidentified this image as the space themed costume Scherr created for Miss Ohio in the 1969 Miss USA competition.

Scherr's embrace of liquid crystal displays exemplified "biofeedback," a popular concept in the 1960s and '70s that combined concepts of cybernetics and personal growth. Biofeedback migrated from the realm of medicine into the popular press in the early-1970s; it was described

[85] Institute of Liquid Crystals, Kent State University, http://www.lcinet.kent.edu/tutorials/index.php?content=introduction/index&title=What+are+liquid+crystals?, accessed June 2016.

as the practice of using instruments to gain greater awareness of one's bodily functions, with the ultimate goal of being able to control those functions at will. An early article on biofeedback in The New York Times defined it as "an offshoot of laboratory research in which electronic instruments are used to amplify changes in the body (such as occur in blood pressure, heart rate, muscle contractions). The changes instantly trigger signals in the external instruments, such as a sound or a light, which on repetition can allow a person to identify the cues of internal changes—the first step in learning to control them."[86] This article, written by two vocal advocates of biofeedback, Gay Luce and Erik Peper, connected the practice to a discourse of personal liberation, "biofeedback promises to return us to a more holistic kind of medicine in which the patient will acquire more responsibility for, and power over, his own health, no longer finding himself treated as a defective organ, but as a person in a context, with a life style and habits that affect his own body."[87] A focus on "training" dominates the article, and the line between health benefits and lifestyle choices are interchangeably discussed. Perhaps the most Pavlovian anecdote comes from a group of child and adult readers who had the problem of silently mouthing words as they read; they learned to drop the habit after being exposed to a loud buzz whenever a sensor noticed a tensing in their larynx.[88] Over time, biofeedback and classical conditioning became so synonymous that articles began referring to BFT, or "biofeedback training."[89]

[86] Gay Luce and Erik Peper, "Mind over body, mind over mind", *New York Times*, September 12, 1971.
[87] Ibid.
[88] Ibid.
[89] Evelyn De Wolfe, "Measuring Alpha Waves: Mind-Boggling Experience", *Los Angeles Times*, March 7, 1972.

Multiple pseudoscientific biofeedback crazes swept the nation. One *Life* magazine reporter wrote about the 1970s fad of monitoring "alpha brain waves" using electroencephalograms, musing "[i]nward, not outward, is clearly the way the signs are pointing. No longer do outer space, encounter groups and protest marches enchant us. Neither, even, does consciousness-raising, which last year was practically a national sport. Now, tired of having raised and publicly examined our consciousnesses [sic], we are zeroing in on the very rhythms of our brains."[90] A cult of self-examination was one of the touchstones of the 1970s. Highlighting the trend of biofeedback demonstrates how this inward gaze was harnessed and magnified by contemporaneous technological and design frameworks.

The rise of the commercial mood ring—made with the same liquid crystal technology as Scherr's pieces—offers a case study into an alternative way that biofeedback entered popular culture, one that attempted to obfuscate the science behind the design. The mood ring hit the national stage in early-fall of 1975, just two years after Scherr successfully completed her liquid crystal pieces. The aesthetics of mood rings were strikingly traditional; they generally contained a large liquid crystal disc held as a center "stone" in a simple band. These rings were first manufactured by Josh Reynolds, who ran the biofeedback training company Q-Tran in New York.[91] The rings first retailed at Bonwitt Teller in New York for the high price of forty-five dollars for a sterling silver setting, and two-hundred and fifty for gold. The store quickly sold-out of their stock, and increased orders led to stock added to stores nationally. By late-October cheaper imitations were abundant; advertisements for his and her "bio-mood rings" promised "to reveal your body's innermost feelings" and offer "great intimate fun" for the low price of five

[90] Jane Howard, "Flow Gently, Sweet Alpha", *Life*, April 21, 1972, 68.
[91] Mary Knoblauch, "Mood Ring Monitors Your State of Mind", *Chicago Tribune*, October 8, 1975.

dollars a piece.[92] Important figures in 20th century fashion and costume jewelry quickly took note; the "impulse stone personality ring," was produced by the well-known and noted "tastemaker" brand Hattie Carnegie.[93] An article in the *Chicago Tribune* quotes a promotional brochure for this ring as claiming "'IT'S BASED ON scientific truth… Your hand gives off different amounts of heat and electrical energy, depending on how you feel. Your Impulse Stone reflects these minute changes, sometimes even before you're aware of them. You'll know when you're tensing up, you'll know when you're pushing yourself too hard.'"[94] While mood rings lauded their connection to "scientific truth," these devices were not used to empower the wearer. One seller of mood rings Jack Tann, who on occasion referred to himself as a "professional opportunist," cuttingly gets to the heart of the underlying criticism of not just mood rings, but biofeedback more largely; namely, that people want to be told how to feel and what to think by outside forces, "[p]eople don't have any kind of confidence in their own judgment. They'll search for anyone who will tell them where they're at. You know, they have to go search in the newspaper for the astrology column every day to find out how they feel."[95] In the midst of sincere belief and extreme cynicism about technology, Scherr's monitors were introduced to the general public.

Portable World and Scherr's Body Monitors Introduction to the Public

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[92] Advertisement for "bio-mood rings", *Los Angeles Times*, October 31, 1975.
[93] Hattie Carnegie opened a custom-made clothes store in 1918. She expanded to ready-to-wear line in 1929 and later included a range of trademarked her costume jewelry line in 1938. While she herself died in 1956, her business continued after her death. See: Toni Greenbaum and Pat Kirkham, "Women Jewelry Designers" in *Women Designers in the United States*, ed. Pat Kirkham, (New Haven: Yale University Press, 2001), 209.
[94] Robert Enstad, "Mood right to ring up sales", *Chicago Tribune*, October 26, 1975.
[95] Judith Martin, "Ring around the mood market", *Washington Post*, November 24, 1975.

Scherr's body monitors were introduced to the public through their inclusion in the MCC exhibition *Portable World* (1973). Scherr's jewelry was showcased in the "body extenders" section of the show, alongside a diversity of objects that included the Apollo space suit that initially inspired her, as well as humbler umbrellas and wrist watches. The exhibition highlights a cultural tension in Scherr's design and American consumerism more broadly; the view that technology would offer growth and salvation, yet it had also made the world more hectic and unsafe. An example of this tension came from "Portable Person," a conceptual design by Jeffery Hannigan and Robert Mangurian of the design studio WORKS (New York, NY). [Fig. 17] Strikingly similar to Gernreich's musings in *Life* magazine three years earlier, Hannigan and Mangurian argued that "Portable Person" was a "vision of future mobile, life-supported earth inhabited and out-fitted with a technologically inspired extension of the body responding to the city environment."[96] Such comparisons show how pervasive the combined fear of widespread technological change and hope for personal technology was through the 1970s.

Pivoting between the twin poles of an awareness of environmental decay and a rejection of post-war suburbia, *Portable World* claims to abandon "an obsession with materialism" by featuring an almost obscene range of goods. To say that the models on the covers of the *Portable World* exhibition catalogue look ridiculous is an act of generosity. [Fig. 18] From the tip of her umbrella hat to the soles of her spring-loaded "Kangaroo Shoes," the woman on the back cover seems laden down with goods, yet prepared for no environment known to Earth. Included in the fifteen products displayed on this model are Scherr's "Oxygen Pendant Necklace," "Incense Ring," and "Body/Air Sensor Belt."[97] The cacophony of objects in this exhibition—over 200 in

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[96] "Portable World", Museum of Contemporary Craft, (New York, 1973)

[97] Also included in the exhibition and accompanying catalogue are Scherr's "Ashtray Bracelet," "Heart Pulse Sensor Bracelet," and "Body/Air Sensor Necklace."

the final checklist—reflect the underlying conceptual framework of *Portable World*. As such, *Portable World* exhibits a tension deeply embedded in the middle-class embrace of the counterculture—to get freer from mainstream materialism, one might have to buy a whole new range of stuff. Indeed, just before the exhibition opened, *Fortune* included the prototypes of Scherr's "Oxygen Monitor Pendant" and "Air Quality Belt" in its "conspicuous consumption" Christmas guide [Fig. 19], alongside an "automatic bartender" from Abercrombie and Finch that could be operated via computer punch cards.[98]

The broader public responded enthusiastically to Scherr's jewelry. Letters poured in from both domestic and international contexts. A section of one newspaper intended for adults to read with small children illustrated a curvaceous, super hero-like woman wearing Scherr's "Body/Air Sensor Belt" with the words "bleep," "ding," and "2001" in bold comic book lettering. [Figure 20][99] Scherr's archives have multiple letters from anxious husbands who wanted an oxygen pendant for wives with chronic respiratory ailments. Other letters are from young children and adolescents, featuring rough sketches of their own takes on how to improve a design. One fifteen year old boy wrote to Scherr suggesting her heart monitor could migrate from bracelet to belt buckle to attract a male clientele, even as he concedes "It might look a little odd if all of a sudden an alarm goes off and a guy starts looking at his belt buckle, but if it saves a life why not?"[100] More than one letter addresses Scherr as "Dear Sir" and inquires about going into production with "his" creations.

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[98] "Gifts for the Conspicuous Consumer", *Fortune*, December 1973

[99] "2001", Newspaper Enterprise Association/New York-Cleveland, M-86 *Portable World* (October 5, 1973 - January 1, 1974) Museum of Contemporary Crafts - Main Gallery Exhibitions, American Craft Council Archives

[100] Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000, Correspondence Regarding Body Monitors

What was it about Scherr's designs that entranced so many people? I suggest that the success of Scherr's jewelry came from the fact that it straddled the boundary between two cultural views of technology, one that envisioned bodies made stronger and safer through technology and the other that desperately sought more information about the self. This desperation came from a growing feeling of environmental dread that developed in the 1960s and '70s, as our understanding on the environment's impact on humans developed into an interest in how humans similarly impact the environment.

The EPA and Scherr

Public concern over the environment increased at a rapid rate in the 1960s. The blockbuster publication *Silent Spring* (1962) by Rachel Carson helped spur the American environmentalist movement, which gained steam following a number of highly visible environmental disasters. For example, over the 1966 Thanksgiving weekend, New York City was blanketed with a thick opaque mix of carbon monoxide, sulfur dioxide, smoke and haze. A photo reprinted in The New York Times depicts a ghostly city in a "sea of smog," with only the highest buildings able to pierce the dense air. The New York group "Citizens for Clean Air" generated several protest events following this event, with members wearing gas masks in the manner described by Scherr. In 1966 John William Gardner, Secretary of Health, Education, and Welfare under President Lyndon Johnson, warned that the public was losing its fight with air pollution. He prophesied the need for gas masks, domed cities, and even underground cities in which people would "live like moles."[101] The efforts of Secretary Gardner resulted in some of the first nation-wide air pollution regulations.

[101] Gladwin Hill, "Nation Is Losing War On Smog, Gardner Warns Pollution Parley", *the New York Times*, December 13, 1966.

On January 1st 1970, President Nixon signed the National Environmental Policy Act (NEPA) stating that "the 1970's absolutely must be the years when America pays its debt to the past by reclaiming the purity of its air, its waters and our living environment. It is literally now or never."[102] That summer Nixon announced a plan to create the Environmental Protection Agency (EPA), which would act as an independent government body to monitor the environment. [103] In doing this, Nixon's stated his goal of viewing the environment "as a single, interrelated system," rather than "along media lines" such as air or water. The plan was approved by congress in October of that year. In a 1973 report, EPA Administrator Russell E. Train framed the agency's success as revolving around receiving "the best information and feedback for decision making"[104] For Train "[a]ccurate and timely information on the status of the environment is necessary to shape sound public policy and to implement environmental quality programs efficiently. It is virtually impossible to develop effective programs and to monitor their implementation without good monitoring data."[105] Train also highlighted "citizen participation" as an essential tool in collecting this information. For the new agency, the value of objects like Scherr's jewelry was not just giving the wearer more information about themselves and their surroundings, but also as a tool that could create more data about the country and its inhabitants.

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[102] Richard Nixon, "Statement About the National Environmental Policy Act of 1969," January 1, 1970. Online by Gerhard Peters and John T. Woolley, The American Presidency Project. http://www.presidency.ucsb.edu/ws/?pid=2557.

[103] Historian Rick Perlstein has pointed out that this action is less noble than it might appear on first glance and may be viewed as an effort to consolidate power under White House control. The EPA's 5,600 employees all came from existing agencies and its budget was merely allocations taken from other programs; see: Rick Perlstein, *Nixionland: The Rise of a President and the Fracturing of America*, (Scribner: New York, 2008), 517.

[104] Russell E. Train, "Management for the Future", in *Managing the environment*. Vol. 1. (Washington Environmental Research Center, Office of Research and Development, US Environmental Protection Agency: 1974) 8.

[105] Train, 8.

In 1979 the EPA held up Scherr's jewelry as a model to aspire to at their "Symposium on the Development and Usage of Personal Monitors for Exposure and Health Effect Studies." [Fig. 21] The cover of the symposium's proceedings features the same photos of Scherr's "Heartbeat Sensor Necklace" (1973) that was used in *Portable World* six years earlier. However, the revised caption has a decidedly more clinical air "[t]he device contains a monitoring electrode that transmits the ECG through electronic circuitry to activate a liquid crystal display of the subject's electrophysiologic heart pattern."[106] The symposium was organized by the Environmental Monitoring and Support Laboratory and the Health Effects Research Laboratory, which were responsible for developing the criteria for nation-wide regulations relating to ambient air quality standards, pesticides, and hazardous or toxic materials. The crux of the symposium was that testing within the highly controlled laboratory environment could only provide so much information; researchers needed field data to understand the response of heterogeneous segments of the population to pollutant exposure.

Stationary pollution monitors were already in place in some locations, but these stationary devices did not give a full picture of an individuals' exposure as they moved throughout their daily life. This shortcoming had been recognized for years; for example, the National Academy of Sciences recommended that the "EPA coordinate and support a program to foster the development of small, quiet, sensitive, and accurate personal air quality monitors for use in conjunction with other methods of measuring human exposure to ambient air quality."[107]

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[106] *Proceedings Of The Symposium On The Development And Usage Of Personal Monitors For Exposure And Health Effect Studies Held At Chapel Hill, North Carolina On January 22-24, 1979*. U.S. Environmental Protection Agency, Washington, D.C., Epa/600/9-79/032 (Ntis Pb80143894), 1979.

[107] *Environmental monitoring: a report to the U.S. Environmental Protection Agency*, National Research Council (U.S.). Study Group on Environmental Monitoring, United States.

The use of these devices seemed initially promising. One session detailed an initial experiment in which personal monitors were used by a number of participants who rode the daily commuter bus that served the Washington D.C. metro area. Results found that on the worst days, riders were subjected to half of the daily recommended limits of carbon monoxide on their bus commute alone, while the driver was subjected to more than double the daily maximum. Researchers hoped to capture "all inclusive" or a "total picture " data "on people who are of all ages, both sexes, well and ill, of all ethnic groups, and in all existing life situations."[108]

A difference between Scherr's designs and the bulk of many of the pieces discussed during the conference is what they monitored. Scherr's pieces were largely physiologic, meaning they monitored the wearer's body and the effect of the environment on the body. Most of the other working prototypes were "passive monitors" in that they focused on recording particulates and pollutants in the air. George Malindzak, a professor of physiology at Northeaster Ohio University and a recent collaborator of Scherr, emphasized this difference in a large discussion following the first days' talks, stating "I don't understand the purpose of putting all this effort in collecting exposure information if you don't understand what the human response is going to be."[109] The heads of the EPA present responded by emphasizing a need to understand the ambient air quality as necessary to create a base-line for their regulations.

Environmental Protection Agency, National Research Council (U.S.). Committee on National Statistics National Academy of Sciences, 1977), 44.

[108] Ralph W. Stacy, "Opening Remarks" in *Proceedings of The Symposium On The Development And Usage Of Personal Monitors For Exposure And Health Effect Studies Held At Chapel Hill, North Carolina On January 22-24, 1979*. U.S. Environmental Protection Agency, Washington, D.C., Epa/600/9-79/032 (Ntis Pb80143894), 1979.

[109] "Shirtsleeve Workshop" in *Proceedings of The Symposium On The Development And Usage Of Personal Monitors For Exposure And Health Effect Studies Held At Chapel Hill, North Carolina On January 22-24, 1979*. U.S. Environmental Protection Agency, Washington, D.C., Epa/600/9-79/032 (Ntis Pb80143894), 1979, 359.

Despite this desire for granular data, the panel on Scherr's jewelry demonstrates the prevalence of lumping women into tired stereotypes. At the symposium, Scherr and Malindzak presented a talk for the session "Personal Monitor Cosmetology: An Aesthetic Approach." Along with a detailed examination of the individual pieces and their potential uses, their talk included a full range of photographs that had been taken some six years previously**.** Following the presentation, one research scientist at the EPA thanked Scherr and Malindzak for their presentation and specifically their creation of objects for the women, as in his opinion, "the female happens to be one of the most ignored subjects in terms of science and in terms of data acquisition. "[110] This statement is puzzling, given the fact that earlier that day another session discussed an experiment using less aesthetic personal air monitors, where twenty-one out of thirty-seven participants were women. Following this potentially patronizing praise was a sense of general surprise that Scherr developed these prototypes, to which Scherr responded by claiming, "I think that maybe I am more or less a scientist, although I could never compete in this area. I am a reactor."[111] Here we again see the Scherr who worked with stainless steel lobbyists and GM businessmen, working within social expectations yet using her skill to make a space for herself and her designs.

In conclusion, Scherr's work with the EPA exemplifies the fears many in the United States had as they wrestled with the technological future. The goal of the EPA was to determine if environmental decay—a process driven by technological change—could also be countered with increased information gathered through technological innovation. In that regard, Scherr's

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[110] "Personal Monitor Cosmetology: An Aesthetic Approach" in *Proceedings Of The Symposium On The Development And Usage Of Personal Monitors For Exposure And Health Effect Studies Held At Chapel Hill, North Carolina On January 22-24, 1979*. U.S. Environmental Protection Agency, Washington, D.C., Epa/600/9-79/032 (Ntis Pb80143894), 1979, 325.
[111] Ibid.

jewelry offered a possible path forward. Interestingly, the her jewelry inadvertently touches on contemporary fears of technology, which focus on the use of individual data, and the ability of large organizations to collect massive amounts of personal information. Additionally, the EPA's framing of Scherr's jewelry illustrates the common trend of creating a flat landscape of homogenous women. As I will discuss in the final section of this chapter, Scherr's work would both counter and reinforce such homogenization.

Which Bodies?

While Scherr's body monitors offer a valuable vantage into contemporaneous ideas of body and technology, her experience with the EPA also demonstrates that her works provide a vibrant opportunity to explore the intersection of gender, disability, and technology. By ornamenting and monitoring the female body, Scherr's jewelry can be seen as policing the surface of the body. Conversely, this jewelry could be seen as offering the wearer greater control through self-fashioning, at a time when women began to exert a louder voice over health issues. Together a targeted focus on the bodies that Scherr's jewelry was intended for highlights the complicated ways in which her designs aided their wearers, while still remaining locked within traditional concepts of femininity.

Scherr's line of jewelry was made during a historic moment when women in the United States were both taking more control over their own bodies and accessing information about its rhythms and functions. The Supreme Court Case of 1965 Griswold v. Connecticut invalidated the Comstack law that prevented the use of contraceptive by arguing a right to privacy, and the landmark Roe v. Wade of 1973 extended this right to privacy to include abortion rights. Cultural touchstones, such as the Boston Women's Health Book Collective *Our Bodies, Ourselves* (1973), were written with an eye towards dismantling of traditional medical authority. For the

Boston Women's Health Book Collective, knowledge about the body was key to general female empowerment. As the opening statement claimed, "for us, body education is core education. Our bodies are the physical bases from which we move out into the world; ignorance, uncertainty — even, at worst, shame — about our physical selves create in us an alienation from ourselves that keeps us from being the whole people that we could be."[112] As discussed previously, the core of counterculture ideology of the body was to dismantle the separation between one's self and one's body—to utilize movement, experience, and information in order to achieve a greater sense of wholeness.

In her now foundational study of women and their perception of the body during this period, anthropologist Emily Martin noted a significant thread amongst the bulk of her respondents, which she phrased as "[y]our self is separate from your body."[113] Through a series of lengthy interviews conducted with women of various ages and socio-economic groups, Martin also identified corollaries with this central thread, that "[y]our body is something your self has to adjust to or cope with", "[y]our body needs to be controlled by your self", and "[y]our body sends you signals."[114] In her study, Martin focuses in particular on the ways in which medicine had professionalized women's reproductive health, resulting in a greater feeling of disconnect and lack of ownership and the often desperate need for a feeling of control of self.

While it would be far-reaching to frame Scherr's creation of jewelry as a self-consciously feminist act, her use of technology to grant the female wearer both information and control is in tune with the concerns for "wholeness" as this historic moment. Yet at the same time, her work

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[112] Preface, Our Bodies, Ourselves, (1973) accessed online June 2016 http://www.ourbodiesourselves.org/history/preface-to-the-1973-edition-of-our-bodies-ourselves/,
[113] Emily Martin, *The Woman in the Body: A Cultural Analysis of Reproduction*, (Boston: Beacon Press, 1987), 77.
[114] Martin, 77.

often seems constrained by traditional notions of femininity. One letter Scherr received came from a man who was concerned that models wearing her work looked masculinized. Scherr answered both defensively—asserting the years of research behind her work and its potential utility—but also endorsed the letter writer's desire for traditional femininity: "I think you should know that I also believe in the gentle beauty of women. The model's boots have a fashionable significance in the current mode with no intent other than to flatter an ensemble. Unfortunately, other photography not shown, pictured the same model in gowns designed to accent feminine attributes as well as the jewelry."[115] While Scherr's designs may have sought to empower their wearers through increased information that could provide a sense of mind/body wholeness, it did so while being conscribed within traditional ideas of feminine beauty.

Some objects from Scherr's body of work literally facilitate a conception of wholeness. Alongside body and environmental monitors, Scherr created "compassionate jewelry" catering to the disabled. This included thimble-like devices called "thumbles," [Fig. 22] meant to disguise damage or partial amputations of one's fingers. She also designed a series of "trach necklaces," [Fig. 23] which took the standard stainless steel neckpiece used to hold the opening made in the neck during a tracheostomy, and ornamented it to disguise the hole. In recalling her inspiration for the "trach necklace" Scherr stated:

> I was teaching and a woman who is a sculptor walked toward me. Her scarf fell away from her neck to reveal some ugly equipment lodged in her throat. The scene paralyzed me, and I asked her if I could cover it up with something that would cause the device to appear less menacing. I made a necklace that caused a remarkable change. She felt amazingly different about herself. She didn't feel 'ugly'—her comment.[116]

[115] Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000, Box 1, Correspondence re: Body Monitors

[116] Interview with Mary Ann Scherr and Barbaralee Diamonstein, *Handmade in America: Conversations with Fourteen Craftmasters*, (Harry N. Abrams, Inc., 1983), 205.

As well-meaning as Scherr was, it is hard not to imagine the sculptor's discomfort at Scherr's "paralyzed" reaction. This remembrance reminds us that, just as we are enmeshed in bodily rhythms and environmental surrounds, we are also ensnared in webs of social relations. As much as Scherr's trach necklaces are medical devices, they are also—if not more so—social devices; objects designed with the goal of creating less social friction for a woman with a tracheotomy in interpersonal situations. Just as Scherr's air quality monitors take in ambient surroundings and crystalize it into visualized data, so too do her necklaces take the immaterial—though no less perceived—force of a stare and give it concrete form.

The period of her necklaces' fabrication was witnessing a transformation in the ways in which disability was considered in the American context. Spurred on by disabled veterans and mirroring the civil rights movement and feminist movement, America saw a shift from a "medicinal model" that viewed disability as something to be medically managed to a "social model," which posited that our understanding of disability is conditioned by social factors and must be nuanced in relation to social and environmental surroundings. The late 1960s and early '70s saw the creation of the 1968 Architectural Barrier Act, the 1973 Rehabiliation Act, and the 1975 Individuals with Disabilities Education Act, all of which sought to lessen social or built barriers for individuals with disabilities.

Scherr's "trach necklaces" were displayed in the exhibition *Triumph over Disability* (1973 –1980), at the Smithsonian's National Museum of History and Technology (Washington, D.C.). *Triumph over Disability* reflects the social changes regarding how disability was considered; as its curator Audrey Davis writes:

> [s]ocietal codes determine in large measure the expectations of handicapped persons when they return to society. In America, where the expansion of the country

> and its industrialization placed a premium on physical fitness, the disabled have not always fared well. … Paradoxically, in American society, which takes for granted the prevalence of labor saving devices and luxuries to bring extra pleasures, those who must depend on certain devices to maintain independence in everyday activities are not fully or readily accepted.[117]

In today's parlance, Scherr's jewelry might best be considered "assistive technology," a variation of "prosthetic technology" that is understood to aid in occupational, social, and independent life. However, curator of medical technology at the Smithsonian American Museum Katherine Ott usefully complicates such terms, commenting that "all useful technology is assistive, it is peculiar that we stipulate that some devices are assistive while others need no qualification. Besides serving to stigmatize and segregate a benign and inanimate entity—a device or appliance—the term 'assistive technology' also needlessly complicates understanding of the devices so designated."[118] As an artist-jeweler, Scherr lent her works an outrageous and sensual appeal not normally found in objects designed from the start as a "medical device". If we contrast her "trach necklace" to its readily available industrial counterpart, the contrast is stark, as its plain medical grade steel opening is held in place by a silicon band it firmly inhabits a utilitarian zone. As Ott points "[m]edical inventors and designers share the goal of creating devices and objects that make the person as 'whole' as possible. … This approach entails an aesthetic of discretion. Engineers strive to minimize the visibility of the 'fix' and maximize wholeness. As a consequence, function is primary and the beauty of the design is secondary."[119]

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[117] Audrey Davis, "Introduction", *Triumph Over Disability*, (Washington D.C.: The National Museum of Science and Technology, Smithsonian Institution, 1973)
[118] Katherine Ott, "The Sum of Its Parts", in *Artificial Parts, Practical Lives: Modern Histories of Prosthetics,* eds. Katherine Ott, David Serlin, and Stephen Mihm, *(New York: New York University Press*, 2002), 21.
[119] Katherine Ott, "Disability Things", in *Disability Histories*, eds. Susan Burch and Michael Rembis, (Chicago: University of Illinois Press, 2014), 127.

Scherr's trach necklaces flip this usual state of affairs on its head. One such example, which was shown in *Triumph Over Disability*, is lavishly ornamented and made of sterling silver with gold accents and semi-precious stones.[120] The central pendant that holds the tracheostomy tube in place draws its visual motif from the hole itself, as the central opening (which must remain uncovered to preserve function) is visually reinforced by a sunburst pattern molded around it and a small round opal mounted right above it. Directly above the top of the pendant a small black star sapphire is mounted facing upwards, while below the pendant hangs three embellishments: a rigid central black star sapphire and two free-moving silver teardrops on either side. This central pendant is held in place by three chains with a rough rope-like texture that run in parallel around the neck; the middle chain is silver and is flanked by two gold chains. Scherr's jewelry does the double work of disguising a wound or amputation and facilitating wholeness, while at the same time drawing a complimentary and even sensual attention to the spot of injury.

Despite any social comfort this necklace may have garnered, it was likely a difficult thing to wear in daily life, the necklace itself being so densely ornamented, it is of a not inconsiderable weight. Perhaps more pressingly is what role Scherr's necklace may have had on the wearer's speech. Currently, many people with tracheostomy use a small valve—frequently called a Passy-Muir Valve—which allows air to pass into the body, but not out through the valve. This forces air to pass over the vocal cords as the person exhales, and allows for the individual to speak. Such valves were not widely available in the early 1970s, but a similar effect could be achieved by placing a finger over the tracheotomy hole when an individual wanted to speak. It is jarring to imagine how such an ornate design as Scherr's might have worked in this procedure. Would the

[120] This necklace is of very similar design and materials as one held in the permeant collection of the Museum of Art and Design (New York, NY).

molded sunburst have impeded getting a tight seal? Did the hanging portions of the jewelry rattle as one pushed against the necklace? The everyday worn realities of living with these necklaces, tempers the beauty of these designs. Yet, unlike Scherr's "body monitors" that stayed within the realm of museums as prototypes, these "trach necklace" were made and sold and entered into the constellation of everyday technological objects. Scherr would often incorporate her female customer's preferred aesthetic into the final design and they were sold at a variety of price points based on the materials used. While this may be due to the relative technological simplicity of the necklaces, it also highlights the need and desire for such objects in the marketplace.

Similar to her trach necklaces, her "thumbles", designed to be worn over a gash or amputation, are of ornate and eye-catching design, one even engraved with self-portraits of their intended wearers that would draw the viewer in for a closer look. In her oral history, Scherr recounts her initial inspiration for these devices:

> I know when I badly slashed my thumb I experienced a handicap, physically and visually. It was a remarkable insult to look at my hand. So I covered it up with one of the "thumbles" I designed. The moment it was covered, I was less embarrassed to use my hand normally. I'm now designing a "thumble" for a lady who cut off her thumb in a boating accident. I made her a self-portrait with the same little diamond earrings that she always wears. Now in viewing her hand she sees herself, not an injury.[121]

Objects such as these offer a radical reimaging of the different forms "adaptive technology" can take, and shed a light on the social roles they offer. Within the field of disability material culture and assistive technology there has been a turn away objects that are designed to be unnoticed and towards objects that not only boldly pronounce their mechanical status, but also endeavor to communicate something of their wearer's personality. In the object archives of the Smithsonian

[121] Interview with Mary Ann Scherr and Barbaralee Diamonstein, *Handmade in America: Conversations with Fourteen Craft Masters*, (Harry N. Abrams, Inc., 1983), 207.

American History Museum, curator Katherine Ott was able to visualize such a transformation for me. While an artificial leg from the interwar period strikes a flesh-like appearance, complete with cotton sock and leather shoe, a later artificial leg from the early 2000s was made of the "flex foot" design and features a colorful pattern of geckoes that takes artistic and expressive advantage of the synthetic material. Historians of disability in the United States have lauded this shift, objects such as the mid-1980s "quickie" wheelchair, which features bright neon paint and sporty design are being singled out as a design that have moved the material culture of disability in important new directions.[122] Scherr's medical jewelry takes part in this movement, her objects are both beautiful and expressive. Yet, with their focus on covering up and gilding over they are designed more to alleviate social discomfort than serve the practical needs of their wearers.

Conclusion

It is the high-visibility of Scherr's works—whether in her body monitors that make technology visible or her "compassionate jewelry" that draws attention even as it deflects it—that places her within interesting historical crosshairs. In her history of wearable technology, Susan Elizabeth Ryan has identified two strains of thought and practice: a "positivist" paradigm that seeks to blend and diminish itself into the makeup of the body, blurring the line between body and technology, and a "critical" paradigm that seeks to use technology to highlight the functions of the body rather than enhance them, while at the same time drawing attention to the interplay between body and machine.[123] By this metric, Scherr's jewelry seems to inhabit the

[122] Joseph Shapiro, *No Pity: People with disabilities forging a new civil rights movement*, (New York: Times Book, 1993)
[123] Susan Elizabeth Ryan, "Re-Visioning the Interface: Technological Fashion." *Leonardo* 42.4 (2009): 307-313.

zone of the critical, not only does it loudly pronounce its own presence, but its very aesthetic design is in harmony with the technology of its makeup.

In an anecdote she often recounted, Scherr wore her "Heartbeat Sensor Necklace" on the Ed Sullivan show. Under the glare of the television camera, Scherr's nerves—and technology—got the better of her; the pulsing of the necklace's bull's-eye increased with the drumming of her own heart, and communicated her own anxiety and excitement to the television audience. As this was pointed out, her embarrassment increased and so too did the pulsing of the bull's-eye. The fact that Scherr often repeated this anecdote is a testament to her pride—rather than embarrassment—at this event. And why shouldn't she be proud? This impressive piece of her design worked under pressure according to its intended goals. However, the fact that Scherr's nerves were on display for the television audience points to a number of important facets. The "Heartbeat Sensor Necklace" makes clear what Scherr's other monitors hint at, that the line between our body's interior and exterior is thin and permeable. Your environment—whether the air particles you breathe or the social environment you occupy—affects the inner workings of your body. Even more forceful is that Scherr's necklace visualizes what certain strains of feminist philosophy of the body have theorized, that the line between the social and the physical is likewise permeable and open to mutual influence.[124] With this mutual influence comes the force of training that was so prevalent in the discourse of biofeedback that was so prevalent when Scherr made her jewelry.

In an interview, Scherr discussed the historical moment when she began working on her body monitoring jewelry, noting that:

[124] For an overview of this literature see: Sarah Ahmed, "Imaginary Prohibitions: Some Preliminary Remarks on the Founding Gestures of the 'New Materialism'", in *European Journal of Women's Studies* 15(1)

> [w]hen I was teaching at Kent State in Ohio in 1970 the students and other young people were concerned with remaining independent from authority and creating a world in which they felt comfortable. The *Whole Earth Catalogue,* describing ways to survive with less mechanical assistance, became the how-to bible, and life returned to hand tools for building houses and making objects. The term 'crafts' became important, generating educational programs that accommodated those needs. The student in 1980 has a very different outlook. The parents of these students are concerned with the futures of their children, the cost of education, and their career potential. Today's student is competitive, enjoys personal authority, and demands an education that will culminate with being prepared to move from education to the marketplace, equipped and informed.[125]

This transition Scherr illustrates is seen in her body of work, as the monitors of the early '70s transitioned to her pieces of the 1980s, which took the element of training the social importance of physical appearance. Her "Posture/weight belt" made during the early 1980s visualizes this transition [Fig. 24], as it is designed to beep loudly if strained, thus ensuring its wearer stands ups straighter and holds in her stomach. Such transitions in material culture can generate a wariness at the thin line between personal information aiding in self-improvement and the force of social pressures in individual anxieties. Historian Sam Binkley highlights how the individualist tendencies in the early 1970s helped develop the stereotypical "yuppie" of the 1980s, as the qualities of self-manipulation and a willingness to "go with the flow" were as well-suited for counterculture self-improvement as they were for an increasingly fragmented labor market.[126] In a similar vein, by examining the evolution of body technology more broadly, and Scherr's analogous practice within that, we see how the qualities of self-knowledge gave way to

[125] Interview with Mary Ann Scherr and Barbaralee Diamonstein, *Handmade in America: Conversations with Fourteen Craftmasters*, (Harry N. Abrams, Inc., 1983), 202.
[126] Binkley, 243-249.

social policing. While the total control of the cyborg gave way in the designs of Scherr, they still fell under forms of social control.

Chapter 2
The Computer Pays Back Its Debt: Janice Lourie and the Origins of CAD and Craft

"Like all things handmade, all that is digital is variable."[127]*-Mario Carpo*

In the mid 1960s, Janice Lourie (b. 1930), a hobbyist weaver and computer scientist employed by IBM, designed a system for creating woven fabrics, which replaced the traditional method of manually converting a design into weaving instructions for a mechanical loom—a laborious process taking many hours and multiple skilled technicians. [Fig. 1] In writing her software, known as "Textile Graphics," Lourie placed herself at a number of historical junctions: the shared history of computing and weaving; the intersection of craft and digital production; and gendered understandings of computing technology. Lourie is a trailblazer in the integration of handmaking and digital production; skilled in both methods, her story demonstrates that—far from antithetical—these two means of making share many complementary characteristics. A faith in the interchangeability between handmaking and digital production is in keeping with architectural historian Mario Carpo's view that "[i]n the long duration of historical time the age of mass-produced, standardized, mechanical, and identical copies should be seen as an interlude, and a relatively brief one — sandwiched between the age of hand-making, which preceded it, and the digital age that is now replacing it."[128] The likening of the hand and the digital can be made across multiple axes. In this chapter I will focus on two of these: how digital production—like handmaking—can lead to a greater variety in objects, and how digital production—like handmaking—can narrow the gap between a designer's vision and the finished product.

[127] Mario Carpo, *The Alphabet and The Algorithm*, (Cambridge: MIT Press, 2011) 51.
[128] Carpo, 10.

Today, in the wake of digital fabrication techniques such as 3D-printing and laser etching, it is a common refrain that the economics of mass production no longer apply. Instead, we are told, we can expect a world of production on demand, with personal customization only a mouse-click away. Popular magazines such as the *Economist* write about factories that will specialize in bespoke production.[129] Meanwhile, economic theorists such as Jeremy Rifkin are deeply optimistic about the social possibilities of what he calls the "third industrial revolution."[130] Rifikin claims that "[g]iant, global companies mass-producing standardized products on assembly lines operated by anonymous workforces can't compete with the kind of intimate one-to-one relationship between artisan and patron."[131] The conviction that new manufacturing tools will inevitably drive an open and reciprocal relationship between maker and consumer is tied to broadly-held beliefs regarding these new technologies: that they're accessible in skill and cost, they're small and community based, and built for bespoke production. These proclamations about the rebirth of artisanal production made possible by technology do not originate with 3D printers, despite how it might seem in contemporary popular press. Instead, they can be traced back to the birth of computer aided design (CAD) in the early 1960s. Lourie was deeply embedded in this historical moment, and she too would contrast her digital tool to mass production, finding an affinity to hand production.

To some, the use of computers to create woven fabrics would suggest a further encroachment of uniformity upon one of the most basic and ubiquitous human materials. Yet to Lourie, an ardent hobbyist weaver and computer scientist, the computer became a means of

[129] "3D printers start to build factories of the future", *The Economist*, June 29, 2017.
[130] Jeremy Rifkin, *The Third Industrial Revolution: How Lateral Power is Transforming Energy, the Economy, and the World*, (New York: St. Martin's Press, 2011)
[131] Rifkin, 119.

reasserting identity in the face of mass production. This idea that digital tools lead to greater variety was in step with the image of the post-war "designer craftsman." This persona was built on a belief that craft could be used to soften the standardization of mass production, creating both jobs for trained craftspeople and making consumable goods more appealing. Lourie's early writings for the craft community took this familiar thread of the designer craftsman, and modified it by adding the computer as a faithful tool. Within this historical narrative, Lourie is an important link ushering in the ethos of variability into the digital age.

The second theme I will focus on is the ability for CAD to bring design and production into closer contact with each other. Writing about production in the 1990s, digital theorist Malcolm McCullough claimed that "tightening the loop between conception and execution has the potential to reconcile some of the separation of design and fabrication that industrialization had previously imposed on craft. Thus, after two centuries of separation, the conception and the execution of everyday objects are once again in the same hands."[132] Some thirty years before McCullough's claim, Lourie wrote about how her software tightened the loop between the designing of textiles and the means of running an automatic loom. While it may seem counterintuitive, what bolstered Lourie's belief in computing's compatibility with creative control was the way in which she envisioned computers as an active partner in the design process. Lourie envisioned her program as an iterative conversation between computer and maker, with each party providing both constraints and solutions in progress towards a final product. This created an immediacy that allowed for trail and error and quick iteration, a process closer to handweaving than production on mechanized looms.

[132] Malcom McCullough, *Abstracting Craft: The Practiced Digital Hand*, (Cambridge: MIT Press, 1997), 178.

A final theme this chapter engages with is how Lourie's Textile Graphics system was framed as a domestication of computer technology. This theme of domestication is prevalent in the history of technology. For example, historian David Nye argues that every new piece of technology undergoes a process of feminization, loosing its connection to the sublime and becoming demystified as it enters the sphere of the everyday:

> Yet women played a vital part in the incorporation of the technological object into ordinary life. Once the initial shock of the sublime object had passed, it was domesticated and made familiar through a process of feminization. The railway engine soon became a 'she,' and train crews spoke of getting 'her' to the station on time.[133]

My research engages with Nye's assertion—the feminine connotations of Lourie and her craft were frequently summoned to make technology more approachable. Yet Nye's use of the term "feminization" largely operates on the symbolic level for his presumably male subject. What would it mean for women to "feminize" technology? Historian Ruth Cowan argues that the emergence of "labor saving" household technology actually created more household labor for women, both through the creation of higher standards of cleanliness and variety, as well as ensuring less aid from other members of the household:

> Tools are not passive instruments, confined to doing our bidding, but have a life of their own. Tools set limits on our work; we can use them in many different ways, but not in an infinite number of ways. We try to obtain the tools that will do the jobs we want done; but, once obtained the tools organize our work for us in ways that we may not have anticipated. People use tools to do work, but tools also define and constrain the ways in which it is possible and likely that people will behave.[134]

[133] David E. Nye, *American Technological Sublime*, (Cambridge: MIT Press, 1996), 283.
[134] Ruth Cowan, *More Work for Mother*, (New York: Basic Book, 1983), 9.

Lourie frequently used femininity to advocate for her software as a neutral tool; my work demonstrates how femininity and technology are imbricated, and place constraints on their users.

Taken as a whole, Lourie's story not only connects current discussions of digital fabrication to a longer history, it also nuances the associated optimism with concerns of gender and war. A product of her post-war technological corporate surroundings, Lourie skillfully leveraged her position and her femininity at IBM to gain acknowledgement for her invention. Similarly, Lourie was a public relations boon for IBM, as the company celebrated her work to emphasize the computer's value to a skeptical public. Her position as a woman in computing, the contrast of fiber and circuits, and her skill as a computer scientist all became bound up with her technology, making it impossible to view the software outside of its social context. This history highlights Lourie both as an important trailblazer in the development of computer aided design (CAD), and the ways in which imagery of people making with computers has been used to humanize the technology.

Women and Computing

Women have been a part of computing since its inception. The very word comes from the pink-collar job of a "computer," whose task was to perform the mathematical calculations needed during WWII to program the firing of ballistics.[135] The name moved from woman to machine as if by osmosis; six women were chosen to program one of the very first general-purpose programmable and electronic computer, completed in 1945, and the name became the machine's.[136] This exchange from woman to object did not operate at the level of name alone;

[135] Jennifer S. Light, "When Computers Were Women." *Technology and Culture* 40.3 (1999): 455-483.

[136] This computer was the Electronic Numerical Integrator and Computer (ENIAC). The six women are Kathleen McNulty, Frances Bilas, Betty Jean Jennings, Elizabeth Snyder, Ruth Lichterman, and Marlyn Wescoff. Their efforts were barely acknowledged until 1996 in an

the history of computing is one in which the machines took their initial characteristics from female stereotypes, and ideas of what made a good computer programmer were mapped onto traditionally feminine activities.

In its earliest formation, the occupation of "computer" was of little prestige and over-determined by gendered associations. Historian Jennifer Light has written eloquently about the history of women in computing, and is quick to caution that women's early participation should not be misunderstood as gender equality since the first women computers were seen as drudges.[137] Elsie Shutt was one such early female computer who later went on to form her own software company; she summed up the perception of female computers in the 1940s thusly "the desk calculating thing was 'women's work,' you needed to be careful and patient, and not very creative; you had to be willing to just sit and crunch the machine, and fill in the blanks."[138] Another example of this rhetoric comes from a memo from the Computing Group Organization and Practices at the National Advisory Committee for Aeronautics (NACA), which claimed: "[t]he engineers admit themselves that the girl computers do the work more rapidly and accurately than they would. This is due in large measure to the feeling among the engineers that their college and industrial experience is being wasted and thwarted by mere repetitive calculation."[139] Importantly, this is not a case of women entering into a traditionally male field;

Institute of Electrical and Electronics Engineers (IEEE) Annals of the History of Computing special issue on the history of women and computing; see W. Barkley Fritz, "The Women of ENIAC." *IEEE Annals of the History of Computing* 18.3 (1996): 13-28.

[137] Light, 455-483.

[138] Elsie Shutt: an oral history conducted in 2001 by Janet Abbate, IEEE History Center, Hoboken, NJ, USA.

[139] As quoted in Light, 460.

rather this is situation when a new type of labor emerged that was coded as feminine at its inception.[140]

Like computers, what it meant to be a good programmer was initially shaped by feminine stereotypes. Due to the relative newness of programing in the 1940s and '50s—a degree in "computer science" was not widely available until the mid-60s—companies often looked for abstract qualities in their perspective employees. Reflecting the pool of individuals already working with computers, these qualities frequently had feminine connotations. Historian Janet Abbate has elaborated on the logic underlying this framing, noting that "[t]here was a temptation to reason backward: if women did well at programing, it must be because programing utilized stereotypical feminine skills such as patience and meticulousness."[141] In an attempt to recruit more women, these characteristics were then mapped onto stereotypically feminine pursuits; for example, one company recruited women by claiming their jobs needed the same "patience to do embroidery."[142] This circular logic by which many women entered into computing allowed for the maintenance of traditional feminine qualities in a new sphere.

Computer companies such as IBM actively recruited college educated women for careers in computing, and the ways in which they tried to recruit women is particularly elucidating. One promotional brochure produced by IBM in 1957—the year Lourie began her career at IBM—is entitled "My Fair Ladies". [Fig. 2] This brochure, complete with allusions to the previous year's musical hit, paints a particular image of women at IBM. [Fig. 3] The women pictured in this

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[140] Light sums up the matter thusly: "While college educated engineers considered the task of computing too tedious for themselves, it was not too tedious for the college-educated women who made up the majority of computers. These were not simply cases of women taking on men's tasks, but rather of the emergence of new job definitions in light of the female workforce.", 461.
[141] Janet Abbate, *Recoding Gender: Women's Changing Participation in Computing*, (Cambridge: MIT Press, 2012), 68.
[142] Abbate, 67.

brochure are real employees of IBM, and present four different career options for female recruits: systems services, education, programing, and systems engineering. They are depicted as easily slotted into IBM's existing structure, providing both their technical skills and—more essentially—their abilities to provide a friendly face for the company. With the exception of systems engineering—the most prestigious of the four careers—the women are photographed interacting with male colleagues. [Fig. 4] For example, the programmer is photographed from above while she is seated at a low-slung desk, she smiles up at a male counterpart whose back is turned to the camera. What she provides, the photo suggests, is her charming personality; an interpretation bolstered by the brochure's claim that candidates for the position with math and logic degrees were ideal, but any college degree would do if she had an "alert, analytical and curious mind."[143]

Janice Lourie entered computing in the late-1950s, by which time the ubiquity of the female computer programmer was established and gendered expectations had begun to solidify. Lourie received her master's in mathematics from Boston University in 1957, while at the same time taking additional courses in philosophy and music at Tuffs University. She joined IBM just weeks after her graduation. While Lourie's involvement in computer programming was not unusual for the post-war period, her rise to a position of authority was. Like many women, Lourie started as a "systems services representative," or as they were often known, "system service girls." These women worked alongside better-paid male sales representatives, and focused on customer support for companies who bought IBM products. However, Lourie's advanced degree in mathematics put her in the preferred group for higher positions, and she advanced quickly. She began working at IBM offices located on the Massachusetts Institute of

[143] International Business Machines, "My Fair Ladies", 1957

Technology (MIT) campus, and then moved to the company's Mathematics and Applications department in White Plains, New York. There she worked on the programing library for FORTRAN, one of the first programming languages.[144] Lourie later moved to IBM's Scientific Center in New York City, which was a research and development hub for the company. Taken as a whole, Lourie's story both conforms to, and breaks the mold of what the typical experience for a female computer programmer was in the 1950s and 1960s.

Lourie's status as highly esteemed female computer programmer and craftsperson might be best understood through a comparison to others in the "protofeminist" generation. She was both in a privileged social position—having a Masters in mathematics was uncommon in 1957 when only 5.8% of the female population had bachelor's degrees—and yet as she rose through the ranks at IBM, her identity as a woman placed her as an outlier.[145] Lourie's story has clear symmetries to the protofeminist generation of female artists and craftspeople put forward by art historians such as Anne Wagner and Jenni Sorkin.[146] In accordance with this narrative, women artists in this period could take comfort in art production as a realm in which the social confines of gendered expectations could fall away. This space was produced by what Wagner calls, in reference to painter Lee Krasner, a "gender blind modernism," that emerged through an employment of the rhetoric of modernism. In this telling, Krasner could believe that painting

[144] FORTRAN was one of the earliest computer languages it was developed by IBM in the 1950s. For a discussion that references Lourie's early career see: "From Loom to Lightpen: Janice Lourie Closes Design Gap", in Volume 4 No. 1 January 10, 1967 Published by International Business Machines Corporation, Armonk, N. Y.
[145] NCES. "Number of Bachelor's Degrees Earned in The United States from 1949/50 to 2026/27, by Gender (in 1,000)." Statista - The Statistics Portal, Statista, www.statista.com/statistics/185157/number-of-bachelor-degrees-by-gender-since-1950/, Accessed 29 Mar 2018
[146] Anne Wagner, *Three Artists (Three Women)*, (Berkeley: University of California, 1996); Jenni Sorkin, *Live Form: Women, Ceramics, and Community*, (Chicago: University of Chicago Press, 2016)

offered "an activity in which a gendered notion of the self—or even selves—might be held at bay, above all by means of the techniques and vocabulary of the modernist idiom at its most advanced."[147] Crucially, this space was temporary; the gender of the artist could never be fully erased, or as Wagner phrases it, artistic identity and gender "coexisted uneasily, even paradoxically, they could not be eluded."[148] The question remains of how this identity might be affected by being placed within the context of corporate technology. Does the same edict of a separation between gender identity and professional persona hold under these different social pressures?

Women in technology during the post-war period were actively pursued for entry level positions because of supposedly feminine traits, but to advance such traits needed to be left behind, or at least skillfully managed. One particularly blunt exploration of women's role in programing is the short essay "The Woman Programmer" published in 1963 in the computing trade magazine *Datamation*.[149] In this essay, staff news editor Valerie Rockmael vacillates between casting women as kept down by prejudicial work places, and blaming them for contributing to their own fate. This essay is written with a matter-of-factness that underscores the fact her observations are unlikely to shock her readers. Rockmael's narrative is a familiar one: due to shortages of qualified applicants, women might quickly find a job in programing, but one should not be tempted to think that career accession will come so fast. Instead, she describes a situation in which many women wish to "not stand apart" from their fellow employees, and a sea of male peers that are only too happy to take on the advanced positions. Similar to the smiling faces in IBM's "My Fair Ladies," Rockmael trots out the industry wisdom that women exude "a

[147] Wagner, 188.
[148] Wagner, 188.
[149] Valerie Rockmael, "The Woman Programmer", *Datamation*, January 1963, 41.

humanizing influence" that "make working conditions more pleasant."[150] Women, she argues, are more likely to advance into the position of programing instructor than as a supervisor, because of their accepted societal roles as teachers. This the world that Lourie was in, welcomed into a workplace to humanize it, yet only allowed to progress so far due to these qualities.

In the technical press, coverage of Lourie was framed as a quirky success, one that mixed her undeniable skill with gendered stereotypes. The IBM periodical, *IBM News*, covered Lourie's software in the winter of 1967. "Loom to Lightpen" features Lourie as a slightly eccentric, yet valuable member of the IBM community. The article reproduces a photograph of her weaving at her handloom in her apartment, and describes her other hobbies, such as playing the "chalumeau[,] an ancient forerunner of the clarinet."[151] It goes on to discuss how Lourie devised a new method to drill very precise holes in this instrument and other woodwinds; the moral of the story being that a technically trained mind can use the lens of computing to solve problems in all areas of life, or as the article puts it "esoteric hobbies have surprisingly down-to-earth results."[152] Lourie then is framed as a boon to the company because of her foot in the humanities, "the key to Mrs. Lourie's success rests on an unusual combination of talents, as well as determination and singleness of mind in pursuing them."[153] The article ends with a rye defiant nod to what it terms Lourie's "hidden satisfaction" over the fact that her software is being adopted by the textile industry as "on technical matters, men in industry seldom like to take the advice of women."[154] In this depiction of Lourie, we see the hallmarks of the general story of

[150] Rockmael, 41.
[151] Geoffrey D. Austrian, "From Loom to Lightpen: Janice Lourie Closes Design Gap" *IBM News*, (January 10, 1967), 2.
[152] Austrian, 2.
[153] Austrian, 2.
[154] Austrian, 2.

women in early computing: she is single-minded and hardworking, yet quirky with domestic leanings; she feels the pressure of male dominated environments, but can use her skill to mildly push against them.

When asked if she ever experienced any sexist treatment at IBM, Lourie insisted that she merely focused on the work, and didn't notice any prejudice.[155] At times slipping into a gender-blind view of her own production, Lourie fits within the proto-feminist model of an artist who chose not to acknowledge the gendered difficulties she faced. Yet as we will see, through an investigation of Lourie's software, the highly gendered history of fiber would make her gender-blindness highly elastic, as she skillfully managed stereotypes of femininity for the strategic visibility of her software.

The Connection Between Computing and Looms

Fiber is women's work, except when it's not. Even before the reclamation of fiber by feminist artists and art historians in the 1970s, 20th century connotations of cloth and thread in the United States conjured images of female labor. Brought on by technological advancements such as the cotton gin (1793) and a variety of mechanized power looms that emerged in the early 1800s, weaving and cloth production moved from a largely cottage industry in the United States to one of most important sites of industrialization. Highlighting just how closely textile production and industrialization were linked, Marxist historian Eric Hobsbawm once wrote that "whoever says Industrial Revolution says cotton."[156] Perhaps the most famous of these workplaces are the Lowell and Lawrence mills, which were started in 1814 along the Charles River in Massachusetts. Today a national park, the Lowell Mill in the eponymous Lowell, MA,

[155] Interview with author, May 2016
[156] Eric J., Hobsbawm, *Industry and Empire: from 1750 to the Present Day* (New York City: The New Press, 1999), 40.

is historicized as a birthing place of the "female factory worker."[157] Due to the popularity of written accounts both by outsider visitors and the workers themselves, the "Lowell Mill Girl" became shorthand for a specific view of women, labor, and textiles. One such source for these written accounts was the periodical produced by the Lowell company, *The Lowell Offering*, which published fiction written by workers at the mills. One of the most salient threads to emerge from these accounts was the strong sense of female community. Workers at Lowell regularly lived at Lowell company boarding houses, and they were a largely homogeneous group in terms of age and ethnic background. In 1836, 85% of those employed at Lowell were women, and the vast majority of these were native born and between the ages of 15 and 30 years old.[158] This image of community was bolstered by years of ensuing protest of declining working conditions, with the first major strike involving over 800 female workers occurring in 1834.[159] These early strikes paved the way for political action and a push for a ten-hour working day. Overall, the picture of the Lowell Factory girl mixed oppressive working conditions with liberation from home and familial structure, as well as a female community from which to stage vocal dissent. Weaving women created a public face of industrialized labor, worker dissent, and political action. Following the period of reconstruction, textile mills moved to the Southern United States as part of engendering of "the New South." These "southern mill villages," as they came to be called, had a different social structure than their Northern counterparts; often whole

[157] The Lowell Factory was established as a National Historic Park in 1978
[158] Thomas Dublin, "Women, work, and protest in the early Lowell mills: "The oppressing hand of avarice would enslave US"." *Labor History* 16.1 (1975): 99-116.
[159] Dublin, 99-116.

families would move to work at a single mill.[160] Within this structure female workers had less visibility, and formed less of a strong knit community to voice their grievances.

In addition to its industrial history, weaving has been used to cultivate an image of artistic past in the United States. Lourie became enamored with weaving at the age of seven (1937) when she watched a live demonstration of handweaving while her family spent the winter in Florida.[161] The weavers Lourie saw were part of a traveling group from Berea (KY), a town in the Appalachian region that is home to Berea College. These traveling weavers constituted part of what would be the creation of an American folk tradition. This vision of American folk art was created by groups like the Southern Highland Craft Guild, which was founded in 1930 with the goal of generating commerce for the region while documenting handicraft practice. While these products were sold as objects untouched by modernity, providing a link to an idealized past, historians such as Jane Becker have demonstrated that the crafts produced in Appalachia were highly influenced by contemporaneous tastes in color and design. [162] Organizations such as the Southern Highland Craft Guild disseminated designs to individuals with the goal of producing more sales and thus creating more commerce for the region. [163] Through the efforts of groups like this, weaving took on the patina of a traditional American art that contemporary visual culture would find appealing as a source material.

In tandem with its use in creating an American visual culture, weaving became a vital hobby for many beginning in the 1930s and increasing in popularity in the 1950s. Weaving is a

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[160] Cathy L. McHugh, *Mill family: The labor system in the southern cotton textile industry, 1880-1915*, (Oxford: Oxford University Press, 1988)
[161] "From Loom to Lightpen: Janice Lourie Closes Design Gap", in Volume 4 No. 1 January 10, 1967 Published by International Business Machines Corporation, Armonk, N. Y.
[162] Jane S. Becker, *Selling tradition: Appalachia and the construction of an American folk*, *1930-1940*. (Chapel Hill: University of North Carolina Press, 1998)
[163] Becker, 9-10.

more intensive hobby than other fiber arts. Compare the investment in time, space, and energy involved in buying an embroidery hoop, needles, and thread versus the commitment of a small personal loom! The sheer effort in setting up a hobbyist loom underscores the historical narrative on crafts as hobbies: that by the post-war era one could buy mass-produced goods far cheaper than the materials and time needed to produce one.[164] Quite simply it was uneconomical to make things at home, so why do it? One of the most popular periodicals for hobbyist weavers, *Handweaver and Craftsman*, asked this question in its 1950 inaugural issue. In response, author Berta Frey took on an air of amused frivolity, "my impulse is to answer, 'But it is such a whale of a lot of fun.' And most of the time, I follow the impulse and answer just that. Certainly none of us would weave if it was not fun."[165] Frey goes on to make clear that this is a pleasure born of a sense of control, which the maker may not have in the everyday rhythms of professional and domestic labor. This sense of control extended not only to how one might spend their time, but also to the material world in which one lived, as "[w]e are willing co accept mass production and assembly lines just so far, but there is always a point at which we rebel and want something that is our very own and is not repeated in every third house on the block."[166] Weaving as a hobby then was built on pleasure framed in terms of individuality and autonomy.

Despite the use of "handweaver" in its title, the periodical embraced both the mechanical and hand aspects of weaving. In fact, *Handweaver and Craftsman* would be the periodical in which Lourie would publish some of her first articles regarding Textile Graphics. The tone of the

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[164] For an account of hobbyism in the United States in the first half of the 20th century, see: Steven M. Gelber, *Hobbies: Leisure and the Culture of Work in America*, (New York: Columbia University Press, 2010)

[165] Berta Frey, "American Handweaving-A Mid-Century Viewpoint", *Handweaver and Craftsman*, April 1950, (Vol. 1 No. 1), 5.

[166] Frey, 5.

periodical was one of hybridity: tradition and modernity; pleasure and commerce; hand and machine; cosmopolitan and rural settings; all situated as zones that the readers could exist in without contradiction. For example, *Handweaver and Craftsman's* first editorial claimed:

> …handlooms are being set up everywhere from the High Plains of Kansas to penthouses on top of New York's tallest towers. Whether this weaving is being done for personal pleasure or personal profit—and a pretty respectable profit, at that—a great variety of fabrics is being produced which are of artistic, social and economic importance. Not only has the artist-craftsman found an increased demand for his original work, but he also has become of greater importance to industry. One of the most interesting phenomena of these machine-turned times, when historians take a long look back, may be the persistent growth of handicrafts in a time of maximum mass production.[167]

Articles from *Handweaver and Craftsman* reflect this diversity; readers could learn of everything from trends in contemporary international weaving, to marketing one's products, to the best weave structure for kitchen curtains. While I will discuss the frequently-dismissive view of hobbyist weavers maintained by some of the studio craft community in the 1960s, it is clear that in the 1950s, amateur weavers saw themselves as vital and dynamic.

Appreciation of Lourie's software requires a cursory knowledge of how woven fabrics are produced. Woven fabrics are made up of horizontal threads—called the weft—and vertical threads, called the warp. The simplest weave is called a "plain weave," where the weaver passes the weft first over and then under the warp in an "every other" alternating pattern. More complicated weaves require increasingly complicated looms that allow the weaver to raise multiple warp threads simultaneously. This is accomplished by attaching multiple warp threads onto a hook called a heddle, which are attached to a bar—called a shaft or harness—that can be

[167] Mary Alice Smith, "Editorially Speaking", *The Handweaver and Craftsman*, April 1950, Vol. 1 No. 1, 2.

pushed up and down. The number of shafts a loom has places a direct constraint on the design possibilities of a woven fabric. Each warp thread requires a pattern for going over and under weft threads—a pattern called the warp path. For each unique warp path in a given fabric design, there needs to be an equal number of shafts. So when a design for a woven fabric is envisioned, a diagram must be created on graph paper, referred to as a draft notation, that determines the number of warp paths—and subsequent number of shafts—needed. [Fig. 5] With complicated designs, the diagram is generally not produced by the original designer, but by a second "point paper designer." This individual has a large degree of control over the final product, often changing the initial design to make it better-suited to the mechanics of weaving. The point paper designer will frequently decide which weave is best for a given portion of the pattern; for example, he or she may decide that one section of the design would look best in a smooth satin weave, while another section would benefit from the visual texture of a herringbone weave. After this process, a second diagram is made to determine which warp ends are assigned to which shaft. A third diagram is then made to determine the pattern of which shafts should be raised for each row of fabric. This process is ultimately time consuming, expensive, and often results in discrepancies between the initial design and final product.

Weaving, particularly the commercial mechanized weaving that Lourie's software was designed for, has a different cultural and material history than knitting, quilting, or needlework. While textiles writ large may conjure the domestic, weaving summons industrial touchstones. Mechanical looms popularized in the early 1800s helped cut down on production times, but did little to increase the speed of the design process. The most influential of the mechanical looms was the Jacquard loom, invented by Joseph-Marie Jacquard in 1804. Beginning in 1800, Jacquard began patenting mechanical looms where the final diagram is transferred onto a series

of punch cards (or in later iterations, magnetized tape). While others had also experimented with punch card systems, what made Jacquard's loom a success was the marriage of punch card control and a mechanized process through which the loom was fed cards.[168] In a Jacquard loom, each card represents a row of woven fabric, meaning that intricate designs can result in thousands of cards. The heddles sit below the card, and when the shaft is raised, the heddles either pass through holes in the card (lifting the attached warp threads) or are stopped if no hole is present. This results in a pattern of raised and lowered warp threads, which the weft is passed though. The loom was a major success in France; in 1805 Napoleon declared the loom public property and compensated Jacquard with a yearly 3000-franc pension and a 50-franc royalty for each Jacquard brought into use.[169]

Histories of modern computing frequently acknowledge the Jacquard as providing an essential breakthrough in control and communication. Unlike other early mechanical approaches to calculations, such as mathematician Blaise Pascal's adding machine of 1642, the capacity to both reliably store and retrieve information as well as automatically perform a sequence of operations set the Jacquard—and contemporary computers—apart.[170] 19th century English inventor Charles Babbage, whose "Analytical Engine," is seen as an essential development in the history of computing, planned to adopt the punch-card system of the Jacquard to carry out the Analytical Engine's purpose.[171] Babbage's contemporary and collaborator Ada Lovelace is frequently referred to as the "first computer programmer," as she recognized the Analytic

[168] James Essinger, *Jacquard's Web*, (New York: Oxford University Press, 2004), 36.
[169] Essinger, 36.
[170] Paul Ceruzi, *Computing: A Concise History*, (Cambridge: MIT Press, 2012) 5.
[171] Babbage even owned a very detailed woven portrait of Jacquard that was woven on a Jacquard Loom. For a discussion of this see: Sadie Plant*, Zeros and Ones: Digital Women and the New Technocuulture*, (London: Fourth Estate, 1997) 14-27.

Engine's potential to perform a multiplicity of tasks.[172] Weaving and computing are thus deeply entwined.

Lourie herself knew of the historical connection between weaving and computers. Writing about her first view of Jacquard cards, Lourie bubbled over with excitement, noting their similarity to the punch cards used to store data and execute commands in computers, "[t]he Jacquard cards reminded me of IBM cards, although they were larger and the holes were much larger. The sight of a Jacquard weaving a complex design is exciting in itself. But the obvious connection between this loom and the computers with which I had been working for about five years was an even more exciting aspect of the visit."[173] Today, Lovelace and the Jacquard loom create an image of women and computers that joins the supposed aberration found in Lovelace's passion for math with the essentialized feminine traditions of weaving.[174] However, as a weaver and computer scientist Lourie was uniquely positioned to leverage the connection between these tools.

History of CAD

Lourie would achieve recognition both within IBM and the press for her Textile Graphics system. As described previously, this system was an early CAD program that allowed even those inexperienced in computers or weaving to design and produce woven textiles. Lourie began

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[172] Today Lovelace is something of a popularized feminist folk hero. There is the "Ada Initiavtive" that seeks to encourage women into computing and "open-culture," an Ada Lovelace Day that is celebrated annually to promote women in STEM roles, and Google celebrated her 197th birthday with one of their "Google Doodles" in 2012

[173] Janice R. Lourie, *Textile Graphics/Computer Aided*, (Fairchild Publications, 1973), 15.

[174] In addition to the history of material weaving, weaving has been used metaphorically to theorize connections between feminized cultural traditions and the networking capabilities of the internet. For example, see: Nina Wakeford, "Networking Women and Grrrls with Information/ Communication Technology: surfing tales of the world wide web" in *Processed lives: Gender and technology in everyday life*, eds. Jennifer Terry and Melodie Calvert London (London: Routledge, 1997).

development of her system in 1964 and filed her patent in the summer of 1967. While Lourie made unique interventions into the field of CAD, it is necessary to understand CAD in the mid-60s to put her work in perspective.

The history of CAD, like that of many technological inventions, is riddled with cases of convergent evolution.[175] While it may be tempting to look for a singular progenitor for each technological breakthrough, it is more intellectually honest to cast a broader net and look at the ways in which individuals collaborated and ideas circulated. The news periodical *Scientific American* is useful in this respect, because it is authored by experts in the field with the aim to inform the general public. We might think of the articles in *Scientific American* as the stories that institutional science tells the larger public about itself. The September 1952 issue of *Scientific American* focuses on automated control, and features an article on one of the very first instances of what we might now call CAD, a "computer numerical control" (CNC) milling machine for working with metals.[176] For the article's author, MIT professor of electronic engineering William Pease, what sets these CNC tools apart from machines that came before them is the granular and responsive control that a general purpose computer affords them. Similar to today's discourse surrounding digital manufacturing, the "general purpose" aspect is key here, as the CNC tool is described as being groundbreaking in that it can offer bespoke creation through variable commands:

> suppose we want an automatic machine which will make not one particular product, or part, but a number of different kinds of

[175] Paul Ceruzi discusses the issue of convergence in the history of computing more broadly, see: Paul Ceruzi, *Computing: A Concise History*, (Cambridge: MIT Press, 2012), xi-xiv.
[176] Steven Coons refereed to this CNC machine as a predecessor in describing the CAD software Sketchpad see: Coons, Steven Anson. "An outline of the requirements for a computer-aided design system." *Proceedings of the May 21-23, 1963, spring joint computer conference*. ACM, 1963. William Pease, "An Automatic Machine Tool", *Scientific American*, Vol. 187, No. 3 (September 1952), 101-115.

> products, and only a few of each—as the versatile machine tool must do. Now the machine must handle a different set of instructions for each product, instead of the single set of instructions for the crankshaft. In other words, it must be able to deal with more information. And the cost of the information-handling capacity needed for each product is spread over only a few items instead of many. This is the essential problem in automatizing machine tools.[177]

What makes such responsive control possible is the constant relay of information within the mechanical system, which the article identifies as a process of feedback. While this intensive system of feedback allowed for increased control, it also kept the designer locked out of the process. The human designer could only create the punch cards and check the final product to see if the instructions were satisfactory. The next generation of CAD machines would allow for more dynamic human/machine interaction through the production process.

It is difficult to write about the history of CAD without referencing to yet another now-ubiquitous computing acronym, the Graphical User Interface or GUI. A GUI is a system that allows a user to engage with a computer through images or icons, rather than text-based commands. Most of the time when a non-expert engages with a computer—whether it is through a word document or an internet search engine—they are using a GUI. One of the first GUIs came from computer scientist Ivan Sutherland's PhD thesis (1963) at MIT.[178] The program, named Sketchpad, was written for MIT's TX-2 computer, which was developed in 1958 for use at MIT's Lincoln Lab.[179] Sutherland's program allowed users to literally sketch with a light pen

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[177] William Pease, "An Automatic Machine Tool", *Scientific American*, Vol. 187, No. 3 (September 1952), 107.
[178] For an example of this see: Thierry Bardini, *Bootstrapping: Douglas Engelbart, Coevolution, and the Origins of Personal Computing* (Palo Alto: Stanford University Press, 2000), 30.
[179] The Lincoln Lab is hugely important to cold war histories of computing, and was the site of many influential technological systems, such as the Semi-Automatic Ground Environment (SAGE) Air Defense System.

upon the computer's cathode ray tube screen. Sketchpad utilized a vector-based image language. A vector graphic system is two-dimensional and creates lines and circles through the creation of points on an x-y axis. This process might be more intuitive if one imagines the tools of the straight edge and compass and the lines achievable through their use. It is not an ideal system if one wishes to create images that communicate depth through shading and is better suited for the clean outlines of a diagram. The user could perform a variety of calculations—a very simple example being, if a value is entered for one point of a line and a key provided, the system could calculate the value for another point on the same line. The program was never intended for general use—it was only initially accessible on one computer at the Lincoln Laboratory. However, it proved incredibly influential, and was met with surprise and acclaim when Sutherland first introduced it at meeting of the Spring Joint Computer Conference in 1962. Steven Coons—an MIT professor who was one of the first and most vocal advocates for CAD–wrote about the GUI system as essential to the process of design and the nature of the designer, who "perceives his idea at first … in some nebulous assembly of building blocks of structure, vaguely beheld; he 'feels' his creation. The sketch forms the natural bridge between these vague stirrings of the imagination and the subsequent precise statement of the refined details of the concept."[180] Graphics then became an essential tool in using CAD to close the loop between designer and product.

While Sutherland's GUI offered a close working relationship between computer and designer, it was one with deeply entrenched roles. According to Coons, the group envisioned "join[ing] man and machine in an intimate cooperative complex, a combination that would use

[180] Steven Anson Coons, "An outline of the requirements for a computer-aided design system." *Proceedings of the May 21-23, 1963, spring joint computer conference*. ACM, 1963.

the creative and imaginative powers of the man and the analytical and computational powers of the machine each with the greatest possible economy and efficiency."[181] Similar to the methodical and overly-determined ways in which female computers were initially described, the computer aspect of CAD was described as incapable of generating novel contributions. For example, Coons described the CAD relationship as follows: "man" provides the invention of new ideas and associations and the realization of broader patterns, as he is "creative and unpredictable"; the computer provides single-mindedness, it is "immune to distraction, precise and reliable...it is emotionless or so we suppose. It suffers from neither boredom or fatigue."[182] This characterization of CAD betrays an anxiety about shifting roles of the maker; by characterizing the computer as a methodical drudge, Coons and other CAD advocates bolstered their creations, while calming fears about the encroachment of technology.

In a case of convergence, IBM also was making immense strides in CAD and GUI technology in the early '60s.[183] Much attention was paid to IBM and their partnership with the car company General Motors (GM).[184] [Fig. 6] GM widely reported that its 1966 Camaro sports car was designed using computer design tools. The hardware used by GM was the IBM 2250 computer, and the entire system—which was christened "design augmented by computer" or DACI—was designed at IBM to GM's specified needs. The 2250 was improved in '66 and sold to the public for $76,800. According to one article in the *Wall Street Journal*, IBM received hundreds of requests for the unit, with roughly equal numbers coming from the defense-

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[181] Coons, Steven Anson. "An outline of the requirements for a computer-aided design system." *Proceedings of the May 21-23, 1963, spring joint computer conference*. ACM, 1963.
[182] Steven Anson Coons, "The Uses of Computers in Technology", *Scientific American*, Vol. 215, No. 3 (September 1966), 177.
[183] Scott R. Scmedel, "Electronic Sketching: Engineers Focus Light On Screen to Design", The Wall Street Journal, October 25, 1966
[184] Ibid.

aerospace sector and the industrial sector.[185] Lourie herself was an important contributor to this project; its successful completion not only gave her the background to envision the future of CAD systems, but also won her the freedom and autonomy at IBM to work on Textile Graphics.

Textile Graphics

Lourie's primary realization was that weaving patterns and computer programs both function through a form of binary language. Returning back to graph paper weaving diagrams, each intersection of warp and weft represents a case of whether or not the warp thread will be lifted by the loom. This "yes or no" binary approach (also known as Boolean logic) led Lourie to comment that "[i]f I did not have graph paper I could write a row or column of a weave, i.e., a filling path or warp path, using the number 1 in place of a painted square and a 0 in place of an unpainted square."[186] From this realization—that weaving patterns could be represented as binary, and binary could be represented graphically—Lourie was able to extrapolate that a warp path represents a string of numbers. For Lourie, the actual execution of weaving was similar to how a computer might run through a programmed flow chart at which each "yes or no" juncture brings the computer to a different operation until it finally reaches its end result. Lourie's filed her patent for the computer aided design of woven textile—a process she referred to as "Textile Graphics"—in August of 1967.

While the actual computer science behind the process is complex, the user experience was designed to be simple and unintimidating. Textile Graphics was comprised of three different tools to aid the designer. The first was the IBM 2250, which utilized cathode ray tubes to visualize graphical data to the user. The 2250 had the advantage that a user could draw on its

[185] Scott R. Scmedel, Electronic Sketching: Engineers Focus Light On Screen to Design, *The Wall Street Journal*, October 25, 1966
[186]Janice R. Lourie, *Textile Graphics/Computer Aided*, (Fairchild Publications, 1973)

surface using a light pen, and was a major part of the "input" stage. [Fig. 7] The second tool was a "Rand Tablet," which allowed the user to further manipulate their design. In contrast to the 2250 that only allowed for the drawing of very rough outlines, the tablet was made of a very fine 100 x 100 wire per-square-inch mesh structure, allowing the user to control the design at a very fine level. Once the user drew the outline of their woven design, they could interact with a selection of weaves stored on the third tool, the IBM 360 mainframe computer, and choose which weave should be placed in which areas of the design. [Fig.8] Lourie intended that this stage would be one of experimentation, taking advantage of the computer's quick recall and visualization of different weaves. Lourie's patent application expounded on the benefits and flexibility granted to the designer at this stage at some length, "[o]nce displayed, the initially chosen weave pattern in any area can be erased, replaced or altered at the option of the operator … Thus, the entire textile design can be built up visually in a small fraction of the time required by the point paper method and without any sacrifice of design flexibility."[187] Once a final design was chosen, Lourie's program could automatically create the punch cards needed for a Jacquard loom. By integrating these tools, the textile graphics system created an easy-to-use interface that allowed for non-expert experimentation.

As a practitioner of a handicraft, Lourie found pleasure in the control and creativity she could execute over a final design, a pleasure not only in the final product, but importantly, in the process. Lourie identified that a major problem with commercial weaving practices was the time and expense needed to orchestrate the many graph paper guides connecting initial design to

[187] Janice Lourie, "Graphical design of textiles." U.S. Patent No. 3,529,298. 15 Sep. 1970.

Jacquard cards.[188] However, as she wrote in the early 1970s, a complete automation of process in the name of cost savings did not interest her:

> [b]ecause I am also a handweaver and caught up in the relationship of craftsman and tools, I think that, had a fully automated solution presented itself to me, I would not have pursued it. Rather, I would have commended it to someone else as a worthwhile computer application. As it happens, computers could not play a fully automated role in the interpretation of artists' designs; the creative aspects of the process preclude this.[189]

Consistent with her interest in flexibility and the relationship between craftsperson and tools, Lourie imagined her CAD system as an active partner in the design process. As Lourie noted, the process was conversational in its nature:

> …computers entered into interactive communication with people, into a conversational mode. The people who carried out such dialogues with computers were not necessarily the technologically sophisticated programmers who previously were the only ones able to communicate with computers. Now people whose problems could be solved by such interactive communication found themselves engaged in a dialogue with a computer consisting of interrogations and responses by both parties, guiding a problem to a solution.[190]

The logic behind Lourie's software shows a great deal of nuance for her historical period; demonstrating that computers can be used both as simple tools of automation as well as creative partners for a community of makers.

The particulars of how Lourie imagined and designed her software speak to her self-identification as not only a computer scientist, but also a handweaver. Lourie published one of the first accounts of her software not in a computer industry trade publication, but in the winter

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[188] Janice Lourie, "The Textile Designer of the Future", *Handweaver and Craftsman*, Winter 1966, 9.
[189] Janice Lourie, *Textile Graphics/Computer Aided*, (Fairchild Publications, 1973), 37.
[190] Lourie, *Textile Graphics/Computer Aided*, 60.

1966 issue of *Handweaver and Craftsman*. While Lourie would routinely pitch her software to the general public as a bastion of creativity in an increasingly automated world, in this essay for the weaving community, she focused on the potential economic and commercial applications of her software. Her essay "The Textile Designer of the Future" follows familiar narratives of the post-war designer craftsman, that those trained in making should work with machinery to compliment (rather than compete) with industry. As Lourie phrases it "[h]aving the freedom of full fabric size for one design would enable a designer to draw Jacquard tapestries, which now theoretically possible but not practicable. Of course these would not be comparable in quality to hand-woven tapestry but they certainly would provide a tool for the artist-craftsman to satisfy large architectural commissions in a reasonable time."[191] While to the mainstream Lourie communicated her software as a means of creativity, here it was served up as a beacon for continuing commercial relevance. Lourie's pitch to her fellow weavers offers an early example of how digital production was likened to handmaking in that it could lead to more variety.

Lourie would continue this framing of her software for those intimately acquainted with cloth and industry. The trade publication "Home Furnishings Daily" printed a long article in the spring of 1969 and featured an interview with Lourie working in her IBM offices in New York. In this article Lourie is the picture of the energetic and brainy computer scientist, described as "walking at breakneck speed and leaving you several steps behind" or looking "a bit exasperated" as she "runs her hands through her black hair and tries again to explain the complicated weaving system on a simple grade school level." Despite any technical knowledge that may have gone missing in translation, one point is made clear, Lourie's software has

[191] Janice Lourie, "The Textile Designer of the Future", *Handweaver and Craftsman*, Winter 1966, 9.

profound implication for industrial production, not only for the ease of creating designs, but for the ability to create many more designs. Inexplicitly reproduced in all caps, a quote from Lourie makes these possibilities clear "THE IMPLICATIONS CAN BE MORE CUSTOMIZED DESIGNS. ACTUALLY THE USE OF TEXTILE GRAPHICS MOVES THINGS OUT OF THE REALM OF STANDARD DESIGNS AND INTO CUSTOM MADE DESIGNS FOR MASSES."[192] In Lourie's framing for those working within the professional realm of weaving, the digital is routinely held up as means to ensure variety.

In the mainstream press, Lourie and her textile graphics system create a specific image of women and computers, one which conflates Lourie's success with the essentialized feminine traditions of weaving. One of the most emblematic examples is a 1967 *New York Times* article, "Quick, Compute Me a Nice Tapestry." The article includes two photos of Lourie at work, one at a handloom the other of her working on the Textile Graphics systems. [Fig. 9] Seen together the two images present a tension between continuity and a historical break. Both photos are captioned with quotes from Lourie, and we learn that "[t]he hand loom hasn't changed much in the last 4,000 years ... Cleopatra or Martha Washington would recognize this one" and that "I.B.M.'s 2250 display unit is a far cry from the classic loom."[193] In this chain of technological development, Lourie's body provides the hinge; whether it is bent in concentration over the 2250 or the handloom, she is what links weaving's past to weaving's future. Lourie's quotes do the work of bolstering this transhistorical image of women and cloth—placing her alongside Cleopatra and Martha Washington—but they also add computing into this relationship. During the course of the article, Lourie alludes to the relationship between the Jacquard and computer

[192] "Short Circuit", Home Furnishing Daily, May 22, 1969.
[193] Bernadette Carey, "Quick, Compute me a Nice Tapestry", *The New York Times*, November 17, 1967.

punch cards, leading her to comment that "[i]t seemed to me that it was about time that [computing's] debt to the weaving trade was paid back … It also seemed about time to bring a woman's touch to the computer age."[194] In this way, Lourie leverages her own feminine associations to create room for herself in the popular perception of computing.

IBM was quick to harness the appeal of what they framed as a charming contradiction. Advertisements that ran in the *New York Times,* the *Washington Post, Business Week, Time,* and the *New Yorker* from 1967 to 1968 feature Lourie and ask "This mathematician wants to spur creativity in textile design. What's she doing at IBM?" [Fig. 10] The answer, according to the advertisement, was "working hard to understand understand problems—and then find ways to solve them through the use of computers."[195] There is a note of incongruity in the advertisement, if this woman in the knitted cardigan could be a computer scientist and even the most "ancient craft" could be aided by computers, then what couldn't they do?

Hemisfair and the Taming of Computers

By 1968 the awesome power of computing technology was already in the minds of many Americans, and advertisements such as the one above were an attempt to direct their imagination in more benign directions. At this historical moment, beliefs in the neutrality of technology were being routinely challenged in mainstream thought. The core critique was that in an era of increasingly complicated and obfuscated systems, individuals were becoming progressively regimented and machine-like, with little understanding of their roles or the systems they were in. A powerful example of this mounting fear came from the free-speech protests by students at the University of California, Berkeley in the early 1960s. During these protests, one student pinned

[194] Bernadette Carey, "Quick, Compute me a Nice Tapestry", *The New York Times*, November 17, 1967.
[195] IBM advertisement, *The New York Times*, April 17, 1967; pg. 28

as sign to himself that read “I am a UC student. Please don't bend, fold, spindle or mutilate me," a play on the text that was printed on IBM computer punch cards.[196] Some students burned their registration punch cards during later protests, the implication being that a technological corporate logic had reduced them to a number, which denied them a holistic feeling of self.[197] In addition to these public displays, there was the ever-present fear of automation. Such fears had been with industrialization since the beginning—for example, there were violent rebellions against mechanized looms such as the Jacquard—but they took on a different character in the face of computers. In addition to the concerns over job loss, the rise of computers was met with a humanistic concern, that enshrined qualities were being encroached on.

Leaders of technological corporations and professional organizations were aware of these fears and growing hostility. IBM in particular launched a public relations campaign by the late 1950s to sway public opinion.[198] One IBM engineer even phrased this attempt as a “the design battle” in which there was a constant struggle to establish control over the public image of the computer.[199] As historian of design and technology John Harwood has phrased this “battle” there was a tension at IBM to appear “futuristic and exciting with a simultaneous attempt to both naturalize both the concept and practice of data processing.”[200] One software integration manager at General Electric Co. put the crisis in all the more desperate terms “[w]e do want to

[196] For a full history of the use of punch card imagery in student protests, see: Steven Lubar, “‘Do Not Fold, Spindle or Mutilate’: A Cultural History of the Punch Card." *The Journal of American Culture* 15.4 (1992): 43-55.
[197] For examples of this and other incidents see: Fred Turner, *From Counterculture to Cyberculture* (Chicago: University of Chicago Press, 2006), 12-13 or John Harwood, *The Interface: IBM and the transformation of corporate design, 1945–1976*, (Minneapolis: University of Minnesota Press, 2011)
[198] John Harwood, *The Interface: IBM and the transformation of corporate design, 1945–1976*. (U of Minnesota Press, 2011) 163.
[199] Harwood, 163.
[200] Harwood, 163.

get through to people, because we are desperately afraid that what happened to the space program will happen to us. They didn't get through to the grass roots, and space just isn't important any more. When it can be demonstrated that computers are for people, then people will be for computers."[201] Lourie's software represented a perfect opportunity to show how computers could be "for the people."

IBM celebrated Lourie in the name of public relations at the 1968 World's Fair—also called HemisFair—which was held in San Antonio, Texas. [Fig. 11] As described previously, Lourie's Textile Graphics program produced a series of punch-cards that could be manually fed into a Jacquard loom. But for the HemisFair, IBM wanted to eliminate this step in favor of a direct connection between the computer and loom. In order to achieve this, Lourie and her team replaced the normal needles on the Jacquard head with magnets that could receive electronic impulses from the IBM computer system. Having the computer directly control the loom was a major endeavor, requiring Lourie alongside a team of engineers and programmers to dedicate nearly a full year to the project. It was also an economically unviable modification, as each loom in a factory would require its own computer and Textile Graphic system. Lourie was ambivalent about the effort and unenthusiastic about the time needed to pull off this stunt. So the question remains as to why would IBM put so many resources into this? This arrangement highlighted the image of the computer as a benign tool that facilitated a direct connection between maker and final product.

Archival photos of Louire's HemisFair demonstration set the scene. One photo is taken from the perspective of the audience seated in low-slung bleachers, directly facing the Jacquard

[201] Computer Convention Will Skip Esoterica and Focus on Layman", *The Wall Street* Journal, August 21, 1970.

loom, which stands over eleven feet tall, dwarfing computers and spectators alike. [Fig. 12] Flanking the Jacquard loom are two textile graphics systems. There is something awe inspiring about this setup, the direct feed from computer to machine obfuscating the transmission of information. Mechanical looms are not quiet things; they clank and shutter as their treadles manipulate threads. One imagines the jarring contrast between the relatively quiet and frictionless experience of moving the light pen across the screen of a 2250, only to then meet the noise and movement of the Jacquard. Visitors to the IBM pavilion were given the opportunity to interact with the Textile Graphics system, and create a design which would be woven on the Jacquard and taken home as a souvenir. An article in the *San Antonio Express* proclaimed that the "[c]omputer gives loom star role" as it describes "[b]eatnik-type men with beards and sandals were as visibly impressed Saturday by computer woven fabric as were grandmotherly types whose primary brush with fabric creation was done with knitting needles, when the towering Jacquard loom was opened for public demonstration."[202] One archival photo shows a young IBM employee grinning as she holds up her newly woven souvenir swatch bearing the design of a small daisy emblazoned with IBM's logo. [Fig. 13] IBM's exhibition used the Textile Graphics system to emphasize two points about its computers: they allow for an unencumbered connection between between designer and product, and and they are unintimidating; a small scrap of a daisy. While Lourie's writing presented the computer as an active and engaged partner in the design process, this demonstration of Lourie's software presented it as a neutral and subservient tool.

This rendering of the docile computer is reinforced by IBM's other display at the fair. IBM had two pavilions at the HemisFair [Fig. 14]: the Durango Pavilion featured Lourie's textile graphics system, and the Lakeside Pavilion showcased the Charles and Ray Eames' film "A

[202] "Computer gives loom star role", *San Antonio Express*, April 7, 1968

Computer Glossary, or, Coming to Terms with the Data Processing Machine." The twelve-minute cartoon aimed to clarify computing for visitors, and is illustrative of the hierarchical understanding of computers that were popularized at the time. At first the film aims to overwhelm; shots move closely over intricately coiled and twisted wires, disembodied voices intone the specificities of data storage into “read only” disks. A male voice then reveals that we have been listening to the voices of specialists who possess a vocabulary in which each word has exact valences of meaning. We then hear a softer female voice, who reads the words on the screen: "Computer: An automatic machine that accepts instructions and information. Following the instructions, it performs operations on the information and reports the results." In a clear example of the gendered politics discussed previously, a woman is brought in to soften and humanize the computer. Simplified line drawings accompany this explanation, and the film begins to break computing into discrete procedures. Definitions are broken down into their parts and analogies are given based on daily life. For example, the film suggests flowcharts are defined by their “[a]bility to compare two values and then take the next step based on the comparison"—we are given the example where different parameters lead to specific outcomes for a cartoon man: married less than five years? Then you should kiss your wife good-bye. Married more than five years? Then you can skip the kiss. The film makes it clear that the ultimate goal of such a methodology is the creation of a set path to lead towards a set of predetermined, desired outcomes. As our female narrator puts it, "[r]epeating the operation over and over until the desired condition is met." In this film the computer is seen as a problem solving device, and we are told that nearly any problem scan be solved by a computer, if it can be adequately stated. Computers in this film were seen much like the women “computers” of the early 1940s from which the machines take their names—simple and convenient tools that

perform according to set instructions and report back their results. Lourie's software gives us another perspective from which computers are not used to simply execute programs but seen as an active tool in the creative and formative process.

Studio Craft and Lourie's Legacy

After HemisFair Lourie became an advocate for computers and creativity, particularly in the studio craft world. She was involved in the first conference on the potential role of computers in art museums, held at the Metropolitan Museum of Art (New York) in 1968.[203] She also worked alongside the American Craft Council, organizing the exhibition *Mind Extenders* at the Museum of Contemporary Crafts (MCC) in 1969, and took part in their annual retreat in 1971. In this last section of my chapter, I will discuss Lourie's involvement in these endeavors, and in doing so demonstrate how her approach contrasted with prominent crafters—particularly fiber artists—during this time. While Lourie's work ran counter to the better-studied, "fine art" approach to craft in the 1960s and early '70s, her approach was closer to the ethos that dominates contemporary digital production.

The period in which Lourie's software was created witnessed a branching of weaving practice. The older generation frequently embraced the mantle of the "designer craftsman," they sought to create designs that could be mass produced. A new vanguard would come into prominence by the mid-1960s, who created "off the loom" fiber art. Lourie differs in significant ways from both of these groups, though she worked at the same time and ran in the same artistic communities as both. Both of these tendencies will be examined in turn to highlight points of difference and continuity with Lourie.

[203] This conference was sponsored by IBM, see: "Computers and their potential applications in museums: a conference sponsored by the Metropolitan Museum of Art', April 15, 16, 17, 1968

In recent museum exhibitions and art historical texts, the 1960s are held up as a moment in which fiber struggled—and depending on which history you're reading, succeeded—to be recognized within the realm of fine arts.[204] In the early 1960s a number of artists working with fiber abandoned the creation of fabric that could be used as an applied covering, and instead created volumetric forms that were more akin to sculpture. The Lausanne International Tapestry Biennial launched the careers of many women working in what was often called "new tapestry."[205] These pieces were frequently large and made out of unexpected materials such as raffia or rope. These artists and styles became codified into something of a canon by the 1969 Museum of Modern Art exhibition "Wall Hangings" and the later publication *Beyond Craft: The Art Fabric* (1972) both organized by curator Mildred Constantine and textile designer Jack Lenor Larsen.[206] Craft historian Elissa Auther has argued that the rejection of the loom equated to a rejection of traditional craft and fine arts hierarchies, with individuals and institutions challenging fiber's role as domestic and instead privileging expressive, concept-driven forms.[207] This rejection of the loom was a means to distance oneself from the taint of amateurism in craft, or, as fiber historian T'ai Smith puts it "anxieties concerning loom technology and the association with amateur craft that had marked the popular spread of weaving in the 1950s."[208]

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[204] Interestingly, craft historians such as Elissa Auther or Glenn Adamson suggest that in their yearning to be considered fine art, fiber art failed at its aim. While recent exhibitions at mainstream art museums such as *Fiber: Sculpture 1960-Present* Institute of Contemporary Arts, Boston might suggest otherwise.

[205] Jenelle Porter, "About 10 Years from New Tapestry to Fiber Art", in *Fiber: Sculpture 1960-Present*, (Institute of Contemporary Arts, Boston, 2014) 166-179.

[206] Porter, 166-179.

[1] [207] Elissa Auther, *String, Felt, Thread: The Hierarchy of Art and Craft in American Art* (University of Minnesota Press, 2010), 25-46.

[208] T'ai Smith, "Architectonic: Thought on the Loom", *The Journal of Modern Craft* Volume 4—Issue 3—November 2011, 273.

Lourie is oddly placed in this rejection of the amateur *via* the rejection of the loom; she was both an amateur weaver, yet the creator of tools meant to aid the large scale production alongside one-off fiber art.

Lourie's approach to the textile graphics system was also at odds with the weaving community that continued to embrace the loom. Textile Graphics encouraged figurative designs; starting as it does by passing a light pen over a screen, patterns invariably take on the character of line drawing. The HemisFair demonstration resulted in a profusion of woven flowers, bumble bees, and houses; the stuff of doodles. [Fig. 15] This observation highlights a particular difference between Lourie's process and contemporaneous philosophies on how weaves should be designed. One of the most well-known figures representing this orthodoxy was Bauhaus-trained weaver Anni Albers, who published her highly influential book *On Weaving* in 1965, just as Lourie was developing her software. In *On Weaving*, Albers espouses a doctrine of medium that underlie her designs,

> [t]he horizontal-vertical intersection of two separate systems of thread is of great consequence for the formative side of weaving. The more clearly this formation is preserved or stressed, the stronger the weaving will be in those characteristics that set it apart from other techniques ... a weaving that exhibits the origin of its rectangular thread-interlacing will be better than one which conceals its structure and tries, for instance to resemble a painting. Acceptance of limitations, as a framework rather than as a hindrance, is always proof of a productive mind.[209]

Lourie's software blithely skips over such limitations allowing the designer to create curved lines and circles without effort.[210] However, to return to the name of Lourie's project is instructive

[209] Anni Albers, *On Weaving*, (Studio Vista: London, 1974), 38-39.
[210] The effort was of course there; it was hidden in Lourie's programing. See the chapter "Automatic Deduction of closed areas in interactive graphics" in Lourie's *Textile Graphics/Computer Aided* for Lourie's discussion on the difficulty of programing her software to render curved outlines in a grid format.

here; Textile *Graphics* was revolutionary in that it was user-friendly, and this is because it used *graphics*, rather than code, as a point of communication between user and computer. This focus on communication highlights the fact that the visual properties of finished works from these two systems of weaving—Albers on the one hand and Lourie the CAD trailblazer on the other—are not so much the source of their difference, as they are a consequence. What separates Lourie and Albers on a more essential level are the ways in which the act of translating a design into a woven tapestry.

Albers' theory of weaving was deeply bound to her views on the importance of direct experience. Art historian T'ai Smith suggests that Albers' theory of weaving and design was dependent on her understanding of the "medium" of weaving. This is due to Albers' view that the essence of weaving can be found in the interplay of materiality—the vast array of different fibers that one might choose, each with their own characteristics—and the structure of a weave, at which point the threads interlace. As Albers wrote, the "interrelation between the two, the subtle play between them in supporting, impending, or modifying each other's characteristics, is the essence of weaving." In this way, weaving's medium is never fixed and stable, it is reimagined through the constant interplay of materiality and structure. This fluid understanding of medium has direct consequences for the relationship between draft notation and final woven object; as Smith writes "[a] woven textile (a piece of fabric) is never just the direct consequence of a given plan."[211] Smith's writing on Albers' understanding of "draft notation"—the gridded diagram that Lourie's software made unnecessary—is particularly useful. To Smith, draft notation functions as a "code-as-image," not so much a representation of the final woven object, but a diagram of the

[211] T'ai Smith, *Bauhaus Weaving Theory: From Feminine Craft to Mode of Design*, (Minneapolis: University of Minnesota Press, 2014), 150.

act of weaving. Subsequently, an engagement with draft notation is only ever a partial experience of the cloth; to fully understand a design one must experience both the materiality of the weaving and have knowledge of its structure. Albers stopped weaving in the late 1960s; her final tapestry was the elegiacally named *Epitaph* (1968). In Smith's narrative, this was Albers' recognition of "off the loom" fiber artists, and her belief that tapestry was no longer a valid artistic practice.[212] Yet the interest that Albers showcased in the act of translation—the variety of changes that might occur from initial design to point paper and finally to material object—has theoretical connections to the realm of CAD design exhibited by Lourie.

While Lourie's software and design philosophy does not explore the diversity of fiber's materiality, it does privilege "experience" similarly to Albers. In Albers' essay "Design: Anonymous and Timeless" she bemoaned the separation of weaving into a disparate set of activities, each with its own "expert" who was only involved with a discrete point of production. This separation was particularly virulent on the grounds that it lessened one's experiential knowledge, as Albers writes "[s]pecialization means the loss of direct, actual, experience beyond the field of specialty and there, substitutes information for experience. But information means intellectualization and intellectualization—one-sidedness, incompleteness."[213] For Lourie the creation of information—be it the library of weaves stored on Textile Graphics or the way the system translated curved lines into weaving's grid—occurred through extensive personal experience. By obfuscating this difficulty from the novice working at a Textile Graphics system, Lourie changed (and arguably hindered) the designer's intimate knowledge of the materials. However, her software and the discourse she built around it put a premium on the experience of

[212] Smith, 171.
[213] Anni Albers, "Design: Anonymous and Timeless", accessed March, 2018, http://www.albersfoundation.org/artists/selected-writings/anni-albers/#tab3

designing. Lourie's world was one of CAD and industry and she frequently bemoaned its current state in which a designer might never see or touch the program that was used to run a mechanized loom. For Lourie, Textile Graphics was a tool to give a designer direct access to a closer version of their final product before it was produced. This rhetoric proved to be influential with the craft community, as Lourie championed her approach with various museums and professional groups.

An example of Lourie's influence on craft can be seen in the exhibition *Mind Extenders: An Assembly of New Tools and Design* (April 19-June 15, 1969). In this show, the MCC sought to cast electronic technology as a partner for studio craft. Such partnership was not a given; as discussed in other chapters in this dissertation, the late 1960s and early 1970s mark a moment when the MCC was embracing the counterculture, which often encouraged romanticized pastoralism and a focus on sensual experiences. In contrast to IBM's pavilion at HemisFair, which endeavored to romanticize the computer, this exhibition let its uneasiness with computing be known. For example, an oft-quoted phrase from the press release claimed that the show was not intended to be a "how to" nor an "ode to computers and creativity."[214] As one one review stated, this exhibition seemed an acknowledgement that the MCC—and by extension mainstream craft—had to "[come] to terms with technology."[215] Yet it would too strong to suggest that the exhibition focused on the potential evils brought on by computers, as the review noted "the modern computer is not shown as an anti-humanistic robot a la 2001."[216] Instead, it might be fair to frame the exhibition on the whole as a middle ground for computers and craft. The show

[214] Press Release *Mind Extenders*, Museum of Contemporary Crafts/American Craft Museum Archives, American Craft Council Library, Minneapolis, MN
[215] "Art Round-Up" *Home Furnishing Daily*, April 18, 1969
[216] Ibid.

featured a wide range of materials, from MIT Professor Nicholas Negroponte's "Urban5" system for designing environmental spaces, to Robert Mallary's wooden sculpture "Quad III" (1968) which was designed with a CAD program. Weavings of Lourie design were included in the exhibition, along with a film made by IBM that featured her designing with the Textile Graphic system. Overall this exhibition is valuable for the ways in which it highlights how computing technology was sold to the studio craft community.

Lourie helped drive the central ideas of the exhibition and select whose work would be shown.[217] One aspect of the exhibition in which Lourie's view can be clearly seen is the way in which the computer and the loom were historicized. The show exhibited older technological artifacts alongside CAD produced works. Special attention was paid to the connection between computing and looms, and the show included a model of a Jacquard Loom and a replica of of Charles Babbage's Difference Engine. The press release quotes Lourie as claiming: "[t]he relationship between weaving and computers has existed from the very beginning, in that the jacquard loom was the first machine to be controlled automatically from coded information punched into paper cards, and provided a direct link to the development of the computer of today."[218] Through this historical connection computers were further naturalized as a tool for craft.

Installation photos of the exhibition demonstrate how this history was communicated spatially. Visitors walked through a corridor that included the model of the Difference Engine, as

[217] Mimi Shorr—assistant to the director at the MCC and a vital force in organizing many of their exhibitions—offers Lourie specific thanks in the press release for the exhibition. Press Release *Mind Extenders*, Museum of Contemporary Crafts/American Craft Museum Archives, American Craft Council Library, Minneapolis, MN

[218] Press Release *Mind Extenders*, Museum of Contemporary Crafts/American Craft Museum Archives, American Craft Council Library, Minneapolis, MN

well as and placards that discussed the history and material similarities between computers and looms. [Fig. 16] The text on one placard makes an important statement about the significance of this historical connection:

> Because of this analogy from the very beginning of the computer, it is logical that computers today can play a part in the weaving process, especially in allowing the designer to control the complexity of the woven patterns. Janice Lourie of IBM New York Scientific Center, says, 'What we want to retain when using the computer is the for individual to make all the aesthetic decisions. We are willing to forego the manual execution of these decision.[219]

After reading this statement, the visitor would enter a room of art made with computers. What is most visually striking is a selection of four textiles designed by Lourie using Textile Graphics. [Fig. 17] These textiles were hung in a two-story tall room that adjoined the corridor. They stretched down like free-hanging scrolls, and drew the viewers' eye along their length. A sliding glass door opposite the corridor lit up the space. Viewing this space is viewing Lourie's narrative of technological progress: from weaving and Babbage we have Textile Graphics.

Lourie's willingness in the above quote to "forego the manual execution" of her works would not have been taken lightly in the craft community at this time. The act of making itself was—and remains—an enshrined quality in the world of studio craft. What was offered in place of this act? Then, like today, CAD was held up to studio crafters as a way to close the gap between design and final product. MCC director Paul Smith described craft's uneasiness with technology and why he thought it might be overcome, saying "many designers shy away from computers because they have so many misconceptions about technology. Actually technology helps develop a more creative person because the rapid speed of expediting a design frees the

[219] Didactic text, *Mind Extenders*, Museum of Contemporary Crafts/American Craft Museum Archives, American Craft Council Library, Minneapolis, MN

designer from routine tasks"[220] If Smith suggests that free time was the main benefit CAD offered, his assistant Mimi Shorr would make clear the importance of computing's rapid speed:

> One essential aspect of electronic equipment is speed. By taking advantage of this capability for accomplishing vast amounts of work, men can have more time available for fundamental aesthetic and design considerations rather than expending it on the mechanical aspects of creative production. The computer offers the possibility of expanding the design process in the time dimension by offering a 'preview of experience' through the process of simulation. Simulation allows for the operation and relationships of design elements to be observed and altered before any production occurs.[221]

As Schorr's quote makes clear, it is not simply that speed means more time for designing, it creates a different type of designing. CAD creates a digital proxy that the designer can interact with and explore before expounding the time and resources to create a material object.

Following the exhibition, the ACC held a two-day conference, "Insight '69," which focused on rethinking the relationship between craft and design. This unconventional conference brought together roughly eighty crafts professionals in Bennington, Vermont. The event was originally conceived of as a "design-in," a take on the 1967 San Francisco Human Be-in. During the event, individuals participated in smaller design workshops led by a group of craftspeople and artists, including Lourie. Workshops were structured as a type of unlearning, offering "a new broom to sweep away sterile notions and stultified Ideas" as an article in *Craft Horizons* phrased it.[222] At the conference, professional craftspeople engaged with household materials and tools to see what they could create as a form of "process discovery." For example, the well-known woodworker Wendell Castle was reported as using a balloon to eject paint "in a near-disastrous

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[220] "Art Round-Up", *Home Furnishing Daily*, April 18, 1969
[221] *Mind Extenders* catalogue, Museum of Contemporary Crafts/American Craft Museum Archives, American Craft Council Library, Minneapolis, MN
[222] *Craft Horizons*, September 1969, 4.

experiment, which he pridefully displayed."[223] For her workshop Lourie taught a group of initially skeptical craftspeople about Boolean logic by creating woven mats of grass and clover gathered from the nearby lawn.[224] During the conference's opening night, potter and poet Mary Caroline Richards sets a playful tone for the conference:

> [t]he inner laws and forms of life are invisible. We get hints of them through studies of growth, proportions, ratios, vectors, resonances. The human eye and ear cannot perceive what is taking place in either physical substance or metaphysical. Matter and electric circuity are invisible. Mathematical equations are invisible. We have to develop new capacities for seeing from the insight out, from the invisible into the physicalized.[225]

While Richards was likely not thinking of CAD, it is hard to not read her quote and think about the insights of design that were gleaned during *Mind Extenders*. With its ability to offer a "preview of experience," CAD offered one path for seeing design take shape before it took material form.

"Insight '69" and *Mind Extenders* offer one view of how studio craft reacted to the burgeoning world of CAD—initially skeptical yet willing to consider it as one of many novel tools. Through these two events, CAD emerged not only as a rightful heir to the venerable tradition of weaving, but was given a chance to be playful, to coexist with other methods of "unlearning." Importantly, CAD was recognized as making an important intervention into the world of design, offering a digital intermediary for industrial designers and thus helping to close the loop between maker and object. These events demonstrate Lourie's connection to the craftsmen and makers that would eventually help build the personal fabrication revolution.

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[223] *Craft Horizons*, (September 1969), 4.
[224] Janice Lourie in conversation with the author, April 26, 2016.
[225] M.C. Richards, "Insight '69", *The Crossing Point: Selected Talks and Writings*, (Wesleyan University Press, 2011), 127.

Conclusion

Lourie's "conversational" approach to technology connects her with an important minority of crafters and technologists who interacted under the umbrella of late 1960s counterculture, and it is these people whose ideology best foreshadows current trends in personal fabrication. Activist Ted Nelson, who published *Computer Lib* (1974) as a call to arms for amateurs to learn computer skills and seize the authority of the expert, made a comparison surprisingly apt for this chapter:

> [s]omehow the idea is abroad that computer activities are uncreative, as compared, say, with rotating clay against your fingers until it becomes a pot. This is categorically false. Computers involve imagination and creation at the highest level. Computers are an involvement you can really get into, regardless of your trip or your karma."[226]

This belief that computing can be a tool for creativity is embedded in Lourie's software, as can be seen in her activities with the MCC and her framing of Textile Graphics.

Contemporary exhibitions are exploring the symmetry between hand and digital production. *Manus x Machina: Fashion in an Age of Technology* (May 5 – August 14, 2016) at the Metropolitan Museum of Art, focused on the blurry distinction between handmade and machine made in current digital fabrication. As *New York Times* critic Roberta Smith phrases it "[t]echnology (machina) is not replacing the hand (manus); rather, the two are collaborating as never before, stimulating innovation and expression."[227] The Museum of Fine Arts, Boston's *#techstyle* (March 6 – July 10, 2016) similarly displayed fashion made with emergent

[226] Ted Nelson, "Computer Lib", in *Major Problems in the History of Technology: Documents and essays*, eds. Merritt Roe Smith and Gregory K. Clancey, (DC Heath & Company, 1998), 474.
[227] Roberta Smith, "At the Costume Institute, Couture Meets Technology", *The New York Times*, May 5, 2016.

technology. Of particular relevance is the "Molecule" Shoe by Francis Bitonti Studio Inc., which is built using variable 3D-printing algorithms. As the exhibition's wall text puts it, the shoes utilize "design systems that allow for planned (or unplanned) variations in the final product. The computer algorithm that drives the design of the Molecule shoe creates a slightly different shoe with each printing."[228] Similar to the rhetoric of the "third industrial revolution" described in the introduction of this chapter, these exhibitions are largely celebratory; the digital is likened to the hand both in its ability to generate variation and in its bringing designers into closer proximity to the tools of automated manufacturing.

Textile Graphics not only displays a longer history for this discourse, but also lays it within a more complicated social story. Lourie and her system were used to humanize computing to a wary public. She skillfully managed gendered connotations of femininity in computing and a longer history of weaving and technology. Taken as a whole, the story of Textile Graphics illustrates how technology is imbricated with gender and cultural values. While economists such as Jeremy Rifkin argue that personal fabrication tools open up a transparent relationship between maker and consumer, Lourie's story highlights how there is nothing neutral about these tools; society's fears of technology and concomitant methods to assuage these fears have been with CAD from the start.

[228] Wall text for "Molecule" Shoe by Francis Bitonti Studio Inc, Museum of Fine Arts, Boston.

Chapter 3
Recurring Aesthetics, Emergent Traditions: Wendell Castle's Continued Relevance

In the archives of the American Craft Council there are three photo contact sheets of woodworker Wendell Castle (1932-2018) creating his "Enclosed Environment for One" (1970).[229] [Fig. 1] The images show the piece in its final stage of production; the bulbous oak body shaped to house a reclining adult has been formed, as has the highly reflective fiberglass-coated tail and curving lid. The lines in the wooden body demonstrate that it has been made via stack lamination—a technique of joining together planks of wood to create a larger, carvable block. Castle, wearing a cowboy hat and denim, manipulates power sanders to smooth away the remaining rough patches of wood. In one photograph he looks out at the camera while reclining in the piece's interior. While it may be easy to dismiss this "Enclosed Environment for One" as so much late 1960s kitsch—The New York Times recently called it "a womb with a view"—this chapter instead orients Castle's work within a context of the counterculture.[230]

I begin this chapter by showing how Castle reinvigorated the technique of stack lamination to create large and biomorphic furniture, which would cement his reputation as one of the foremost American furniture makers of the 20th century. [Fig. 2] Castle's pieces were praised for their immersive nature and organic form, and embraced by prominent art collectors such as Lee Nordness. Nordness tried to sell Castle's work by elevating craft to the level of fine art, which was successful to an extent. However, Castle's greatest successes came from his ability to create large works that touched on burgeoning 1960s conceptions of the environment; I will

[229] "Enclosed Environment for One" is often referred to as "Environment for Contemplation," I am choosing to use the former name, as it is what was used in the earliest published materials regarding the piece.
[230] Rima Suqi, "An Extended Celebration of a Lively Career", *The New York Times*, Oct. 17, 2012.

explore how the counterculture and ecological movements shaped the idea of the "environment" in the 1960s, and how Castle's works resonated with these movements. An important takeaway from this discussion is how an increased recognition of pollution—not only in the sense of environmental decay, but also in living in a media-saturated culture—was generating public anxiety. I will focus on the piece "Enclosed Environment for One" to demonstrate how Castle domesticated countercultural attempts to alleviate this anxiety through the control of one's environment, and in doing so made such ideas palatable for a middle-class American audience.

In the final section, I will consider how Castle's works was received in corporate spaces. Woodworking has historically been gendered as a masculine endeavor, and images of "Castle the woodworker" became deeply entwined with the consumption and reception of his furniture.[231] Castle was frequently depicted as an appealing blend of new and old masculine values: on the one hand, the traditional woodworker with honed manual skills, and on the other, a trailblazer who eschewed the modernist forms of a previous generation for new countercultural tastes. This blend helped Castle's furniture succeed in a different masculine space, the corporate office. Castle's furniture illustrates a negotiation seen in middle-class masculinity in the early 1970s, which blended traditional hallmarks of financial and corporate success with traits tied to the 1960s counterculture. Castle's pieces from this era were thus embraced by corporations that no longer saw design simply as a tool to encourage public consumption, but as essential to the

[231] This is, of course, a comment on the general public face of the craft and there are notable exceptions such as Mary Gregory who for many years ran the woodworking shop at Black Mountain College or contemporary artist, Alison Elizabeth Taylor, who is well-known for her intricate marquetry.

maintenance of corporate identity; indeed, they could give material structure to their logic and systems.[232]

Castle's work offers a negotiation between the "organic"—seen in his biomorphic designs and his use of wood—and the mechanical—seen in his unnatural use of stack laminating processed planks. This negotiation was a major part of his success during the 1960s and 70s, when technology was viewed as the cause of, and solution to, many of society's ills. Similarly, this contrast between the organic form of the furniture and the precision of Castle's method connects his furniture to shifting cultural attitudes regarding work and identity during the period. At the very end of his career, Castle reinvigorated his stack lamination practice using new technology, such as computer numerical control (CNC) routers. As I will discuss in the conclusion of this chapter it is also this tension that connects Castle to an ethos of digital production today.

Castle's Early Career

Wendell Castle rose to national prominence because of his unique blend of innovative technique and expressionistic style. He received a Bachelor of Fine Arts degree in industrial design from Kansas State University in 1958, and went on to achieve a master's in sculpture three years later. During this period, Castle moved away from abstract, purely sculptural forms towards fantastic furniture, which maintained his expressive style while incorporating a functional component. The piece that best illustrates this evolution is his "Stool Sculpture" (1959). The object is roughly five feet high, made of a rich walnut, and has thin, curving lines that lend it the appearance of multiple delicate branches. At the end of each piece of wood,

[232]Wim De Wit, "Claiming Room for Creativity the Corporate Designer & IDCA", *in Design for the Corporate World: Creativity on the Line, 1950-1975*, ed. Wim De Wit, (Lund Humphries, 2017), 16-39.

Castle placed ivory veneers. In photographs, this ivory highlights the material, giving the viewer a false sense of raw, exposed wood capping off the highly polished walnut. While the stool has the functional components of furniture—a back rest, a seat, a foot rest—its delicacy insists that it is not meant to be sat in. Castle claimed as much in one interview, remarking that "It's like a chair but there's no place to sit."[233] This interest in sculptural quasi-furniture culminated in "Scribe Stool" (1960) [Fig. 3], which has the same reedy appearance of Stool Sculpture with the addition of a "seat." This seat is comprised of four connecting supports with a large gap at its center; it provides little to no assurance that it can serve as a functional seat. Despite the lack of utility—or perhaps because of it—this piece won him national prominence and moved him firmly into the world of studio craft.

From an early stage, Castle's career was nurtured by a network and infrastructure of studio craft. "Scribe Stool" was met with acclaim at the exhibition *Young Americans 1962* (1962) at the Museum of Contemporary Crafts (MCC) in New York. This experience helped foster Castle's decades-long involvement with the American Craft Council, its founder Aileen Osborn Webb, the MCC director Paul Smith, and the formal network of studio crafters. Harold Brennan, the Dean of Fine and Applied Arts at the Rochester Institute of Technology, became enamored with Castle's work, and offered him the position of Associate Professor of Furniture Design.[234] This job not only provided Castle a steady income, but also access to a fully-equipped woodworking studio, as well as individuals proficient at specialized woodworking techniques

[233] Alastair Gordon, *Wendell Castle: Wandering Forms*, (New York: Gregory R. Miller & Company, 2012), 36.
[234] Gordon, 36.

that he could take on as assistants.[235] These circumstances allowed Castle to increase the production of his furniture and sell pieces to a network of buyers that he found through the ACC.

Castle's movement into studio craft was strategic; in one interview, Castle recalled the reasoning behind his move:

> [a]round 1963 it was clear to me that if I continued with sculpture I'd have a tough row to hoe, but if I went to furniture there was no competition. If I could make furniture that was the same as sculpture, that had the same kind of qualities, then I wouldn't be working at some lesser activity and the field was wide open.[236]

This quote represents a thread that runs throughout Castle's career—a willingness to think strategically about his best position in a crowded arts market. This is not meant as a pejorative commentary on Castle; rather, it is an acknowledgement that he approached his process as a savvy maker aware of market pressures. His self-fashioning as a craftsman who could provide buyers with functional "furniture that was the same as sculpture" would mark the early success of his work.

Castle's work was often cast as more expressive than other furniture makers. For example, *Scribe Stool* was singled out in an article on young design talent in *House and Garden*, a magazine aimed towards middle-class suburban women. In this article, Castle is pictured in a plaid sports coat and trim goatee; he rests one foot casually on the footrest of the sculpture with a hand on the armrest. [Fig. 3] This photograph shows Castle as a relaxed, modern alternative to contemporaneous furniture makers. Accompanying the photo is a caption that emphasizes freedom and creativity, "[f]urniture freed from the foursquare. The uninhibited creations of woodworkers like Wendell Castle suggest a new freedom of form for tomorrow's furniture."[237]

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[235] Gordon, 46.
[236] Gordon, 56.
[237] "Worth Thinking About," *House and Garden*, (October, 1962)

Here we can see the legacy of Castle being formed in popular opinion; he is a maker who brings artistic expression to the everyday world of furniture.

Castle's use of Stack Lamination and its Organic Form

The key to Castle's career comes through an understanding of the stack lamination process. Lamination as a technique was not invented by Castle; it has been used by woodworkers since at least the 12th century. However, Castle reinvigorated the practice, making it a quintessential woodworking technique of the 1960s and 1970s.[238] Stack lamination broadly refers to the process of gluing layers of wooden boards together to create a large block that can be shaped via a subtractive process. [Fig. 4] Castle's practice began with a hand-drawn design, after which boards of wood were cut—often with a band saw—based on the design's dimensions. The boards were then glued and clamped together to form a solid block in a rough outline of the final form. The block was refined and smoothed with hand or power tools; Castle often employed an electric chain saw and ball mill for this work.[239] Castle's use of stack lamination enabled him to disregard standard constructive formulas of woodworking. Instead, he worked in a sculptural fashion, frequently beginning his process with freehand sketching. This process allowed Castle to create furniture without extensive prior knowledge of traditional joinery techniques. Perhaps most importantly, stack lamination allowed for the easy production of hollow and curved forms; this permitted Castle to produce large, often immersive pieces that would be too heavy or costly if made from solid wood. Ultimately, Castle's approach to

[238] Davira Taragin and Edward S. Cooke Jr., "The Career of Wendell Castle", *Furniture by Wendell Castle*, (Manchester: Hudson Hills Press, 1989), 48.
[239] For a step-by-step run down of his process, see: Wendell Castle, *The Wendell Castle Book of Wood Lamination,* (New York: Van Nostrand Reinhold Company, 1980), 88-101.

woodworking—as well as the giant curving pieces that would make his career—would not have been achievable without the stack lamination technique.

The adjective that is most consistently used to describe Castle's stack lamination work from the 1960s and '70s is "organic." It is productive to put particular pressure on this term, in order to elucidate the tendencies that run throughout his career. Castle's early furniture not only alludes to the organic, it literally depicts it; for instance, the piece "Blanket Chest" (1963) looks like a pomegranate; "Library Sculpture" (1965) can be interpreted as a sprouting plant. Yet even as Castle's furniture moved toward abstraction, his work continued to be described as organic. [Fig. 4] This is because the curves of Castle's furniture are suggestive of change, even in stasis; as one critic of *The New York Times* put it in 1968, his "furniture seems to be growing."[240] This image of growth caught-in-a-moment is particularly relevant, because it reflects the public discourse that struggled with the emerging Information Age.

Castle's conception of the "organic" form can be traced back to the Romantic English poet Samuel Taylor Coleridge, who popularized the concept as antithetical to the "mechanical."[241] Broadly speaking, Coleridge bestowed the term "organic" with the meaning of something formed from an internal drive, while "mechanical" implied something that was shaped by external forces. By the post-war era the meaning of "mechanical" had evolved considerably due to the influence of information technology. The concept of cybernetics, developed by mathematician Norbert Wiener, shifted the focus from the ability to understand

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[240] Rita Reif, "Furniture That Seems to Be Growing," *The New York Times*, April 9, 1968.
[241] Coleridge's conceptions of the organic and the mechanistic in regards to form were expressed in his lectures on Shakespeare, and were greatly informed by the German poet and critic August Wilhelm Schlegel. See *The complete works of Samuel Taylor Coleridge: With an introductory essay upon his philosophical and theological opinions*. Vol. 4. (New York: Harper & Brothers, 1853), 55. For an overview of the term "organic" and its uses see Raymond Williams, *Keywords: A Vocabulary of Culture and Society*, (New York: Oxford University Press, 1985), 227-229.

discrete machines, to how the transmission of information could influence control within systems.[242] Such thinking was not only applied to technology, but also to a range of other problems, including theories of biological homeostasis and economic markets. This broad-reaching intellectual discourse began to foment a fear that scientific and academic realms were transforming all of American life. Writers such as the sociologist C. Wright Mills and the cultural critic Lewis Mumford adopted an increasingly wary tone in their discussions of technologically ordered societies, as they were worried that individuals were becoming progressively regimented and machine-like.[243] The spread of the "mechanistic" into increasingly broad facets of life led to a framing of the "organic" in opposition to these large-scale social structures. This broader conception of the organic became a cornerstone of countercultural thought during the 1960s. Castle explicitly claimed that the organic could be valued for its authenticity: "[t]o me an organic form has the most exciting possibilities," he said, "not shaped by the current vogue in furniture fashion, but rather by inherent life forces."[244] In this way the overall form of Castle's furniture was in keeping with discussions of the organic in the 1960s.

Yet despite the animated appearance of Castle's works, they resulted from a balance between organic curves and the mechanistic order that comes from the stack lamination process. If one looks closely at the stratified lines of one of Castle's stack lamination pieces, the illusion

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[242] Norbert Wiener, *Cybernetics or Control and Communication in the Animal and the Machine* (Boston: MIT press, 1961). These concepts were made more accessible to the general public in his later book. *The Human Use of Human Beings: Cybernetics and Society*, (Boston: Da Capo Press, 1988).

[243] For a review of this phenomenon see Thomas Hughes*, American Genesis: A Century of Invention and Technological Enthusiasm 1870-1970*, (New York: Viking Penguin, 1989), 443-472.

[244] Promotional brochure, S.D. Warren Company, a Division of Scott Paper Company, Lee Nordness business records and papers, circa 1931-1992, bulk 1954-1984. Archives of American Art, Smithsonian Institution.

of their organic growth immediately dissolves. [Fig. 5] At its core, Castle's stack lamination process was revolutionary because he took the highly variable material of hardwood and standardized it by utilizing processed planks. Castle's pieces take an organic material shaped by mechanical forces, and reassembles it into biomorphic shapes that recall organic form. In this way, they are both wood and not-wood.

A comparison to other noted woodworkers from the period highlights Castle's unusual blend of the organic and mechanistic. In 1972 Castle was included in the inaugural exhibition of the Renwick Gallery, the Smithsonian Institution's museum dedicated to studio craft and design. The exhibition, *Woodenworks,* featured the best known American woodworkers of the 20th century and included Castle, Arthur Espenet Carpenter, Wharton Esherick, Sam Maloof, and George Nakashima. Nakashima is still renowned in the world of American woodworking for his deep reverence for wood as a natural material.[245] *Woodenworks* featured several pieces from his "Conoid Benches" series. [Fig. 6] Each seat of the series was made from a roughly hewn plank with splits and uneven edges, though polished to a mirror sheen. A partial back was added in accordance to the unique shape of the wooden seat, using traditional joinery skills. Contrast a Nakashima Conoid Bench to Castle's oak dinning chair (1966) [Fig. 7] While the roughhewn nature of Nakashima's bench seat recalls the original wood, this is absent in Castle's work—the wood has instead been processed into standardized boards. Instead, it is the curving form of Castle's carvings that are emblematic of organic growth. Castle's pieces are *representationally organic*, but the stratified lines of the dinning chair reveal the stack lamination technique. So while one might argue that the pieces of Nakashimia have a closer connection to the trees to

[245] Nakashima would go on to publish *The Soul of a Tree* (1981), which outlined his philosophy that connected his furniture to the natural world.

whom they owe their material existence, Caste's stack lamination method recalls an organic method of growth.

The MCC exhibition *Fantasy Furniture* (January 21-March 13, 1966) demonstrates a phase in which Castle's furniture began to dictate the totality of a space, growing larger and more expansive until they became environments themselves. Concurrently, ideas of "function" began to be displaced by an interest in form. *Fantasy Furniture* featured the work of five craftspeople: Thomas Simpson, Pedro Friedeberg, the partners Fabio De Sanctis and Ugo Sterpini, and Wendell Castle. Some of the pieces in this exhibition represented Castle's early style. This included Castle's "Chest of Drawers" (1962) [Fig. 8], which features walnut drawers held up by curving oak supports that reach an impressive narrowness, and take on the appearance of tangled roots. Also included in *Fantasy Furniture* was Castle's "Blanket Chest" (1963). [Fig. 9] Made of cherry wood and reaching three feet high, "Blanket Chest" looks like a sculpted pomegranate. The bottom third is a small domed base from which a surprisingly narrow support holds the bulbous chest, the top of which sprouts a few tendrils reminiscent of a stem or sprouts. But the implications of stack lamination were fully realized in Castle's "Library Sculpture" (1965) [Fig. 10]. "Library Sculpture" moves away from furniture and towards an all-encompassing environment. The singular piece is made of walnut and includes two seats, a table, and a lamp, all of which are connected to a central column over seven feet high. "Library Sculpture" follows in the organic style of "Blanket Chest" and heightens it; from a distance the central column resembles a curving stalk, the seats and table look like leaves, and the lamp at the very top of the column curves like a drawing of a daisy. "Library Sculpture" represents a moment where Castle's utilization of stack lamination allows him to make ambitious strides in thinking through the possibilities of form, and the fact that the entirety of the large piece is

supported by a single support is extremely impressive from an engineering standpoint. In her review of *Fantasy Furniture* for the journal *Craft Horizons*, Helen Giambruni noted that Castle "wants to shape a total environment with each component subordinated to a single aesthetic statement. It is the experience of his interiors that is his first consideration."[246]

It is not just the use of space that defines Castle's work, but also an indulgence in surrealistic imagery. In a statement Castle made for *Fantasy Furniture*, he claimed that "[m]y furniture goes against the main stream of 20th century design. I have no special interest in form following function. I try in my work to fulfill both the aesthetic and the practical purpose, but if one were to become dominant I would choose the aesthetic."[247] In her *Craft Horizons* review, Giambruni noted that Castle's interest in organic form was deeply entwined with his views of craft:

> [h]e saw (having briefly succumbed to their nostalgic lure himself) the futility of adzes and drawknives in an era of chain saws and power tools, and concluded that whatever method best met his needs was the best method. On the other hand, he also saw that for all their romantic traditionalism of technique, furniture makers were dominated aesthetically by ideals originally developed for industrial production. … It seemed to him that because the craftsman cannot hope to compete with the machine in efficiency, or economy, he should emphasize the one thing in which he cannot be surpassed by the machine— his imagination. Each craftsman should find, out of endless expressive possibilities, what speaks for him; he must reach beyond questions of utility to individuality, to the ideological functions of art.[248]

"Library Sculpture" thus illustrates the progression of Castle from a designer of furniture to a designer of environments.

Lee Nordness and the Creation of Castle's Public Persona

[246] Helen Giambruni, "Wendell Castle", *Craft Horizons*, (September/October 1968), 31.
[247] *Fantasy Furniture*, (New York: Museum of Contemporary Craft, 1966), 5.
[248] Giambruni, 51.

Despite their unconventional nature, Castle's pieces found willing and eager buyers. Shortly after its exhibition in *Fantasy Furniture* "Library Sculpture" was purchased for domestic use by Allen Macomber to place in his Rochester home's library.[249] As Castle noted, the installation of such furniture in a home was no small undertaking. "Library Sculpture" hinges on the support of its central column, which needed a large amount of support; Castle ultimately had to convince the Macombers to allow him to cut a hole in their Persian rug to attach it to the floor![250] During this same period, Castle received a commission from Douglas Baker to design his Rochester dining room. [Fig. 11] The dinning set approaches the aesthetic of a science fiction; the table hovers off the ground like a flying saucer, and is comprised of two semi-circles with a gap at the center. Four wooden appendages extend from the ceiling, one of which ends in a fluted flower-like lamp with a large round bulb. Castle's dining chairs circle the table, with their dynamic u-shaped backs. It was described in one article as the "tree that grows in the Rochester dining room." Ultimately, the commission had to be bolted to the Bakers' ceiling.[251]

Lee Nordness (1922-1995) is a major figure in 20th century studio craft, and was of particular importance in the launching of Castle's career. Nordness started by exhibiting abstract expression and color-field painting in his New York City gallery, but in the mid 1960s he transitioned to promoting craft and design. Castle was one of the makers that inspired Nordness' evolution. Nordness was impressed with Castle's work after viewing his pieces in the MCC show *Young Americans* (1962), but was hesitant to add furniture to the roster of sculpture and

[249] "Library Sculpture" in fact only received this name after its installation in the Macomber home.
[250] Jane Aldin, "Wendell Castle Now" in *Wendell Castle: A Catalogue Rasionné,* (New York: The Artist Book Foundation, 2014), *44*.
[251] Rita Reif, "Furniture That Seems To Be Growing", *The New York Times*, April 9, 1968.

painting that he included in his gallery and curatorial endeavors.[252] But after seeing *Fantasy Furniture* (1966), Nordness' interest in Castle solidified. He purchased "Chest of Drawers" (1962) and wrote to Castle in the fall of 1966 inquiring as to the possibility of furnishing his New York City apartment's living room entirely with his furniture. In a later letter he praised Castle, claiming "I am just mad about your furniture, feeling that your handsome pieces are as much sculpture as furniture," and ending it with a desperate appeal, "I am now living on apple crates in the living room, but I am willing to wait so that I can have the pleasure of living with your beautiful furniture."[253] Nordness' living room was ultimately furnished, creating an informal showroom where he could host prospective buyers and highlight Castle's skill. [Fig 12] Like the residential commissions that Castle completed for the Baker and Macomber homes, Nordness' living room pivots around one piece supported by a central column. The oak "great sofa," reaches over 9 feet high, and is attached to the ceiling of Nordness' apartment for support. The stack lamination technique allows the wooden sofa to take on a rounded form, with its arms reaching inward towards the center of the sofa and encircling the user. By using Castle's furniture in his living room, Nordenss not only made concrete his support of Castle's work, but also ensured that social functions at his home could lead to professional opportunities.

Castle became one of Nordness' greatest case studies in his endeavor to erase the distinction between studio crafts and fine arts. Nordness decided to open a gallery, called the Lee Nordness Gallery, which focused completely on the studio crafts in New York City. He gave Castle the first exhibition at this gallery, *Handcrafted Furniture by Wendell Castle—New York*

[252] Davira Taragin and Edward S. Cooke Jr., "The Career of Wendell Castle", *Furniture by Wendell Castle*, (Manchester: Hudson Hills Press, 1989), 48.
[253] Wendell Castle papers, 1965-1975. Archives of American Art, Smithsonian Institution.

Debut (1968), and the show was a press success.[254] This led Nordness to further focus on craft in his gallery, including woodworker Wharton Esherick, fiber artist Lenore Tawney, and ceramicist Peter Voulkos. For the next few years, Nordness would aggressively promote Castle's career and the cause of craft as art more broadly. Advertisements for the gallery ran in *Art in America* in the fall of 1968, and featured one of Nordness' wooden sofas made by Castle, flanked by a bronze statue by David Aronson. The ad asks "dare a sculpture endorse a sofa?" It proceeds to answer its own question in the affirmative, "When the sofa is created by one of the new breed of craftsmen-cum-artists." This advertisement exemplifies Nordness' endeavor to elevate studio craft to the realm of fine art.

Shortly after Nordness began focusing on craft, he started planning the large traveling exhibition *Objects: USA*, which opened at the Smithsonian National Collection of Fine Arts in Washington DC (1969)**.** This show followed on the heels of Nordness' show *Art:USA:Now*, which focused on abstract-expressionist and color-field painting. *Art:USA:Now* was sponsored by the Johnson Wax Company, and Nordness convinced them to invest in his new endeavor as well. The massive exhibition contained over 300 objects in a full range of mediums, from the usual suspects of wood and fiber to emerging mediums such as plastics. The use of the word "objects" in the exhibition's title was purposeful; as Nordness wrote in the exhibition's catalogue, it was "a word almost without emotional content. Nevertheless, the purity of 'object' is preferable to the pejorative connotations of 'handicraft'."[255] Castle was given a high-profile position in *Objects: USA*. Alongside Voulkos and Tawney, Castle was highlighted in the catalog's introductory essay as changing the "creative concept of the object" in the post-war era,

[254] Rita Reif, "Furniture That Seems to Be Growing", *The New York Times*, April 9, 1968.
[255] Lee Nordness, *Objects: USA*, (New York: The Viking Press, 1970), 7.

making it more artistic and less functional.[256] In particular, Castle was applauded for his sculptural approach to furniture. In Nordness' telling, Castle liberated wooden furniture from its traditional form:

> … [Castle] attacked the man-built mass of wood as a sculptor would a mass of granite, carving the furniture in one piece. As a result new freedoms were opened, and Castle's flowing organic forms received quick national and international response: his furniture was taken as near sculpture as possible while still remaining functional.[257]

The show gained massive public attention; it traveled to twenty-one American and ten European venues, and attained record-breaking attendance numbers. The critical response consistently claimed that the exhibition successfully dismantled the hierarchy between art and craft. A headline in the *Chicago Tribune* boldly declared that "the craft media is art!" The article went on to insist that the media one chooses to work in should not direct an object's reception:

> … a sizable and growing part of the public, conditioned to and by today's media-message world, rejects any notions of one material's innate superiority over another. Grandma's crazy quilt and great-grandma's patent medicine bottles are not naturally inferior to Rembrandt and Rodin. Bronze and marble, oil and canvas, are durable and gratifying media to work on and in. They are not magical guarantees of quality.[258]

Above the attendance, it is this reception that made the exhibition a success for Nordness, who above all endeavored to elevate craft to the realm of fine art.

Despite these career successes, Nordness' interest in studio craft as fine art was moving counter to prevailing ideas in the art world. For one, Nordness' emphasis on the "objectness" of studio craft is curious at a moment when the fine arts were beginning to reject the notion of art as

[256] Nordness, 13.
[257] Ibid.
[258] Thomas Willis, The Craft Media is Art, *The Chicago Tribune,* July 12, 1970.

object. *Objects: USA* opened in the midst of what art critic Lucy Lippard would later identify as the period of the "dematerialization of the art object."[259] Lippard's central thesis was that the period witnessed a privileging of concept over form, driven by a social and political climate in which the commodification of art objects emerged as morally untenable.[260] In contrast with Lippard, and the rise of conceptual art more broadly, Nordness' intellectual framing seems built off of increasingly anachronistic fine art ideals. Craft theorist craft theorist and historian Glenn Adamson has argued as much, claiming that Nordness' championing of craft can be connected to his own conservative artistic leanings; as Adamson writes "Nordness saw craft not as a means by which progressive art might be furthered, but on the contrary, as an arena in which tried-and-true modernist artistic values might be preserved."[261] Instead, Adamson argues that Nordness saw craft as presenting an alternative to the alienating reputation of contemporary art. Adamson's reading is bolstered by an examination of Nordness' patrons the Johnson family, of the Johnson Wax Company. A profile of the Johnson family published in The New York Times shortly after the opening of *Objects: USA* quotes Gene Johnson as championing crafts over the fine arts, "I suppose it's fair to say that we like the crafts a bit better than the arts ... I think a lot of other people will feel the same way. Crafts are something most people understand."[262] This is the face of studio craft—and by extension, Castle—achieved under the sponsorship of Nordness, craft not

[259] This term was first utilized in Lucy Lippard and John Chandler, "The Dematerialization of Art", *Art International* 12.2 (1968): 31-36.
[260] Lippard discusses the social and political motivations of this phenomenon in her preface to *Six Years: The Dematerialization of the Art Object from 1966 to 1972*, though it is worth noting that she acknowledges how surprisingly quick the market has been to absorb these works in the book's postscript. Lucy R. Lippard, *Six Years: The Dematerialization of the Art Object from 1966 to 1972*, (Berkeley: University of California Press, 1997).
[261] Glenn Adamson, "Craft paradigms: The studio craft movement and the avant-garde, 1966--1972." (Doctoral dissertation, 2001), 156.
[262] Sarah Booth Conroy, "At Home with Johnson (Wax) Family: Decor Shows What They Enjoy Doing", *The New York Times*, October 19, 1969.

just elevated to the fine arts, but offered as a substitution for those who found contemporary art confusing or alienating.

Nordness' experiment in elevating craft and art came to an infamous conclusion at the show *Attitudes* (July 27, 1970 - October 01, 1970) at the Brooklyn Museum. The show was a mix of studio craft and fine art, and meant to be a final, victorious acceptance of craft in the art museum. Included in the show were figures commonly associated with the studio crafts—Castle, glass artists Marvin Lipofsky and Dale Chihuly, ceramicist and metal worker Clayton Bailey—as well as artists Robert Morris, Claes Oldenberg, Robert Smithson, and Don Judd. If the curators of the show had any hope of recreating the inclusive vision of *Objects: USA*, the reviews of the exhibition quickly brought them to reality. The title of one particularly savage review in *The New York Times* sums the response up neatly, "If That's Your Attitude, That's That, I Guess," complete with the sub header "sometimes it's awfully hard to give a damn."[263] The reviewer is especially critical of a quote from Castle reprinted on the gallery text, which states that furniture, "should be conceived with vision. Living in a sculpture would certainly dictate changes in living habits." The reviewer calls this out as "gibberish."[264] When seen alongside Castle's pieces—a stack laminated table, stool, and a plastic lamp—the reviewer decides that Castle's statement is worse than gibberish, it is pretentious. In the reviewer's telling, these pieces are not only useless, but also visually repulsive; as the article claims "you have the dreadful suspicion not that Mr. Castle is putting you on, but that he is serious."[265] The studio craft world damned the exhibition with faint praise. As a review in *Craft Horizons* noted, the exhibition was a "disparate, albeit

[263] John Canaday, "If That's Your Attitude, That's That, I Guess,", *The New York Times*, August 9, 1970.
[264] Ibid.
[265] Ibid.

lively grouping; a confrontation of contrasting sensibilities that, because of the natures involved, worked together."[266] Following this show, Nordness and Castle relationship gradually dissipated.

While Nordness marketed Castle a sculptor of wood, Castle exhibited a more nuanced relationship with his material. For example, only two of Castle's three works in *Objects: USA* were made of wood; one piece was the result of his recent experiments in plastic. His plastic "table" (1969) was more support than table, with a long curving swoop forming the base and support ending in a small flat surface. The catalogue claimed that Castle "infused this cold material with unusual warmth, retaining the organic references which characterized his work in wood."[267] The inclusion of this plastic table was clearly an important choice for Castle. In his artist's statement included in the catalog, he made it clear that material had little meaning for his work, stating "it is important not to be subservient to a material. The significant thing about my work is not what it is made out of but what it is."[268] This persistent distancing of his work away from material and towards concept is telling for an uneasy fit with Nordness' narrative, which shows an allegiance to modernist fine art ideals.[269] Despite the cool reception to *Attitudes*, Castle would go on to have great success. Castle continued success might be best understood not through the lens of the "object" that Nordness espoused, but through another term that shaped artistic output during this period—the environment.

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[266] Ron Lusker, *Craft Horizons* 30/6, December 1970.
[267] Nordness, 243.
[268] Nordness, 257.
[269] This attitude was persistent during Castle's career, as he claimed in 2012 "I don't want this to be about how the work is made, or even what it's made of. I'm not even that interested in wood as a material. I want the work to be about form – and if the technology used to make the object is too apparent, the form starts to get lost…I'm very interested in technology but I just want it to help." As quoted in see Amy Cheatle and Steven Jackson, "Digital Entanglements," in *Wendell Castle Remastered* (New York: Museum of Arts and Design, 2015), 69-75.

Connected/Quarantined: Counterculture, Ecology, and the Shaping of the Environment

Castle's conception of the environment wrestled with many prevailing trends in the 1960s and 70s. As outlined by art historian James Nisbet, the period was marked by a synergy between artists creating immersive spaces, and intellectuals developing the field of ecology. The intersection of these practices resulted in two divergent visions of the artistic environment: a "modernist gallery environment" focused on creating closed, enveloping spaces, and a systems paradigm that encouraged immersion and interconnectedness without the need for physical containment.[270] In support of the latter practice, the rise of hallucinogenic drugs in the 1960s helped develop an interest in environments as spaces to foster "trips" that could blur the boundaries of space and subjectivity. Artistic trends subsequently moved towards large "intermedia" environments, which used group experience and a cacophony of images and sounds to facilitate these trips, even in the absence of drugs. A major part of Castle's success was his ability to produce small, personalized environments that emulated the style of countercultural intermedia environments without the associated mayhem. Similarly, the organic form of his works allowed him to allude to ecology, even while his pieces rejected the overwhelming interconnectedness implicit in the field for a more private, protected sanctuary. In this way, Castle pieces tamed many of the fears present in the American middle class.

By 1966 the countercultural arts scene had established the genre of the multimedia environment (sometimes called the intermedia environment), which integrated imagery and sound in order to create an LSD-like state in viewers. Although the genre has no stable definition, it was exemplified by groups such as the multimedia collective USCO (short for

[270] James Nisbet, *Ecologies, Environments, and Energy Systems in Art of the 1960s and 1970s*, (Cambridge: MIT Press, 2014), 41-44.

"Company of Us"), whose environments had a major impact on those "in the know" as well as the larger American imagination through stories in the pages of *Life* magazine. USCO was started in 1964 by Steve Durkee, Gerd Stern, and Michael Callahan who along with a changing group—for example, Stewart Brand was briefly associated—sought to alter the consciousness of viewers with a diverse array of technology, such as strobe lights and projectors. Architectural historian Felicity Scott has argued that the amorphousness of form and media used by groups such as USCO resulted in fluidity at multiple registers, including "the loss of distinction between media, the loss of demarcations between the self and the environment, the amorphous visual and psychological character of the psychedelic trip, and the melting of the self into a communal religious, and mystical domain."[271] With a striking cover story, the September 1966 issue of *Life* magazine introduced its readers to "psychedelic art". This article examined artist-made spaces touted as "a drugless trip," through which color, pattern, and motion could induce the feelings of "turning on." The article focused on the USCO exhibition at the Riverside Museum (NY). The style is described as pluralistic, bombastic, and unrelenting; its artists specializing in "bombarding the spectator with all kinds and combination of effects, go after every available nerve ending from the eyes to the soles of the feet. The voyager who wants to blast off into inner space has the choice of many routes." The cover features an image of artist Richard Aldcroft wearing a pair of goggles that altered his binocular vision, causing him to see double. Colored lights from Aldcroft's *Infinity Projector* play over his shirtless, exposed body, while his face is stoic and expressionless. The article makes clear who should participate in these experiences: the "[y]oung people who grew up with TV and transistor radios and who take electronic equipment

[271] Felicity Scott, *Architecture or Techno-utopia: Politics After Modernis*m, (Cambridge: MIT Press, 2007), 192.

for granted have no difficulty in attuning themselves to the audio-visual bombardment. Older people who prefer what is called a rational sequential experience, i.e., just one movie or a single radio station at a time, tend to freak out."[272]

Castle's success has much to do with taking the psychedelic art employed by intermedia environments, and coopting them for calming spaces. There is a consistency of imagery in these environments; natural forms such as the honeycomb, cobweb, tunnel, and spiral emerge again and again.[273] Castle's organic pieces such as "Library Sculpture" (1965) and "Great Sofa" (1967) play with this imagery, but do so with an opposing goal. In the intermedia environments, the combination of a naturalistic visual vocabulary and technological bombardment was meant to provoke organic conceptions of personal growth through the melding of self into group experience. In Castle's environments, the same vocabulary was translated into meditative spaces, meant to provoke organic conceptions of personal growth through individualized experience.

The systems thinking that encouraged groups like USCO to imagine their bodies as limitless and interconnected has direct parallels to the burgeoning field of ecology. Ecology is a science built on systems thinking, with a focus on the interactions between the Earth and its life forms as opposed to a reductionist exploration of discrete entities. As *Time Magazine* described it, "[e]cology is the systems approach to nature, the study of how living organisms and the nonliving environment function together as a whole ecosystem."[274] Like the intermedia environments, the ecological movement had its own ability to inspire awe and anxiety, as both emphasized the overwhelming number of connections between individuals and their

[272] "Psychedelic Art", *Life*, (September 9, 1966).
[273] Robert Masters and Jean Houston, "Art and Psychedelic Experience," *Psychedelic Art* (New York: Grove Press, 1968), 91-92.
[274] Burt Shavitz, "Fighting to Save the Earth from Man", *Time,* (February 2, 1970), 57.

surroundings. Again, Castle's ability to tame such anxieties was one of the hallmarks of his success.

Understanding Castle's reception in the 1960s requires an understanding of ecology's relationship to post-war American conservationism, which was tied to suburban affluence.[275] In the late-1950s, the ecological conservationist movement was embraced by the Democratic party, which put forth a platform focused on "quality of life" issues.[276] This platform—under the intellectual leadership of historian Arthur M. Schlesinger Jr. and economist John Kenneth Galbraith—argued that the New Deal rhetoric of a social safety net was no longer adequate in such an affluent nation. As Schlesinger put it, what was needed was a shift from "quantitative liberalism" that sought to provide a basic support, to a "qualitative liberalism," which would boost the opportunities and surroundings in the United States. In this conception of liberalism, the environment became a bellwether for quality of life; fresh air, water, and green spaces all offered public goods that could not be bought in a consumer marketplace. As Historian Adam Rome points out, debates hinged on the issue of "private wealth" versus "public poverty", in which the general abundance of the growing middle-class household was seen to come at the cost of polluted air and water and deteriorating shared public spaces. As Schlesinger phrased it, "[w]e are heading for the classic condition of private opulence and public squalor."[277] Importantly, this approach to environmentalism focused on local changes that conserved recourses and beautified natural landscapes, as opposed to taking an interconnected, systems approach.

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[275] Adam Rome, "'Give Earth a Chance': The Environmental Movement and the Sixties", *The Journal of American History*, Vol. 90, No. 2 (September, 2003), 526.
[276] Ibid.
[277] Arthur M. Schlesinger Jr., "The New Mood in Politics," *Esquire*, 53 (January 1960), 59.

A second approach to environmentalism dominated American discourse following the publication of Rachel Carson's best-selling book *Silent Spring* (1962), a scathing critique of the unintended global consequences of the "chemical revolution." Carson's focus on the chemical pesticide DDT was not just horrifying because of its side-effects on people and wildlife, but also in its inability to be contained on an interconnected planet. Carson includes one especially chilling portion that details how the indigenous peoples of Alaska—used by Carson here as a stand in for the untouched wilderness—have trace amounts of DDT in their body fat.[278] Migratory birds off the coast of Antarctica are no luckier, they too bear traces of the dangerous chemical. The popular press furthered the idea that environmental decay knows no boundary-line, be they between rural, urban, and suburban communities, or those of the nation state. The public outcry over DDT intensified with the feeling that nothing was out of its reach. One protest poster, reprinted in popular periodicals like *Time*, features a young, shirtless pregnant woman in profile. [Fig. 13] The woman's hair covers her face making her an anonymous figure fit for projection, while the curves of her breast and belly are framed by her dark hair and the background foliage. Stamped on her breast are the words "CAUTION KEEP OUT OF THE REACH OF CHILDREN," while the text below informs us that "Milk in Such Containers May be Unfit for Human Consumption" and "DDT Content .10 to .30 Parts per Million in Milk of Nursing Mothers (2 to 6 times the Amount Allowed in Milk for Commercial Sale)".[279] The poster intends to shock, and it does, signaling that the presumably safe spaces of maternity are not bracketed away from our contemporary environs. The scientific discipline of ecology was

[278] Rachel Carson, *Silent Spring*, (Boston: Houghton Mifflin Harcourt, 2002), 173-186.
[279] This poster was prefigured by signs at the Women's Strike for Peace (November 1, 1961) that read "Pure Milk. Not Poison.", see: Amy Swerdlow, *Women Strike for Peace: Traditional Motherhood and Radical Politics in the 1960s*, (Chicago: University of Chicago Press, 1993), 83.

ignited by Carson's work, and its primary contribution—that the Earth is an interconnected system of biological and geological processes—meant that people could no longer view the environment as a local issue.

The rise of the ecological movement did not mean that the locally-focused, conservationist movement disappeared; instead both forces interacted, and helped develop a popular desire to protect the individual from a dangerous, interconnected, and polluted world. Literature theorist Ursula Heise, has noted a contradiction in the ecological rhetoric of this era "between the embrace of and the resistance to global connectedness, and between the commitment to a planetary vision and the utopian reinvestment in the local."[280] To fully place the burgeoning environmental movement within its historical moment is to realize that this lack of boundaries extended beyond the ecological into other aspects of daily life. The phenomenon of "sound pollution" is a prime example of environmentalist principles extended into social life. By January of 1964 The New York Times was alerting their readers to this "new type" of degradation. It was not primarily seen as an issue of physical health—though the possibility of long-term hearing loss was generally alluded to—instead sound pollution was seen an intense burden to the psychic well-being of individuals, "[n]ot as dangerous as smoke pollution, perhaps, yet city noises set our teeth of edge, our nerve-ends tingling and, in a few tortured case, actually bring on deafness. The opposite of unwanted man-made noise is something rare called quite."[281] In March of 1970, a government-sponsored panel—headed by vice president of Research and Development of Xerox Jack Goldman—recommended that the federal government regulate noise

[280] Ursula K. Heise, *Sense of Place and Sense of Planet: The Environmental Imagination of the Global*, (Oxford: Oxford University Press, 2008), 21.

[281] "The Angry Horns," *The New York Times*, (January 4, 1964).

pollution. Their concerns ranged from lasting physical damage—such as that experienced by industrial workers—to psychic disturbance brought on by the "din of modern living" or "firearms and rock 'n-roll music".[282]

Products quickly came into the marketplace to aid the individual who wished to combat sound pollution and find solitude. One particularly popular item was the vinyl record *Environments* (1969), one of the very first "nature sounds" recordings sold for personal use. As the name suggests, *Environments* reproduced the sounds of crashing waves and seagulls to lull the listener into a state of relaxation. The then-novel record was singled out for drowning out the stresses of the world. One editorial in *Newsweek* laid the setting for listening to *Environments*:

> What a day. The kids are playing the Velvet Stranglers at top volume. Outside, the gas company is ripping up the street to a chorus of car horns. What do You do? Take a Compoz? Nope. You sink into an easy chair don your stereo headphones and listen to a record called "Environments," the side entitled "The Psychologically Ultimate Seashore." Soon amidst the surfs soothing roll, you are cavorting among golden girls at Malibu.[283]

What is interesting about the reception of *Environments* is not only the way it was seen as an antidote to the noises of the world—specifically youth culture and "rock n-roll"—but also as something hip and cool. For example, in the spring of 1970 *Life* reviewed *Environments*, its popular culture critic found it "[c]heaper than booze, safer than pot, less monotonous than the hum of an air conditioner, the sounds of sea, rain, wind, birds, and crickets may prove to be the ultimate tranquilizers."[284] *Environments* offered a sonic Band-Aid, a refusal to engage with an interconnected, oversaturated environment and instead slip into a moment of calm. These pollution remedies drove the popularization of personal, protective environments that were

[282] "Fight Noise Pollution, U.S. Urged," *Chicago Tribune*, (March 21, 1971).
[283] "Sonic Tonic", *Newsweek*, (November, 10, 1969).
[284] Albert Goldman, "Surf, Birds, and Acoustic Overkill", *Life,* (May 1, 1970).

embraced by the middle class. In short, the knowledge that systems transverse boundary lines was not enough to stop people from longing for a zone of safe solitude.

Contemplation Environments and the Taming of Counterculture

A review of Castle's "Enclosed Environment for One" was included in the same issue of *Time* dedicated to the burgeoning ecological movement. [Fig. 2] The piece was included in the exhibition *Contemplation Environments* at the MCC (January 20 to March 8, 1970). Looking like a miniature submarine, Castle's "Enclosed Environment for One" stretches twelve feet long and just over four feet high. Its body is made of stacked laminated oak, while a curving tail-like appendage and two round knobs are encased in a dark matte black fiberglass. A hinged door on the side of the piece opened to reveal a small carpeted interior, complete with fuzzy throw pillows, a skylight, and a small reading lamp. Despite the unusual design, *Time* singled out Castle's piece as the "hit of the show."[285] Exploring *Contemplation Environments* and "Enclosed Environment for One" illustrate how artists like Castle were internalizing growing anxiety about an interconnected and polluted world, and using the language of the counterculture to create organic, calming, and individualistic refuges.

Contemplation Environments was held at the MCC from January 20 to March 8, 1970. The exhibition took on the rhetoric and aesthetic from the mid-60s immersive environments, but with an intense focus on solitude. The catalog text claims:

> Traditionally, man's contemplative needs were fulfilled with his daily direct access to nature. However, today we live in overcrowded, noisy, dehumanized communities where there are few places ideal for contemplation. As a result, there is a growing need among people for places of solitude. This exhibition, CONTEMPLATION ENVIRONMENTS, does not deal with the process of contemplation as such, but rather with physical

[285] "Time for Spaces", *Time*, (February 2, 1970).

> surroundings which somehow elicit a response which can be called contemplative. There can be said to exist a kind of ineffable presence in the architectural space itself which exerts a quieting, peaceful influence on the mind and emotions of the individual who enters it.[286]

Under the leadership of MCC curator Paul Smith and architect Gamal El-Zoghby, the exhibition included sixteen installations that visitors could experience. Many of the pieces were solo environments that utilized sensuality and mediation practices. The theme of Eastern mysticism was particularly strong in the exhibition; research assistants contacted a diverse array of religious and cultural figures from leaders in the Krishna consciousness movement to experts of the Japanese tea ceremony. An example of the resulting appropriation is Ralph Hawkins' "Environment for Casting the I Ching Electronically" (1969). The installation resembled a telephone upholstered with moss, wood, and stone, in which a single occupant could electronically interact with the *I Ching*. Other environments used pseudoscientific sensual triggers to aid the visitor in achieving a meditative state. For example, Robert Brown's "Environmental Conditioning Room" (1969) gave audio and visual form to the visitor's heartbeat, respiration rate, and skin temperature with the goal of reaching a more knowledgeable and relaxed state. Unlike the intermedia environments from earlier in the decade, *Contemplation Environments* was centered on the individual rather than the collective. Many of the installations could not hold more than one person at a time; admission to the exhibition was kept to strict maximums and tickets were reserved for one hours blocks in order to ensure that the installations could be experienced without crowds. Popular articles highlighted the idea that a contemplation environment was not a fundamental change to the way one lived, but instead offered a quick fix for the stresses of the day. One review of the show states "The artists say it's much better than

[286] *Contemplation Environments*, (New York: Museum of Contemporary Crafts, 1970).

the coffee break. It would work this way. Whenever the harried office worker just can't take the pressure anymore, just can't scribble his signature on another letter; whenever the secretary just can't answer another phone; whenever the boss just can't make another weighty decision—that is the time to hop into the nearest Contemplation Environment."[287] The author made this quick-fix view point even more explicit by claiming that "A Contemplation Environment serves the guy who wants five minutes of relaxation the same way a telephone booth serves someone who wants to make a phone call."[288] The focus on solitude in these environments reflected the cultural change in which the dream of a collective, higher consciousness had turned into the more prosaic hope for inward calm.

One of the most stunning examples of this cultural transition from the collective to the personal comes from the intermedia pioneers USCO, who contributed "Contemplative Sounds" (1969) [Fig. 14] to the exhibition. The piece was a solo immersive environment in the form of a sleek fiberglass chair that utilized high domed sides, thick upholstery, and sound recordings to envelope the user. The piece was mass produced and sold—a product of the movement of "environments" into middle-class domestic spaces. The chairs were not marketed as consciousness-expanding devices, but as devices to make living in a crowded and noise-saturated world easier and more contained. In his seminal book *Expanded Cinema*, theorist Gene Youngblood described how USCO members partnered with behavioral scientists from Harvard University to form Intermedia Systems Corporation, in order to " ... explore multi-channel audio-visual techniques and design of facilities, hardware and software … primarily for use in

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[288] "East meets West in an artistic 'telephone booth'", *Star-Leder, Newark N.J.*, (January, 26, 1970).

education, but with a view toward entertainment as education."[289] A brochure for the chair is a bi-folded sheet of glossy paper, on the outer side is a fold-out poster in the style of psychedelic rock band. [Fig. 15] The page is dominated by a garish red, yellow, and black color scheme, with thick alternating stripes of red and black and a Muybridge-esque sequence in a central panel featuring a brawny shirtless man flexing his back muscles. The poster entreats us to "Sit Back and Relax" in two flourished and embellished fonts, while a cool and neutral sanserif font on the bottom is used for "Intermedia Systems Corporation." The other side of the brochure is a rather standard promotional affair, with a large black and white photo of the chair in the center. The text boosts its counterculture credentials by defining their chair as a "total listening experience beyond the traditional stereo, or in the words of film-maker Stan Vanderbeek, '20-20 listening'.[290] The chair, according to the brochure, can be enjoyed by a variety of private individuals—the dad listening to opera and drowning out the sounds of his children's television—and corporations, the ecological resort offering visitors an immersive tour of their island.

While not nearly as visually spectacular or as physically large as other pieces in the exhibition, Castle's "Enclosed Environment for One" was routinely cited as a standout of the exhibition. The wooden structure was meant to be relaxed in; nearly all pictures from the era show the piece in the midst of being used. One photo from the exhibition catalog shows a hand reaching out from the environment, caught just at the moment of shutting the door. Another photo used in *Time* magazine shows a young woman about to exit the environment, her shoes

[289] Gene Youngblood, "The Artist as Ecologist," *Expanded Cinema,* (New York: Dutton, 1970), 348.
[290] "Sit back and relax" brochure by the LEE (Listening Environment Engineers) – Archives of the American Craft Council M.68 Research Folder.

neatly placed outside the door. The syndicated column "Woman to Woman" by Patricia McCormack reviewed *Contemplation Environments*, singling out Castle's piece for the womb-like atmosphere it created:

> [t]he show-stopper is this lie-on, crawl-through, sit-in exhibit was just big enough for one. You crawled into it, warmed up to the furry interior and closed the door after you …This, by Wendell Castle, of Rochester, N.Y., bought all kinds of reactions. The most interesting came from a teenage girl in bell bottoms. 'It makes you feel very affectionate,' she said, 'like being with your mommy. I'm convinced. Everyone wants to be born again and mothered.'[291]

Similar sentiments were expressed in a review from *Architectural Forum*, which claimed "when the light bulb on the curvaceous 'neck' is lit, the womb is occupied."[292] *Progressive Architecture* reviewed the exhibition and noted that based on the exhibition's stated intent to focus on respite from daily irritations, it was Castle's "womb-like structure" and Ted Hallman's mediation environment with woven threads that were the most successful.[293] Time and again, commentators compared Castle's space as one of rebirth and calm. It envelopes the viewer, but in comforting and stable material, such as solid wood and shaggy rugs, and was enjoyable by anyone from teenagers in bell bottoms to harried workers. While the intermedia spaces of the mid-60s were described as a "bombardment" that could "freak out" older viewers, Castle's space provides the antithesis for a suburban audience looking for refuge.

The Chill Mad Man

While only a small part of his prolific body of work, the furniture Castle designed for corporate spaces are particularly illustrative of his staying power. Although most of Castle's pieces were not specifically designed for the corporate office, the potential was in people's

[291] "Woman to Woman", Patricia McCormack, *Herald Journal*, (February 19, 1970).
[292] "Environment", *Architectural Forum*, (March 1970)
[293] "Museum Provides Exhibits for Contemplation", *Progressive Architecture*, (March 1970)

minds. One reviewer of the landmark 1969 craft exhibition *Objects: USA* noted that "[b]y far the most spectacular furniture piece is Wendell Castle's 'table-chair-stool,' in one end of which the dictating executive can be cuddled in the laminated afromosia[294] while his secretary on the other end sits on the stool and leans on the table to take notes."[295] [Fig. 16] The language here illustrates the strength of gendered assumptions, at a time when conversations about women's unequal pay and access to work opportunities were just beginning to make national headlines. Like the blend of organic form and disciplined order, Castle's furniture productively offers a tension between traditional and new views of the corporate man. The man in Castle's "table-chair-stool" is still secure in his role as executive, yet "cuddled," which suggests new sensory ways of operating and a new mode of self-presentation. Castle's works were envisioned for the office because they offered a means towards realizing a new corporate culture.

Between 1976 and 1977 he produced 27 pieces for the national headquarters of Gannett Company Incorporated, a newspaper corporation with smaller subsidiaries throughout the United States.[296] By this period Castle was well-known nationally for his organic stack lamination style; he was also a resident of Rochester, New York, the town in which Gannett was located, and the company celebrated the fact that they worked with a famous local artist. A brochure from Gannett includes several photographs of Castle's pieces. [Fig. 17] In the foreground, a woman sits on a plush rug in the confines of one of Castle's biomorphic reception desks. Behind her, the front lobby features a walnut spiral staircase with a fluted sculptural element. The entire room

[294] Afromosia (*Pericopsis elata*) is a type of hardwood that also goes by the common name African teak.
[295] Frank Getlein, "New Things Are Happening in Some Old Media," *The Star*, Washington, D.C., (October 5, 1969).
[296] For a catalogue of these pieces, see Emily Evans Eedermans. *Wendell Castle: A Catalogue Raisonne, 1958-2012*, (New York: The Artist Book Foundation 2015)

pivots around Castle's work; it was designed to be a "flow through space" encouraging employee interaction.[297] Why is Castle's impractical, expensive furniture being used in an office setting? Part of the answer is that Castle's furniture allowed Gannett—a conservative news corporation that would later found *USA Today*—to maintain the position of the arts patron (similar to the Johnson family's role in *Objects: USA*). But more interestingly, the patronage illustrates an uncanny fit between Castle's organic/mechanistic style, society's heightened focus on the individual, and the emerging changes in the managerial class during the 1970s.

This new corporate culture was informed by the decades of solidifying the "managerial class". The corporation as a category of organization emerged as the 19th century gave way to the 20th. The "administrative revolution" during this period saw the doubling of "white-collar" workers between 1900 and 1920.[298] This increase was due to the ways in which work was structured. While in the earlier period of the Industrial Revolution, businesses would contract with outside individuals for tasks such as sales and accounting, during the "administrative revolution" these roles were brought in house. Once in house, these functions would be consolidated under the responsibility of a professional "manager." In overseeing a diverse array of tasks, the job of manager itself became more specialized, and with increases in specialization came increased prestige.

In this formative period, the managerial occupation utilized a rhetoric of control and rationality used to bolster claims of their essential nature. As historians of business such as Reinhard Bendix have illustrated, managers lacked the traditional benchmarks that assured

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[297] Promotional brochure for Gannett Company's new corporate headquarters, Lee Nordness business records and papers, circa 1931-1992, bulk 1954- 1984. Archives of American Art, Smithsonian Institution

[298] Rosabeth Moss Kanter, *Men and Women of the Corporation*, (New York: Basic Book, 2008), 18.

authority—such as ownership—and instead had to create a rhetoric and system that would confer and legitimate their status.[299] Frederick Winslow Taylor—and the eponymously named "Taylorism"—was one of the first and most successful attempts to harness the langue of rationality and apply it to business. Taylor heralded what he termed "scientific management" and applied systems of task specialization and work flow to production.[300] Crucially, Taylor argued that those involved in the carrying out of tasks were unable to have the distance, and even the intelligence, to create such abstracted systems. Instead, they needed managers who could coolly and logically see the entirety of a system of production and design the most efficient means of running it. In the interwar period, sociologist Max Weber would further cement the linking of rationality and bureaucracy and gave it the air of a virtue for its supposed exclusion of human passions and prejudices.[301] Historian Rosabeth Moss Kanter has written at length about what she terms the "masculine ethic" and the ways in which traits traditionally identified with men were mapped as necessary qualities for an effective manager.[302] Kanter argues that this ethic functioned as a form of gate-keeping, as most managers were in fact men from the beginning of the profession, yet when women tried to enter into the managerial sector "the 'masculine ethic' was invoked as an exclusionary principle."[303] Overall, the manager emerged during these decades rational with a scientific way of viewing work and masculinity.

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[299] Reinhard Bendix, *Work and Authority in Industry*, (Piscataway: Transaction Publishers, 1963).
[300] Frederick Winslow Taylor, *The Principles of Scientific Management*, (New York: Harper and Brothers Publishers, 1919)
[301] Weber writings would find later be cemented in American academia following their translation from their original German by the sociologist C. Wright Mills in the 1940s.
[302] Kanter, 22.
[303] Kanter, 23.

During the post-war era, a specific image of the male office dweller came into the popular imagination with increasingly negative associations. Sociologist C. Wright Mills' account of white-collar workers who lost any sense of individuality to a larger corporate identity, became a dominant narrative. Mills was especially important in recognizing that "rationality" and bureaucratic norms were not naturally better, or even more efficient, than other modes. Indeed, Mills would argue that the post-war office nurtured their own set of preferences. Returning to the roots of the managerial profession—the curtailing of uncertainty by bringing tasks in-house—intense conformity was another method for guarding against the risk of allowing individuals too much oversight over daily operations of a department. These qualities were well described by the sociologists and business historians of the period: largely white, Protestant, and from privileged economic positions that allowed them to attend elite schools. This criticism of the managerial class was not confined to academic circles, but moved into popular culture. For example, Shepard Meads' 1952 satirical guide, *How to Succeed at Business Without Even Trying*, was inspired by Meads own experiences in corporate America, and was a *New York Times* bestseller. The manual offered the "advice" of how to climb the corporate ladder by—what one review in the Washington Post termed—"clever credit-grabbing, back-stabbing and apple polishing."[304] The corporate manager was becoming a figure of wide-spread social critique.

An important context for understanding Castle's furniture within the corporate sphere is the supposed plight of the white-collar male during the early 1970s. Headlines warning of mounting "blue-collar blues" were quickly met by other woes: "white-collar blues," "executive

[304] John Crosby, "How to Succeed Without Trying", *The Washington Post*, (August 8, 1952).

blues," and even the "middle-level blahs."[305] Encouraging this coverage was the study "Work in America," a report delivered to the Secretary of Health, Education, and Welfare and published in the winter of 1972. The authors connected worker dissatisfaction to a changing cultural sphere that spurred perceptions of stagnant work environments and roles:

> Dull, repetitive, seemingly meaningless tasks, offering little challenge or autonomy, are causing discontent among workers at all occupational levels. This is not so much because work itself has greatly changed; indeed, one of the main problems is that work has not changed fast enough to keep up with the rapid and wide scale changes in worker attitudes, aspirations and values. A general increase in their educational and economic status has placed many American workers in a position where having an interesting job is now as important as having a job that pays well.[306]

While the report makes gestures towards the value and meaning of work for women, stereotypical male breadwinners are the primary protagonists. This emphasis was repeated in the press; for example, *The New York Times* ran the story "Executive Blues: The Failure of the Successful" in the summer of 1973, with a photomontage that adapted René Magritte's *Golconda* (1953), with side-burned young executives floating down into the New York cityscape. [Fig. 18] The article claims that the managerial class had been shaken by the cultural revolution and was no longer content with the usual hallmarks of material wealth and social prestige.[307] These

[305] For an example of this coverage, see "'Blues' in Job Not Exclusive with Hardhats", *Los Angeles Times*, (November 30, 1972); Peter Milius, "Workers Bored with Jobs", *The Washington Post*, (December 22, 1972)
[306] James O'Toole, "Work in America. Report of a Special Task Force to the Secretary of Health, Education, and Welfare" (1972), x-xi.
[307] This phenomenon might be usefully compared to the latter half of the 19th century spread of depression known at the time as "neurasthenia." For a rundown of the is see: T.J. Jackson Lears, *No Place of Grace: Antimodernism and the Transformation of American Culture, 1880-1920*, (Chicago: University of Chicago Press, 1981), 47-58.

workers, influenced by the counter-culture, were unwilling to work solely for material gains and a traditional work ethic; instead they demanded self-fulfillment.[308]

Corporate culture was elastic enough to accommodate these changing desires. New approaches to the office became more prominent; as the trade magazine *Management Review* put it, there was a shift from the "organization man" to the "corporate individualist."[309] Intriguingly, the research files for the exhibition *Contemplation Environments* includes an article called "Chaos as System," which was published in the magazine *Progressive Architecture* in the summer of 1968.[310] This article mocks the "military academy aesthetic" of the early '60s, and argues that what may seem at first glance to be a new paradigm of disorder is in fact an efficient way of creating a new order, particularly in regards to communication between office workers.[311] Its author leans heavily on Douglas McGregor's book *The Human Side of Enterprise* (1960), which proposes a theory of management that emphasizes a looser style of supervision, where workers regardless of level are able to set and achieve their own goals.[312] "Chaos as System" argues that this lateralization is necessary as an increasing number of corporate roles require creativity, since the more tedious and highly monitored work is gradually being outsourced to computers.

Robert Propst, the director of research for the furniture manufacturing company Herman Miller, was one of the first major players to try to bring such an office into practice. His "action

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[308] For a history of this trajectory in the blue-collar sphere, see Natasha Zaretsky, *No Direction Home: The American Family and the Fear of National Decline, 1968-1980* (Chapel Hill: The University of North Carolina Press, 2007), 105-142.
[309] "The Growing Ranks of Corporate Individualists," *Management Review,* October 1, 1970, 59.
[310] Research for *Contemplation Environments*, M-68 Contemplation Environments January 16 - March 18, 1970, Museum of Contemporary Crafts - Main Gallery Exhibitions, The American Craft Council Library and Archives.
[311] "Chaos as System," *Progressive Architecture* (10) October 1968, 160-169.
[312] Douglas McGregor, *The Human Side of Enterprise* (New York: McGraw-Hill, 1960)

office II" line of furniture was launched in 1968, alongside his book *The Office: A Facility Based on Change*. Propst too was greatly impacted by McGregor; he proposed that anyone can "behave like a manager at any level" and encouraged a "developmental" office that allowed for more lateral decision making and autonomy.[313] His ideal office plans were built from easily moveable three-walled cubicles connected at obtuse angles. He argued such design allowed for modularity and flexibility, and created both "enclosure" and "access" for the office worker.[314] In Propst's text, constant change was the catalyst for this dramatic rethinking of the physical environment of the office. This not only included rapid technological change, but also social transformation, as Propst stated: "our culture shows all the signs of digesting ideas and producing new values at a dismayingly rapid rate … Social evolution is bursting by all the old progress norms."[315] In Propst's view, all workers must become self-managers, because all are under the forces of constant change. Here we see a new corporate worker, someone who is not only more individualistic and "authentic," but also under extreme pressure to undergo reinvention.

Castle's giant pieces of wood furniture could never be as interchangeable as the cubicle walls of the action office; but these features of individuality and change are reflected in his furniture. The shapes of Castle's furniture, the ways in which they seem to be growing, exude an organic quality that is in conversation with the goals of the new corporate individualist. Similar to "Enclosed Environment for One," the enveloping, curving shapes provide a calming setting for an office worker under the force of constant change. Yet the stack laminated order speaks of standardized practices and efficient use of a familiar material. Ultimately, the organic form of the

[313] Robert Propst, *The Office: A Facility based on Change*, (Elmhurst: Business Press, 1968), 18.
[314] Propst, 42-48.
[315] Propst, 29.

furniture and precision of method created a pleasing whole out of contradictory approaches, fulfilling the desires of corporate culture.

Conclusion

In last few years of Castle's life, he revisited stack lamination through the use of digital tools.[316] In the late-1970s Castle abandoned the stack lamination process. Historian Edward S. Cooke Jr. argues that he rejected the practice for a number of reasons, including an eventual distaste for the composite nature of the product, a need to distance himself from a broad field of imitators, and a growing appreciation for historic style of furniture and making.[317] However, Castle returned to stack lamination in the 2010s, invigorated by emerging digital techniques. Like Castle's earlier stack lamination process, his digital process began with a sketch, after which Castle carved a model out of thin, laminated layers of urethane. These foam models were given to an off-site studio, which scanned the models to create a three-dimensional computer assisted design (CAD) that took note of the layers.[318] The CAD diagram controlled a CNC router, which allowed multiple blocks of stack laminated wood to be carved into the same design.

How should we as craft historians think about the fact that the curved, biomorphic pieces produced during these two phases of Castle's career have a striking formal similarity, yet are made through different processes? [Fig. 19] Several authors suggest that Castle's consistency

[316]As curator Ronald Labaco writes, "In retrospect, Wendell Castle's unique method of stack lamination from the 1960s … may be viewed as a type of proto-additive fabrication or 3D printing." Ronald Labaco "Introduction" in *Wendell Castle Remastered* (New York: Museum of Art and Design, 2015) 17.

[317] Davira Taragin and Edward S. Cooke Jr., "The Career of Wendell Castle", *Furniture by Wendell Castle*, (Manchester: Hudson Hills Press, 1989), 50.

[318] Amy Cheatle and Steven Jackson, "Digital Entanglements," in *Wendell Castle Remastered* (New York: Museum of Arts and Design, 2015), 69-75.

provides visual proof that a skilled craftsman can retain his product's quality regardless of the tools used.[319] I argue that these similarities in design also represent a shared cultural relevance. Castle's older works engaged with the tension between organic and mechanistic forms during the 1960s and early 1970s, and his newer works similarly thrive because they re-engage with these themes in the Digital Age.

More than forty years after the introduction of his handmade stack laminated furniture, Castle has once again captured the spirit of contemporary design, using similar forms but a different process. The rhetoric of '70s corporate offices—dominated by individuality—is particularly relevant to the Silicon Valley-style ethos of contemporary technology companies. The idea of the "corporate individualist" was built on a faith that computers would allow for more transparent knowledge, which would in turn allow employees to pursue more authentic approaches to work. Current advances in digital production have relocated this faith from management into manufacturing. In 2017, the *Economist* magazine devoted an issue to the latest advances in additive manufacturing, making the oft-repeated prediction that economies of scale are no longer the rule.[320] Approaches previously limited to bespoke craft are now being used in serial production, resulting in what is often called "mass customization." The athletic company Adidas is now using 3D printers to produce shoe soles, while companies such as John Deere and Caterpillar have begun using geographically dispersed centers to print products from company-wide standardized design files.[321]

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[319] For an example, see: Ronald Labaco "Introduction" in *Wendell Castle Remastered* (New York: Museum of Art and Design, 2015).
[320] "3D printers start to build factories of the future", *The Economist*, June 29, 2017.
[321] ibid.

In a 1972 lecture, Castle expressed his interest in serial production, opining that when designing in wood, it took just as much time to create the last piece of an edition as the first.[322] Today, thanks to CAD and CNC methods, wood too is available for serial production. For example, in 2014 Castle's workshop took digital scans of his handmade piece "Long Night" (2011) and converted it into a digital CAD model. Castle's studio craftspeople then cut and stacked rough layers of wood that the studio's CNC tool could carve based on the CAD model.[323] [Fig. 20] One of the most transformative aspects of this new production is that the lines between mass manufacturing and craft production have become blurred, as algorithms can be used to create thousands of copies of the same object, with each piece being a unique variant on the same basic design. This is one reason why Castle's works remain relevant; his woodworking materializes organic growth, which remains an ideal of individual-oriented culture, while his embrace of digital tools speaks to the excitement about this contemporary industrial revolution.

[322] This lecture was in conjunction with the exhibition *Woodenworks* (1972) at the Renwick Gallery. Smithsonian Institutional Archives, Collection 116-149 Renwick Gallery Exhibition Records 1970-1983, Box 1, Folder Wendell Castle Lecture.
[323] Cheatle and Jackson, 69-75.

Postscript

Craft is being radically reshaped by the rise of contemporary technology. Today one can print a porcelain vase, or use algorithms to create a series of jewelry, with each piece demonstrating random variations on a basic design. Exhibitions such as the 2014 *Ctrl + P* at The Center for Craft, Creativity and Design's Benchspace Gallery and Workshop, or the 2015 exhibition *Crafted: Objects in Flux* at the Museum of Fine Arts, Boston, offer an extensive view of this phenomenon. Yet despite the enthusiastic display of this integration, there is uncertainty in the broader craft community regarding the implications these tools have for their discipline. Torn between the deeply embedded critique of industrialized labor, and a subsequent desire to reject a simplistic romanticism of tradition, many contemporary conversations in craft are driven by a mixture of celebration and anxiety. My dissertation shifts the conversation regarding the relationship between craft and technology by taking a longer view. In the last few decades, vital research has argued that in order to see craft more clearly, we must see it not through a lens of connoisseurship, which encourages a valorization of select makers and styles, but through a critical lens. Such a lens highlights that—far from an anachronistic practice—craft is in fact deeply imbricated with technological production.

As craft wrestles with emerging digital tools, technologists wrestle with the ways in which these same tools are changing the practice of making. For example, The Massachusetts Institute of Technology (MIT) Center for Bits and Atoms has a core mission of understanding "how to turn data into things, and things into data". Professor Neil Gershenfeld's course "How to Build (Almost) Anything" is a cult favorite at the university, as it guides students through the hands-on experience of making with industrial-quality tools. Gershenfeld is a driving force behind the "personal fabrication" movement—a purposeful play on the term "personal

computing"—which aims to hasten the speed at which the tools of industry are brought into the home. Public intellectual life seems animated by the possibilities of "dispersed manufacturing" brought on by emergent technologies. The rise of user-friendly computer aided design (CAD) software paired with laser cutters and 3D printers has resulted in a vision where every home can be a factory, every maker a potential entrepreneur. Epitomizing this view is cultural and economic theorist Jeremy Rifkin, who is deeply optimistic about the social possibilities of what he calls the "third industrial revolution." Rifikin claims that "[g]iant, global companies mass-producing standardized products on assembly lines operated by anonymous workforces can't compete with the kind of intimate one-to-one relationship between artisan and patron."[324] At the heart of such statements is a technological determinism familiar to historians of science. The faith that new manufacturing tools will inevitably drive an open and reciprocal relationship between maker and consumer is tied to broadly-held beliefs regarding these new technological artifacts: that they're accessible in skill and cost, they're small and community based, and built for bespoke production. My research historicizes this ideology by examining some of the first artists to embrace personal digital technology. Craft theory and history, with its attention to the intricacies of production, careful consideration of class and gender, and the history of labor under industrialization, can shed light on the social impact of these artifacts.

Ultimately, this dissertation historicizes the abovementioned conflicts within a larger tale of the handmade and technologically produced. The individuals in my case studies—Mary Ann Scherr, Janice Lourie, and Wendell Castle—worked in traditional mediums of metal, fiber, and wood. However, they also utilized computer coding and circuitry networks to give material form

[324] Jeremy Rifkin, *The Third Industrial Revolution: How Lateral Power is Transforming Energy, the Economy, and the World*, (New York: St. Martin's Press, 2011), 119.

to abstract "systems theory" concepts that were a cornerstone of intellectual inquiry at their time. These case studies temper any view of technological determinism—or its inverse, a pure technological neutrality—and instead asks what possibilities are bolstered, and which are obstructed, by the proliferation of digital tools in the arts and humanities. It is my suspicion that many additional, generative connections exist between craft practice and digital technology. The contemporary craft community echoes this focus, with exhibitions such as *Ctrl + P* (2014), which exhibited the objects of craftspeople working with open-source programs and 3-D printing. These craftspeople radically re-imagine the role of the maker and technology; as exhibition curator Anna Walker, comments, "the artists featured in *Ctrl + P* question issues of shared authorship, decentralization of labor, and the possibility of making entire industries available to the individual."[325] A younger generation of female makers/technologists, such as Pamela Liou, are making a cultural splash, from *Vice* magazine to the Museum of Art and Design (New York, NY). Her "Doti loom" allows individuals to make tabletop mechanized looms in order to design and produce their own woven fabrics. In both the technological and the craft sectors then, we see an enthusiasm for technology not shackled to industry, but accessible to the individual maker. In my dissertation, I have argued that we can better understand the current state of making through a richer study of the historic blending of craft and technology.

The principles of highly skilled, collaborative, and interdisciplinary practice that govern craft today can be traced directly back to the technologically enthusiastic craftspeople in my dissertation. Emerging technological tools have not only impacted the objects craftspeople make, but also changed how collaboration and outreach is performed within the community. Too often

[325] Press Release *Ctrl + P,* The Center for Craft, Creativity and Design's Benchspace Gallery and Workshop, April 15, 2014

digital technology is seen as disembodied, labor-saving, and without its own material culture. As a whole, my research demonstrates how technology is instead imbricated with gender and cultural values, solicits particular forms of embodiment and affect, and demands its own form of labor that blurs lines between the handmade and the mechanically produced.

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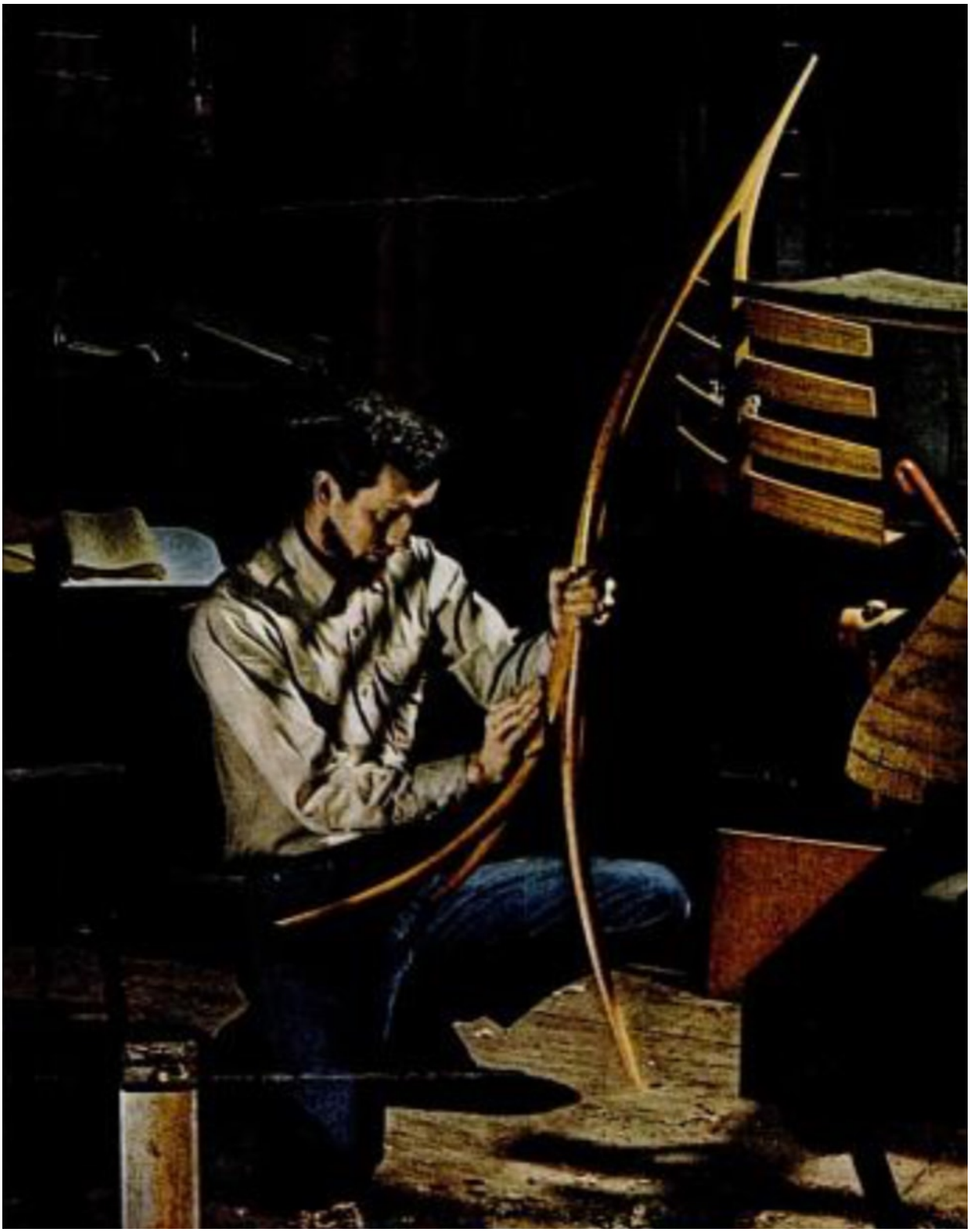


Figure 1
Photograph of Wendell Castle. Photograph by Nina Leen. "The Old Crafts Find New Hands", *Life*, July 29, 1966

Figure 2
Illustration by Boris Artzybasheff. *Time*, January 23, 1950

Figure 3
Photograph of Aileen Osborne Webb and James Rorimer. "The American Genius Crafts", *House Beautiful*, January 1965.

Figures for Chapter 1

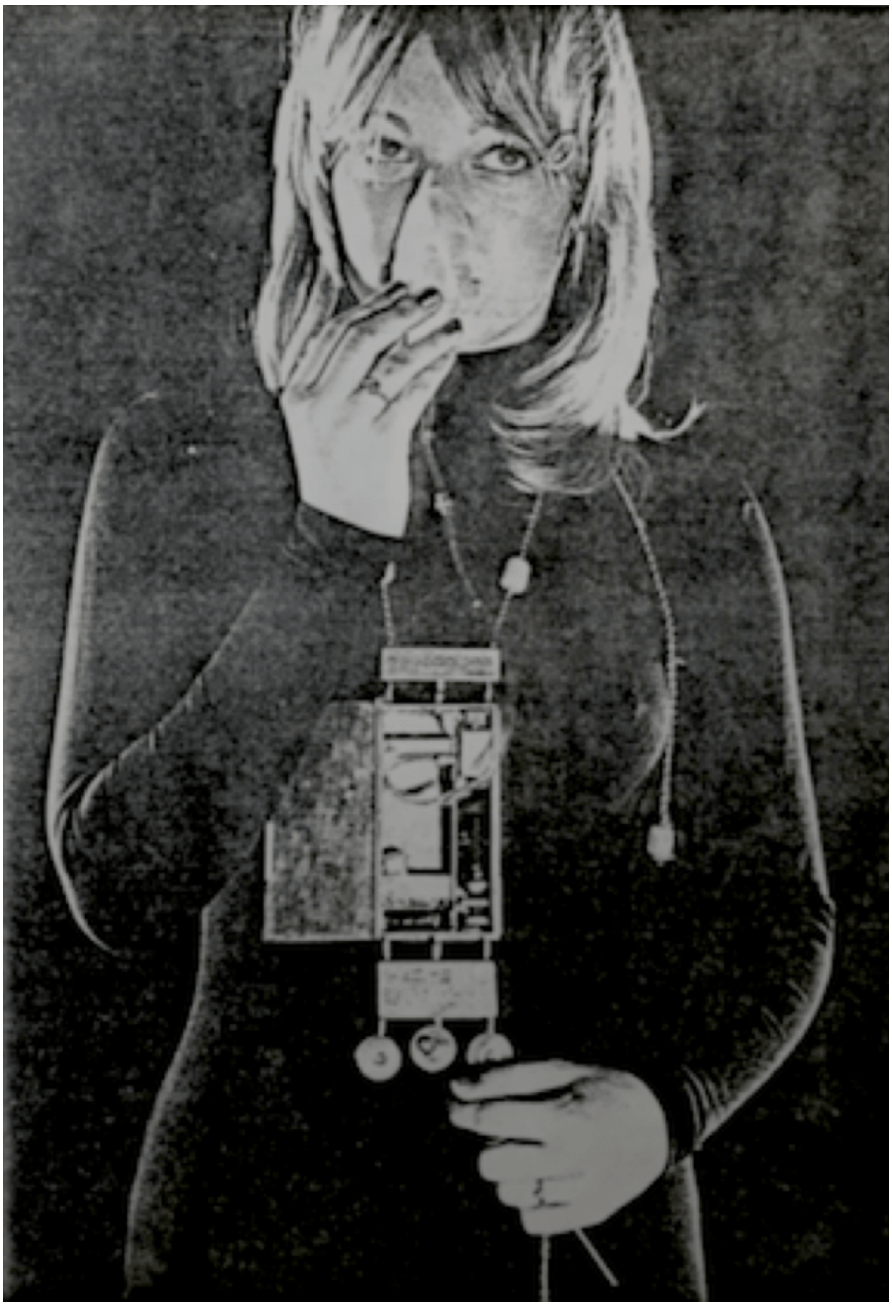


Figure 1
Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

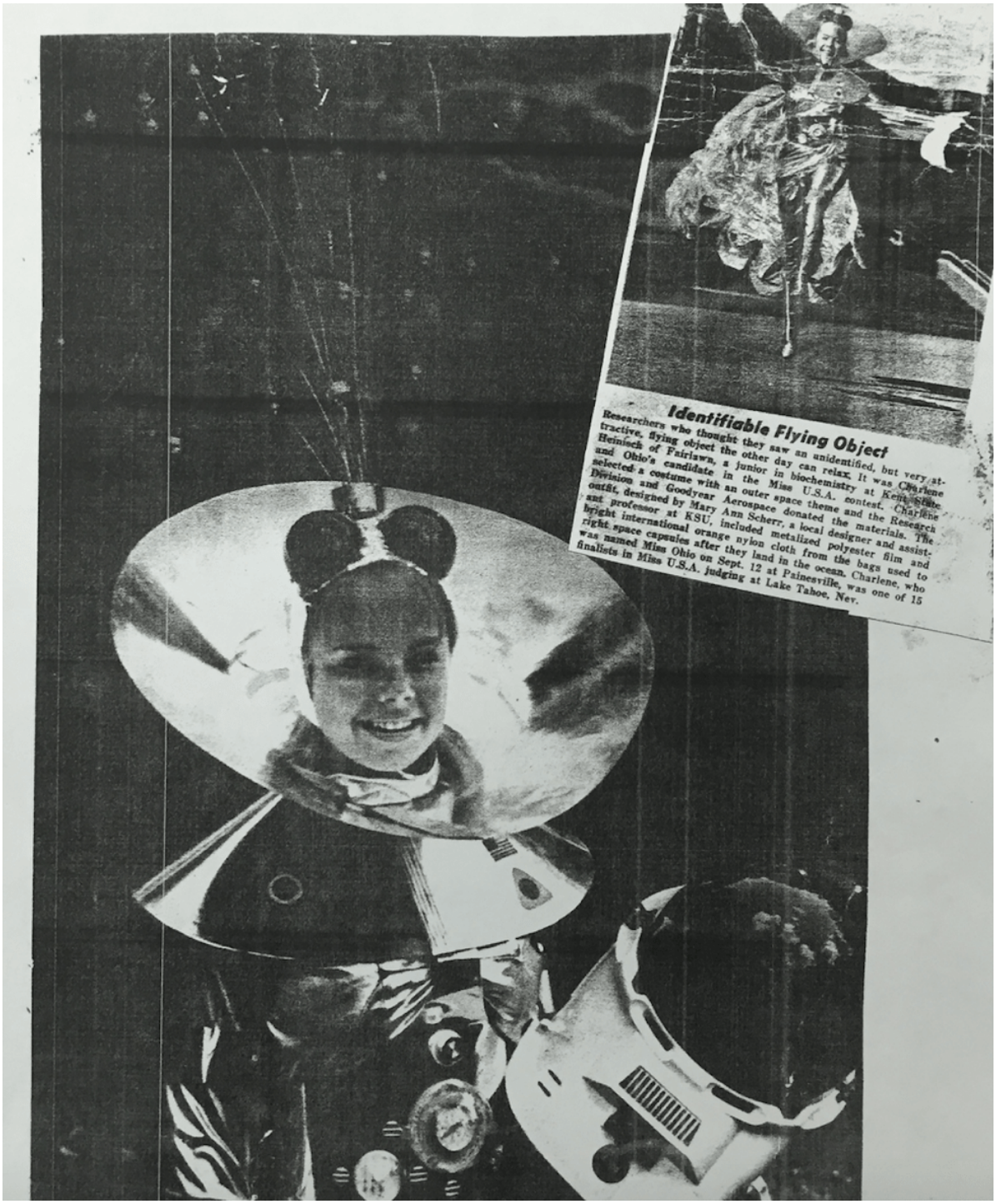


Figure 2
Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

Figure 3
Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

Figure 4
Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

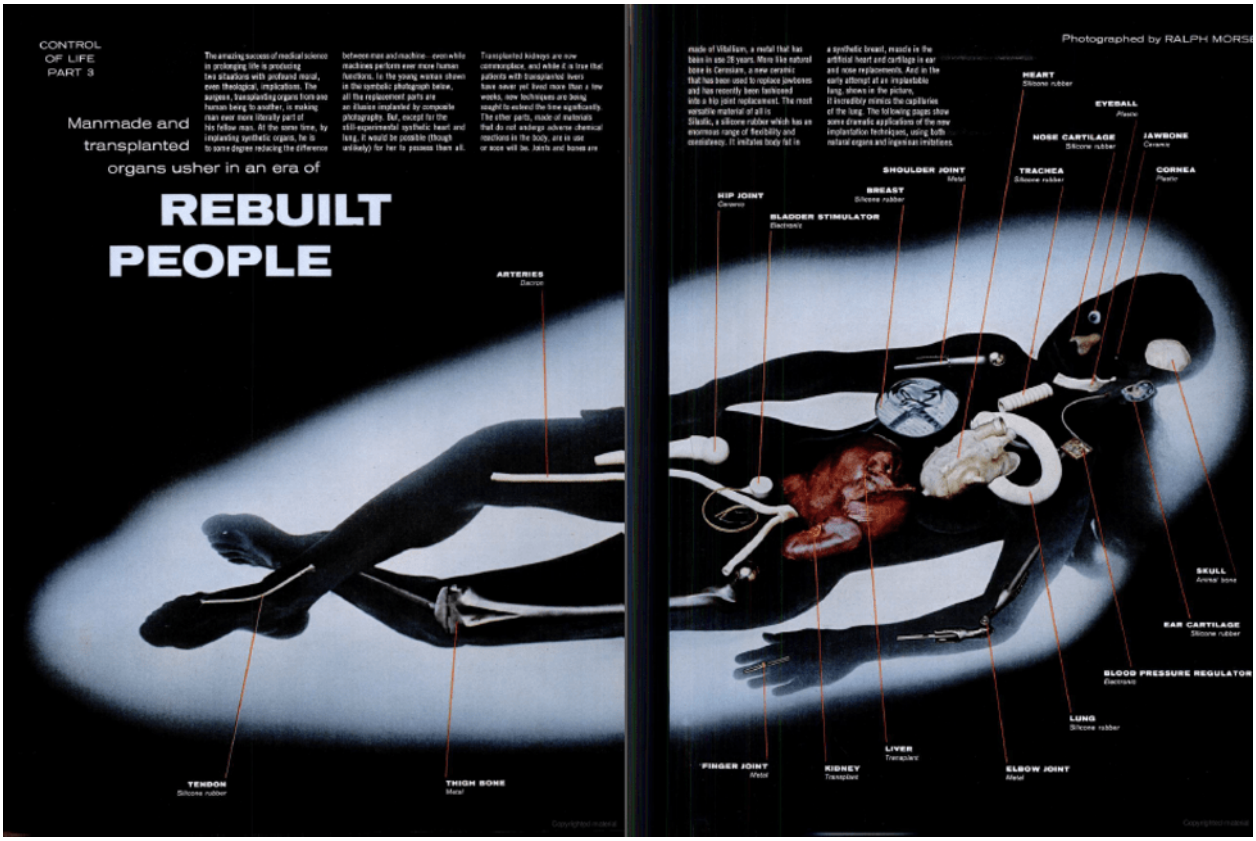


Figure 5
"Rebuilt People", *Life*, (October 1, 1965)

Figure 6
Author Photo, Museum of Art and Design (New York, NY)

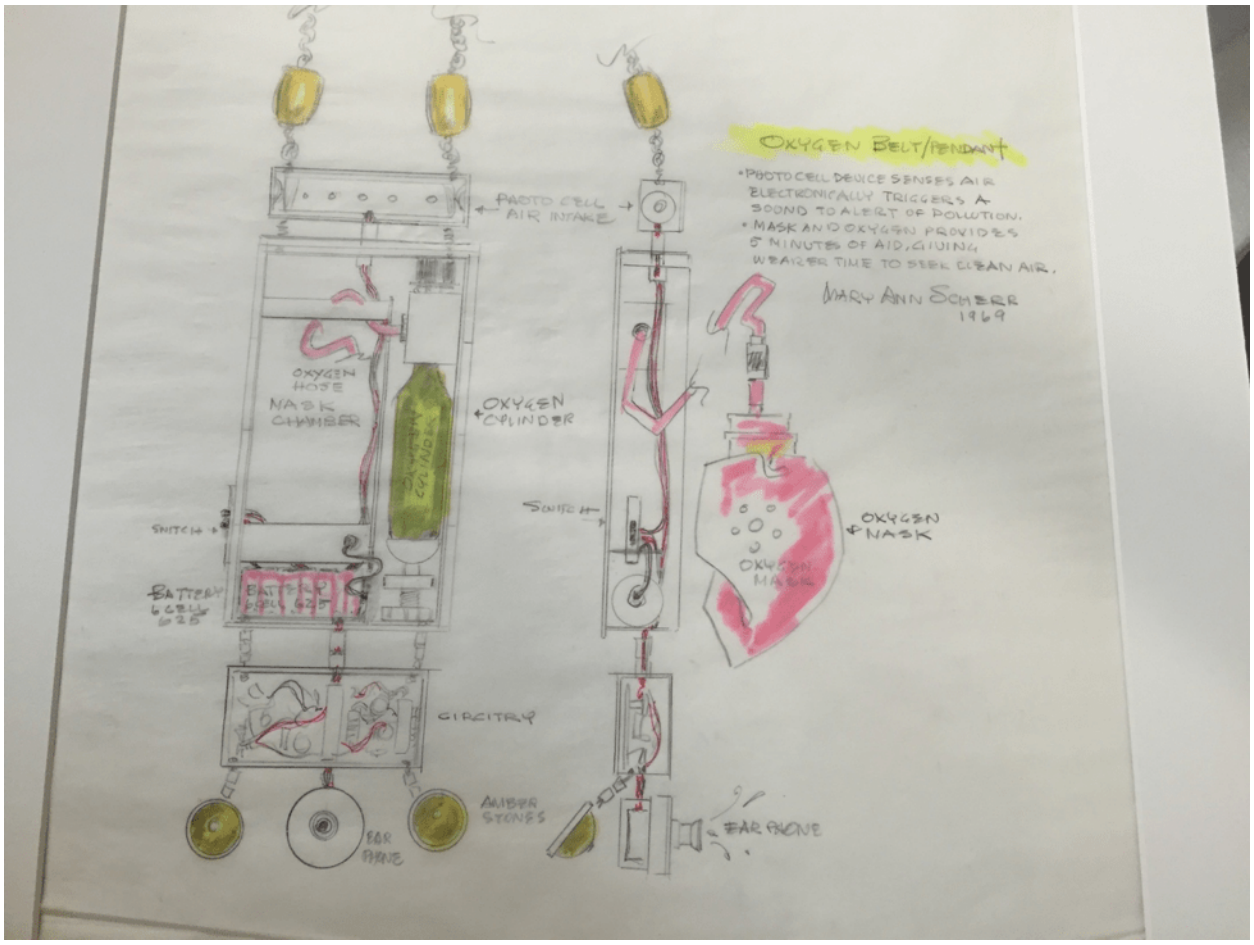


Figure 7
Author Photo, Museum of Art and Design (New York, NY)

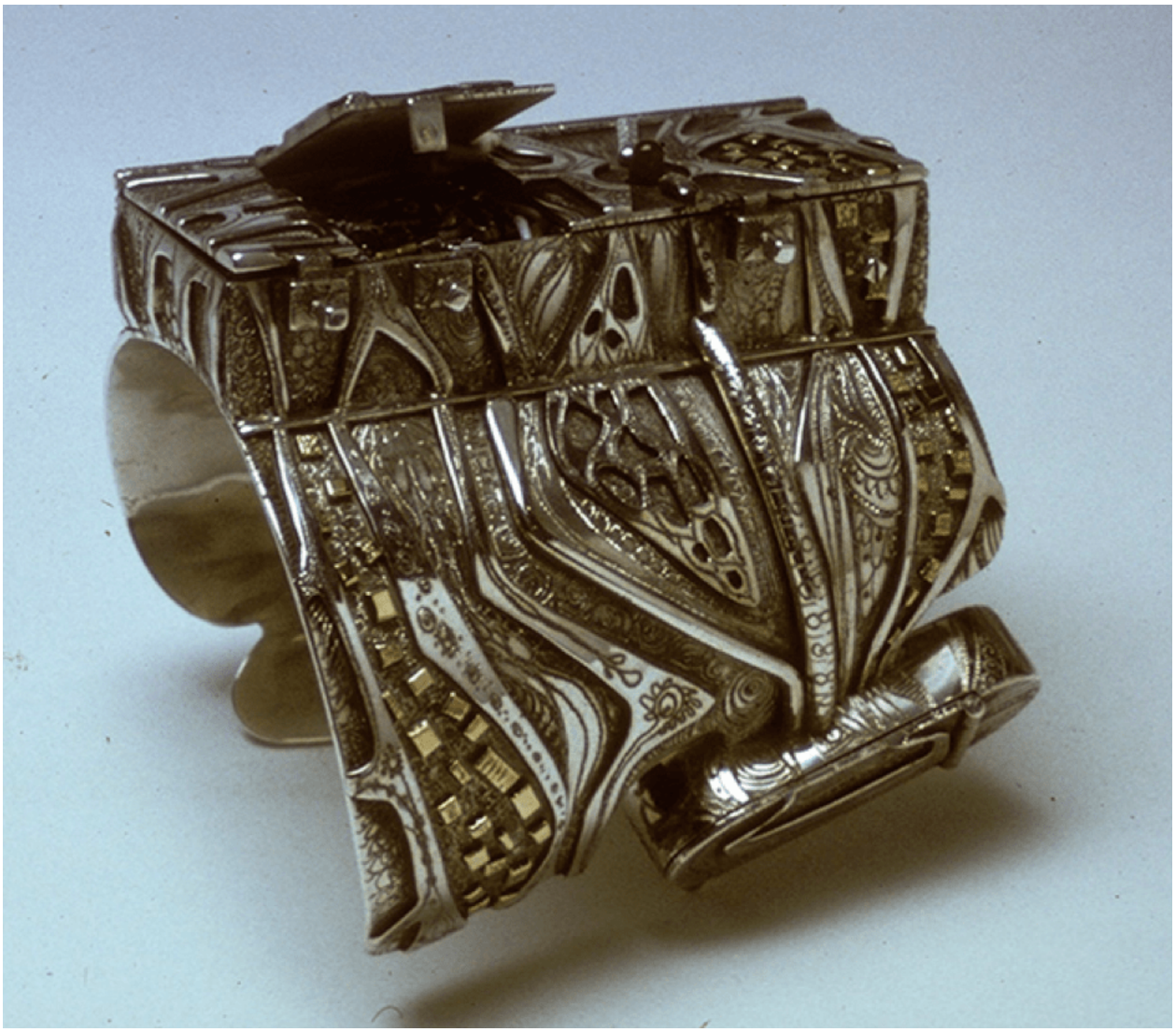


Figure 8
Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

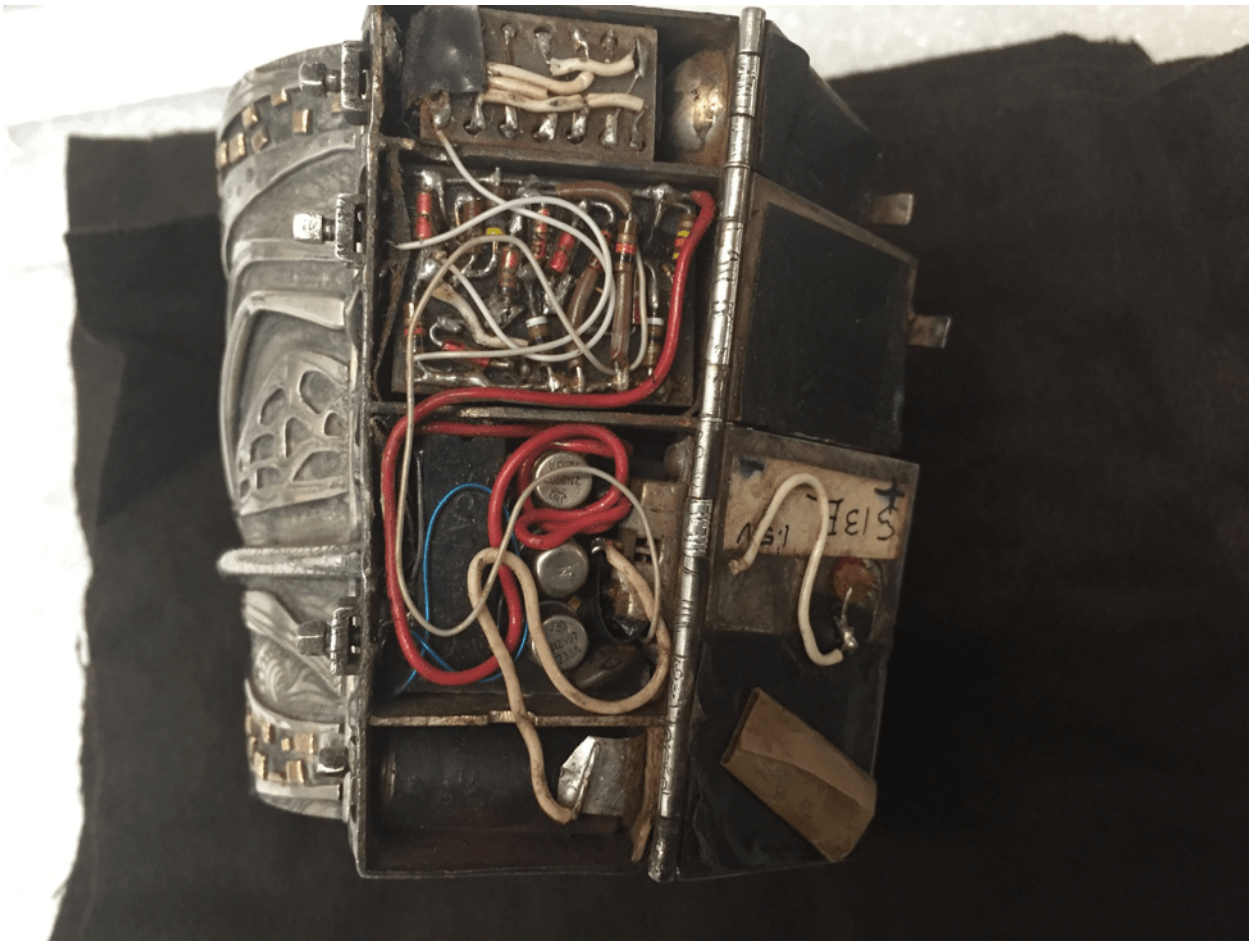


Figure 9
Author Photo, Museum of Art and Design (New York, NY)

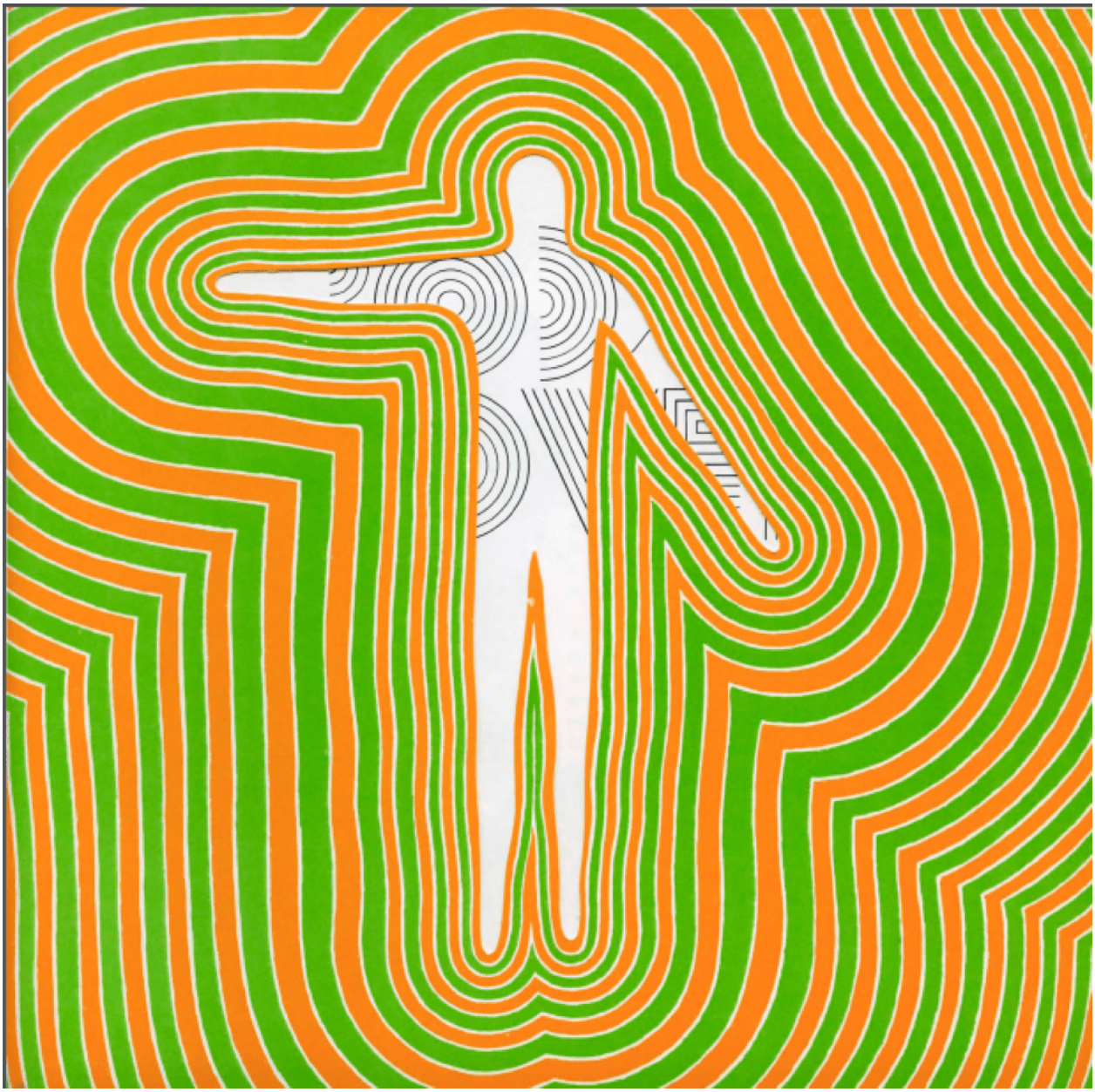


Figure 10
Body Covering (1968) Museum of Contemporary Crafts

Figure 11
Feel It (1969) Museum of Contemporary Crafts

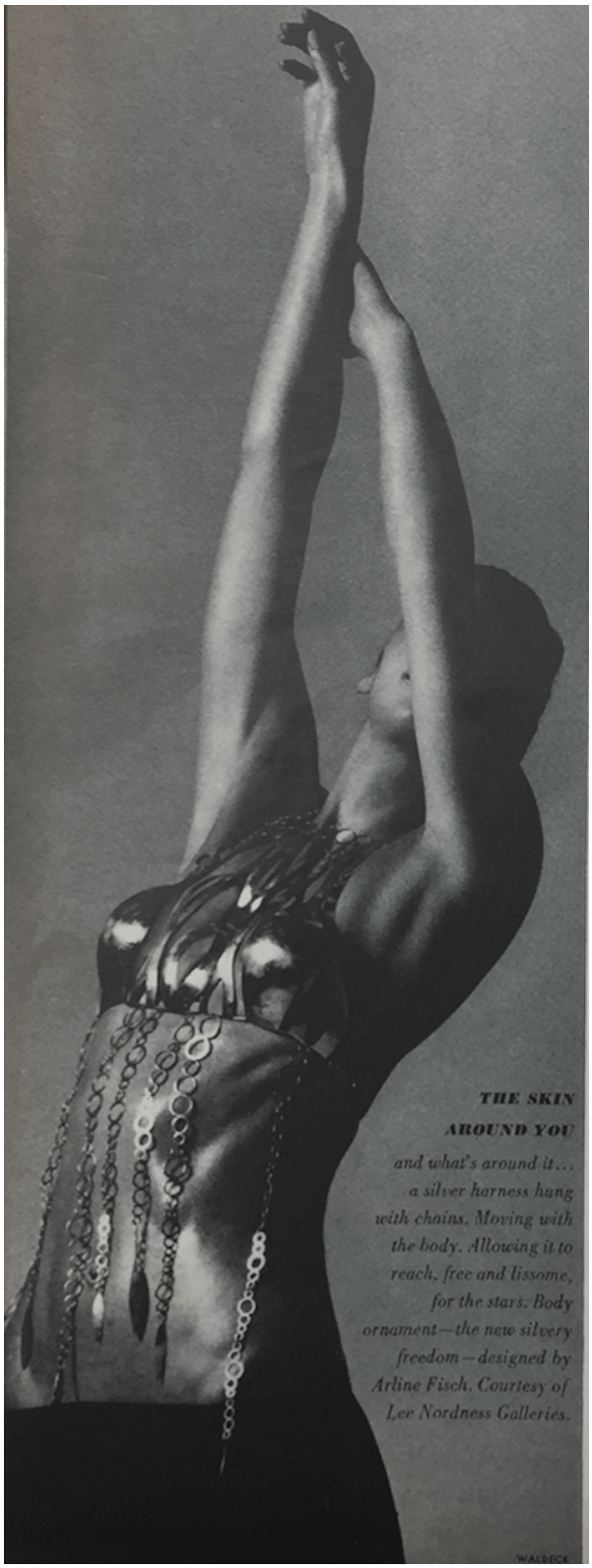


Figure 12
"Forecast: 1969", *Vogue*, (February, 1969)

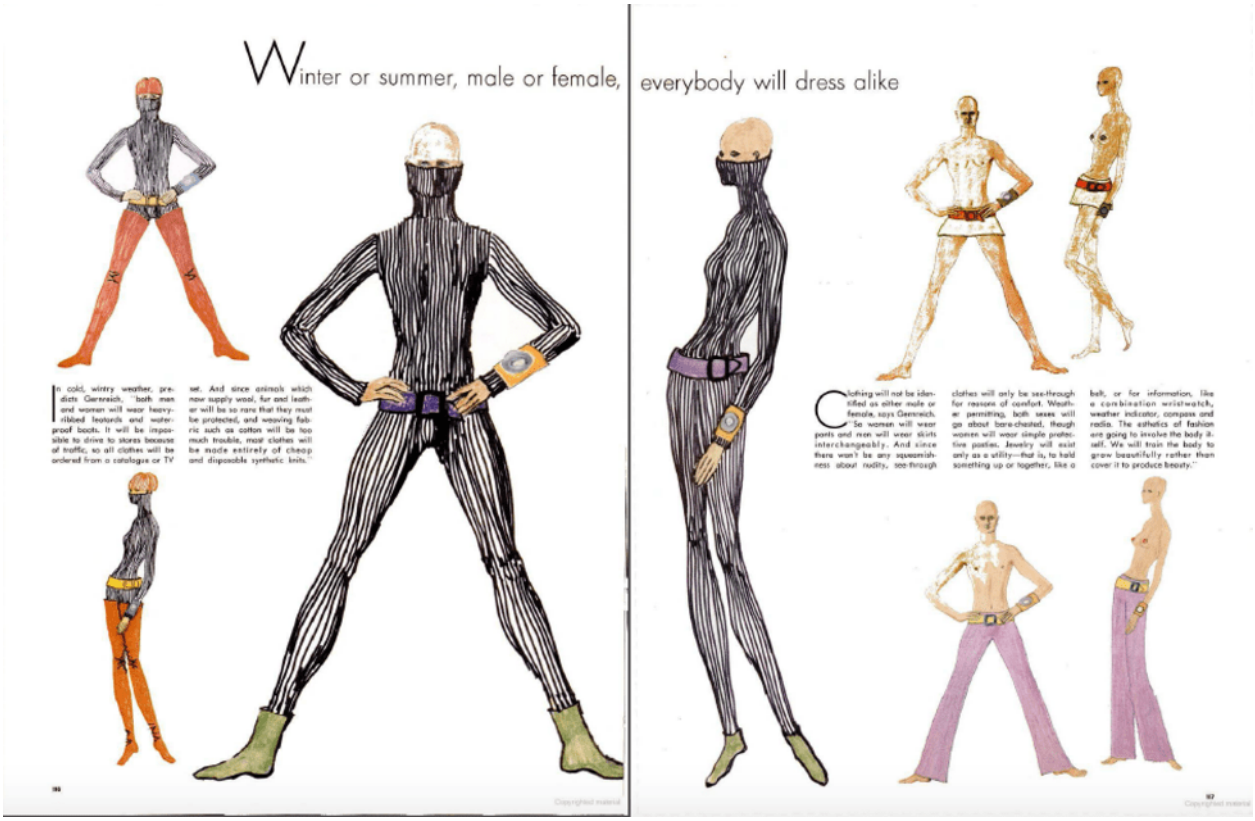


Figure 13
"Fashion for the '70s", *Life*, January 9, 1970, 117.

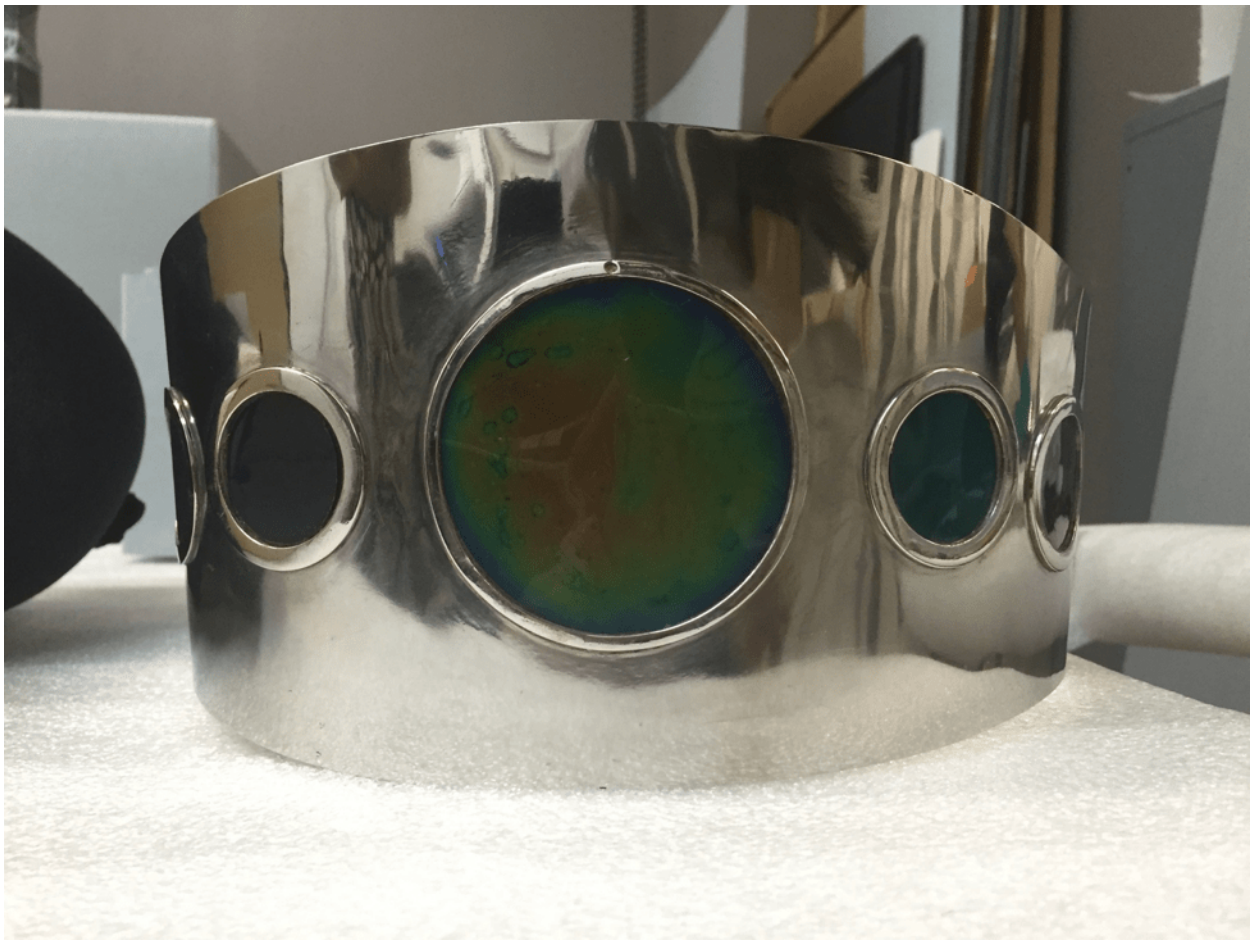


Figure 14
Author Photo, Museum of Art and Design (New York, NY)

Figure 15
Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

Figure 16
Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

Figure 17
Portable World, (1973), Museum of Contemporary Crafts

Figure 18
Portable World, (1973), Museum of Contemporary Crafts

Figure 19
"Gifts for the Conspicuous Consumer", *Fortune*, December 1973

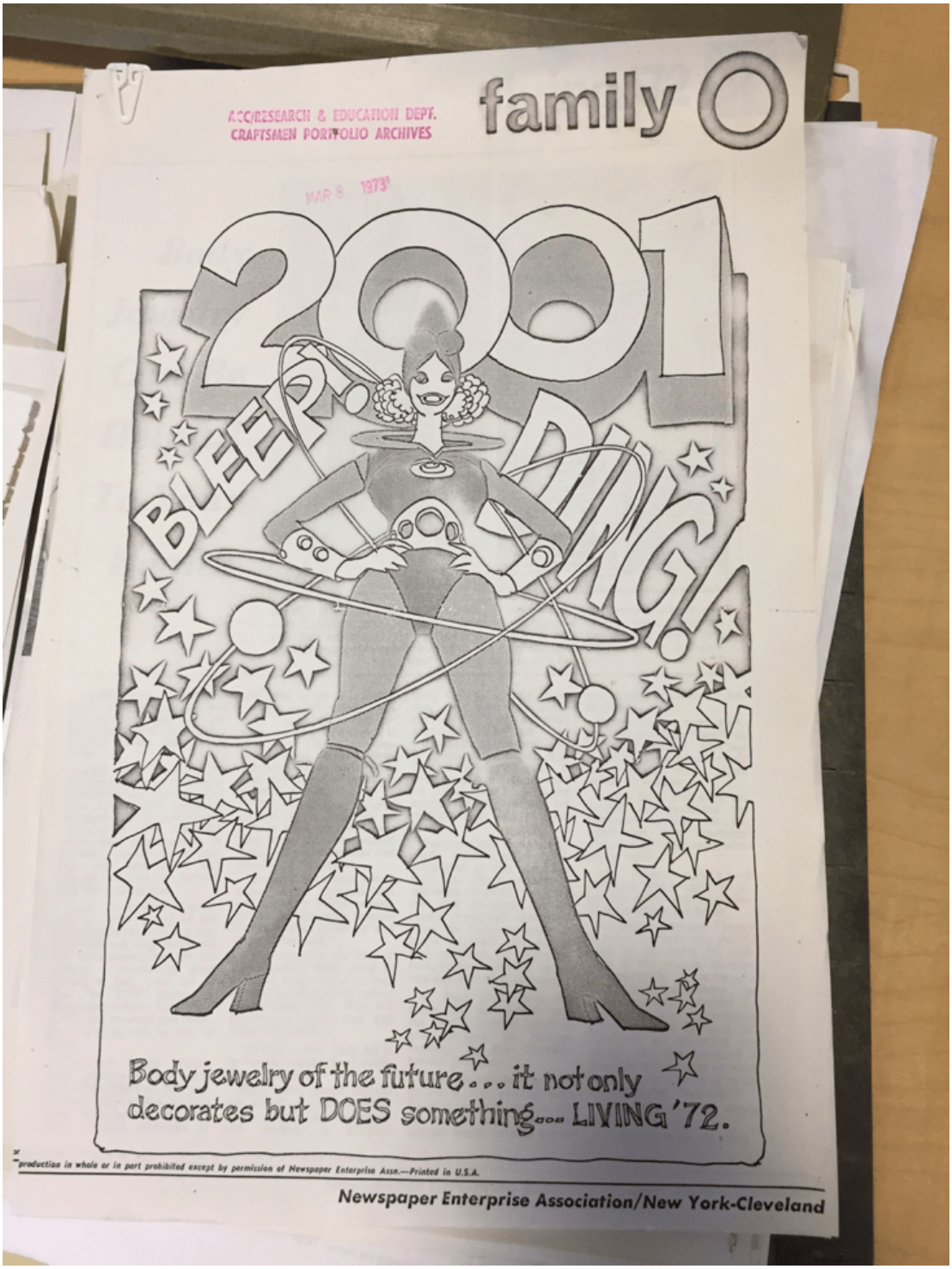


Figure 20
M-86 Portable World (October 5, 1973 - January 1, 1974) Museum of Contemporary Crafts - Main Gallery Exhibitions, American Craft Council Archives

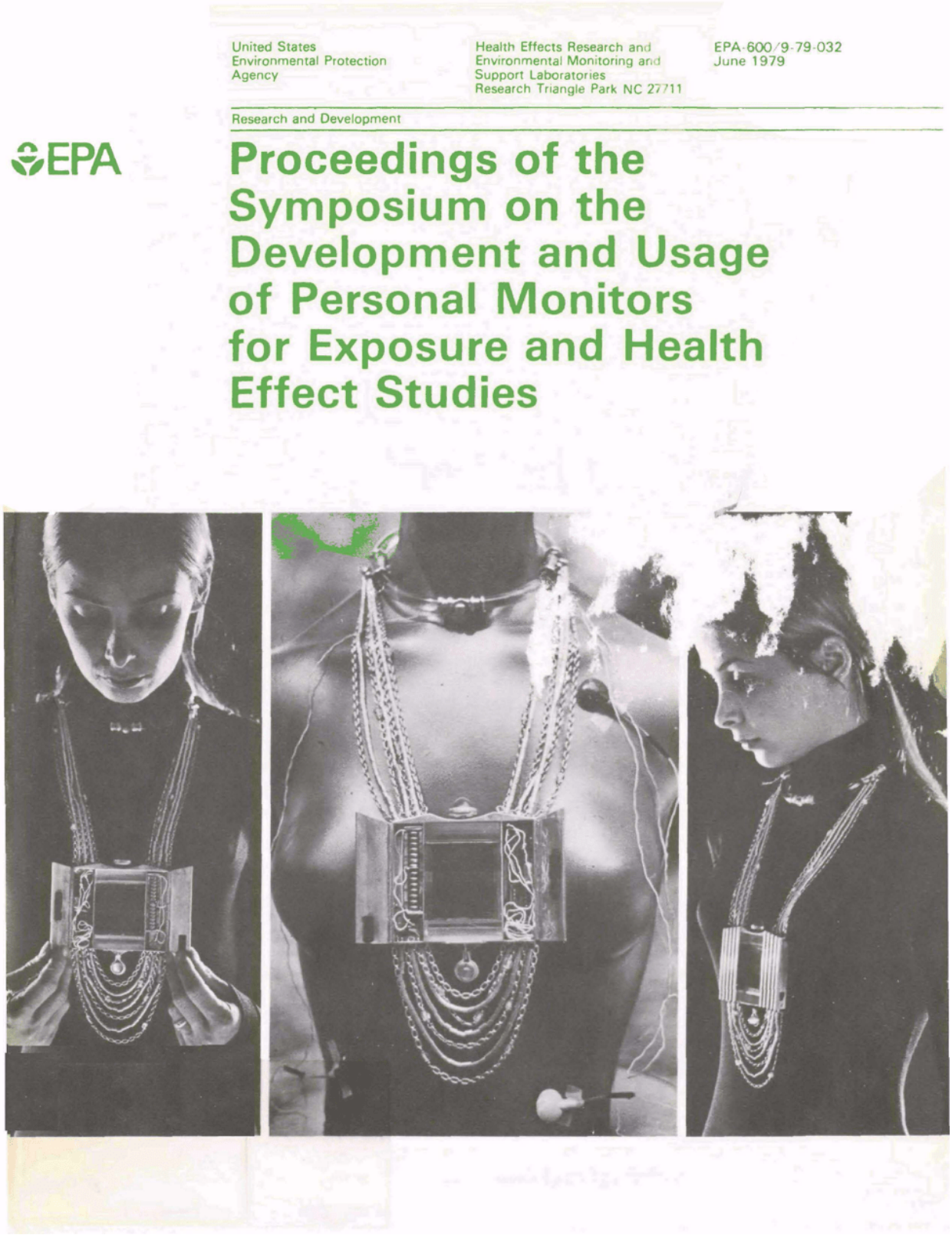


Figure 21
Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

Figure 22
Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

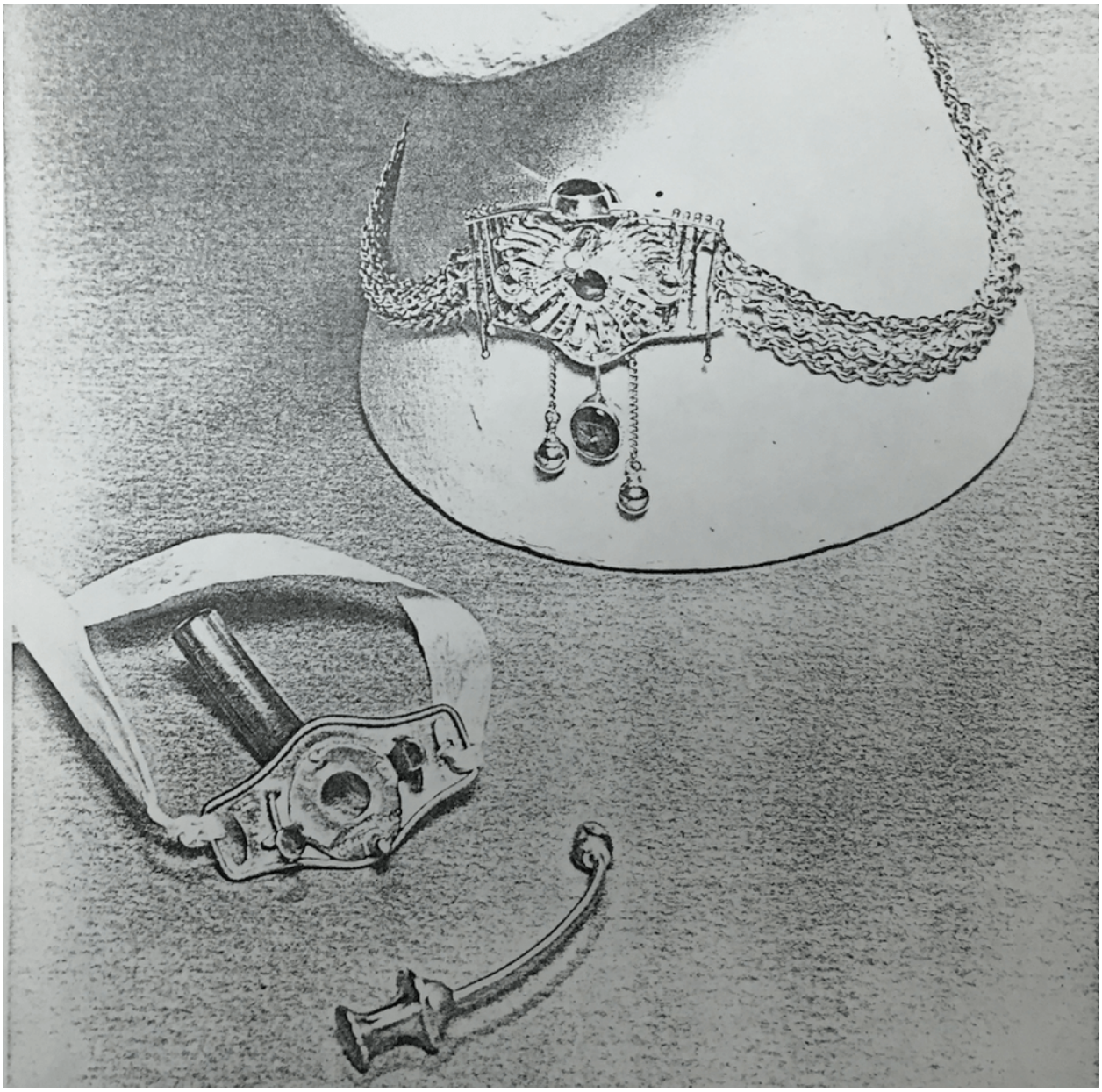


Figure 23
Archives of American Art, Mary Ann Scherr papers, 1941-2007, bulk 1960-2000

Figure 24
Author Photo, Museum of Art and Design (New York, NY)

Figures for Chapter 2

Figure 1
Janice Lourie with a weaving designed and produced with her CAD system, circa 1967.
IBM archives.

Figure 2
International Business Machines, “My Fair Ladies”, 1957

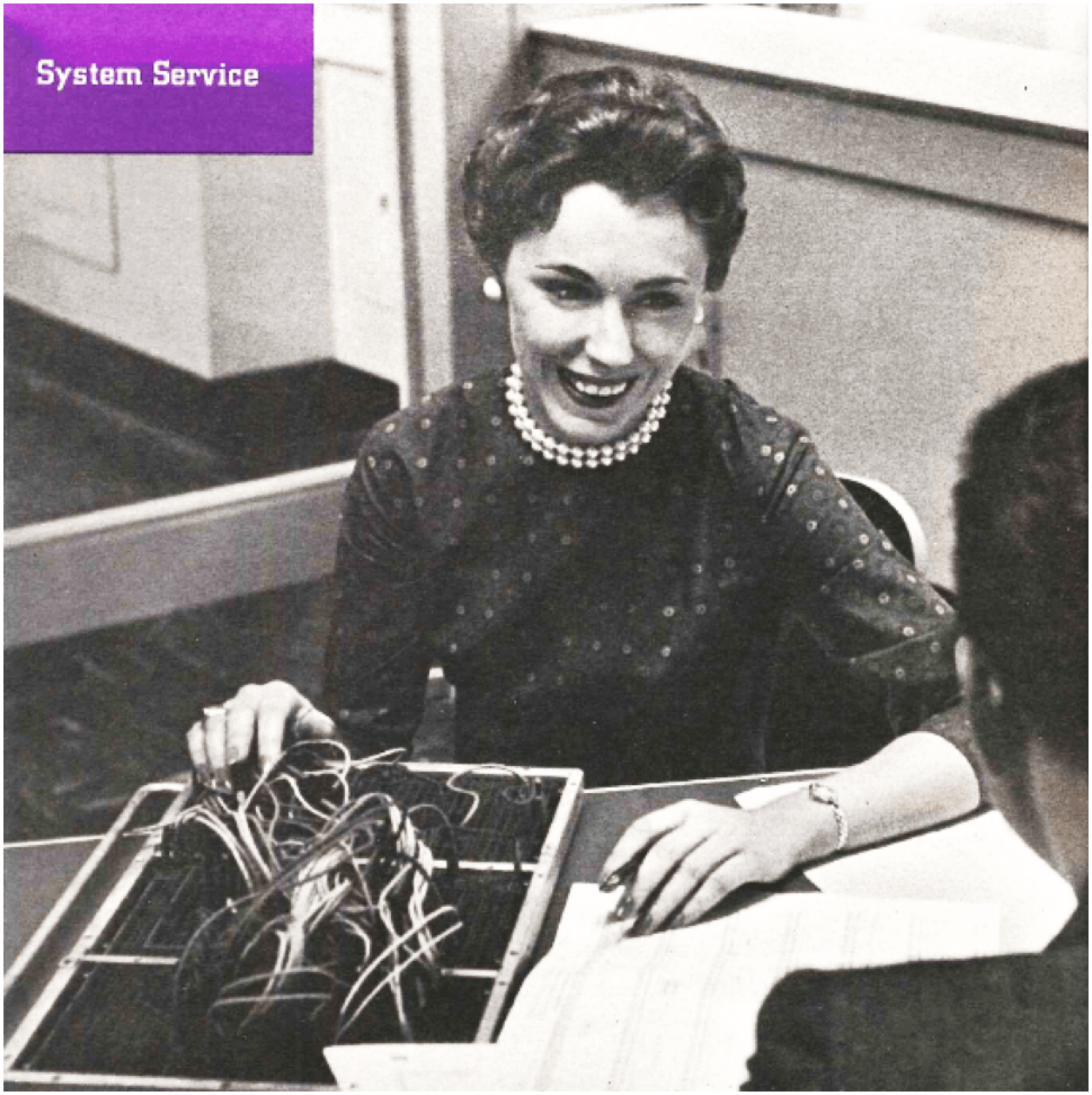


Figure 3
Page from International Business Machines, “My Fair Ladies”, 1957

Figure 4
Page from International Business Machines, “My Fair Ladies”, 1957

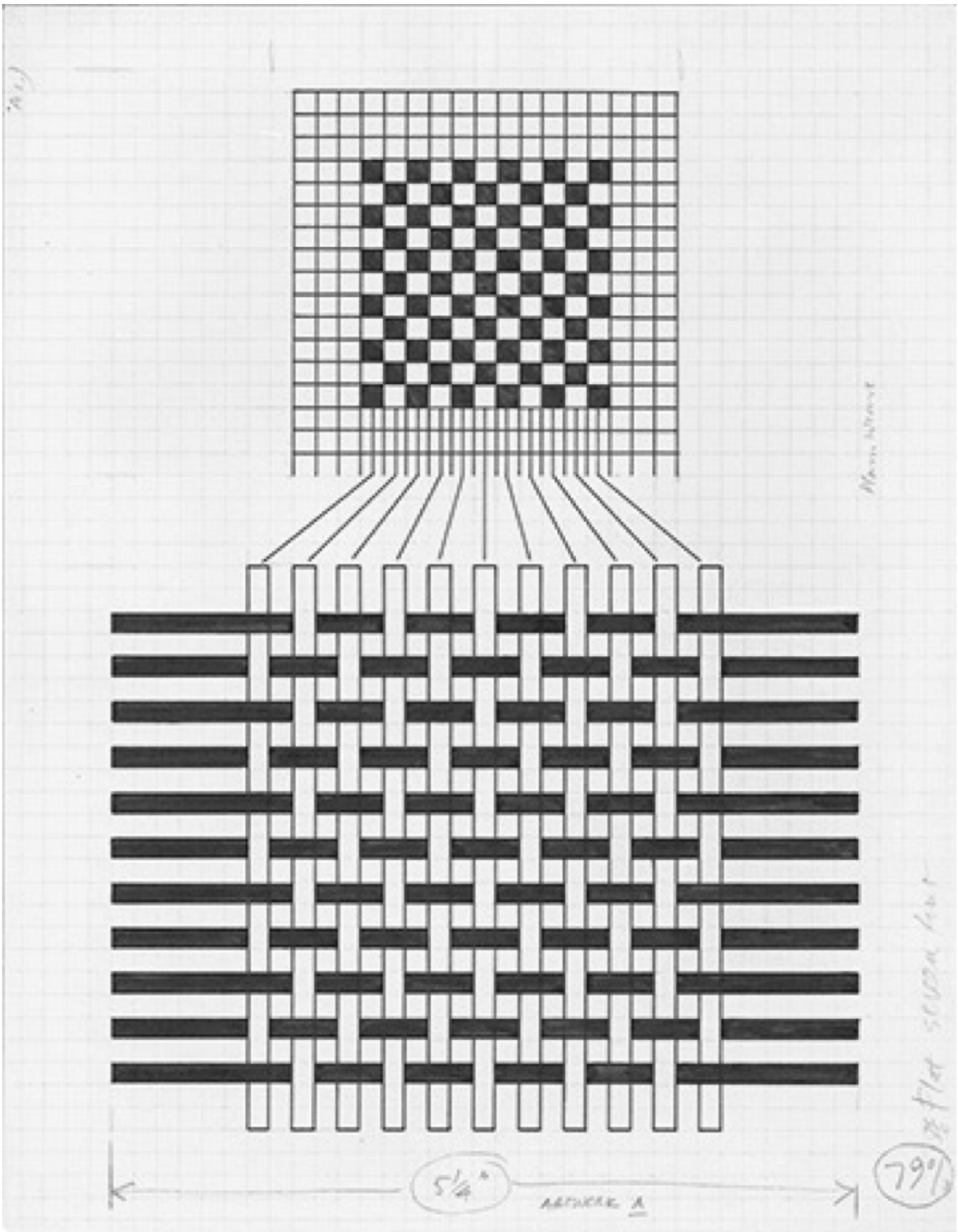


Figure 5
Example of a draft notation for a plain weave. From Anni Albers, *On Weaving*, plate 10

Figure 6
Image of CAD car and photo of GM and IBM designers at work, as published in "Design Augmented by Computers" by Edwin L. Jacks in *Design Quarterly*, No. 66/67

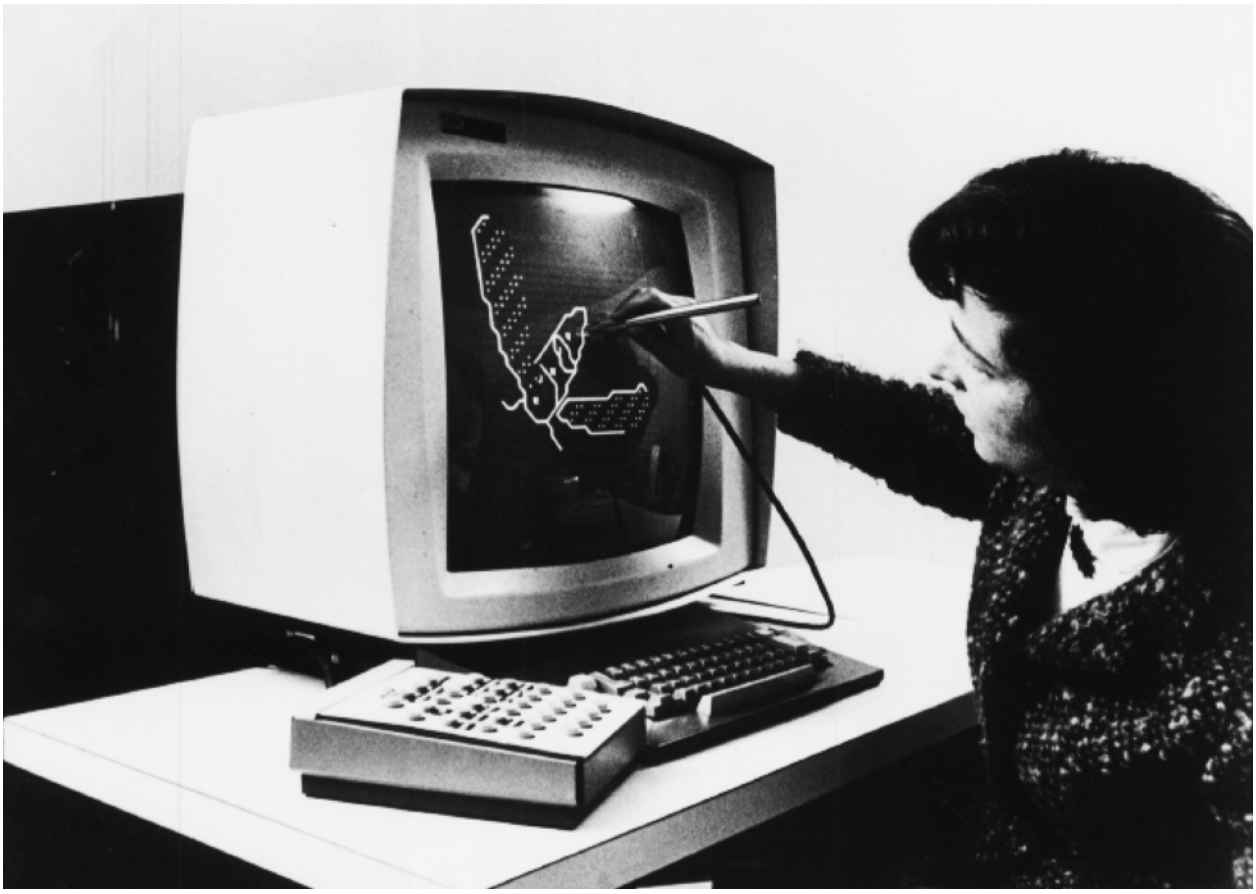


Figure 7
Lourie designing on her textile graphics system.

Figure 8
Lourie selecting a weave pattern for her design.

Quick, Compute Me a Nice Tapestry
By BERNADETTE CAREYThe New York Times (by Neal Boenzi)
New York Times (1923-Current file); Nov 17, 1966; ProQuest Historical Newspapers: The New York Times
pg. 60

Quick, Compute Me a Nice Tapestry

By BERNADETTE CAREY

"The hand loom hasn't changed much in the last 4,000 years," Janice Lourie, a Boston-born computer analyst, said as she worked on yellow rug. "Cleopatra or Martha Washington would recognize this one."

TEXTILES for fashion and interior decorating may soon be created with a pen that writes with light on an electronic drawing board linked to a computer.

The process, called "textile graphics," is the brainchild of Mrs. Janice Lourie, a staff member of the International Business Machines Corporation with a string of degrees from the Massachusetts Institute of Technology, Tufts and Boston Universities, whose job is developing new applications and uses for computers, and whose hobby is handweaving.

A craftsman who has exhibited her work at New York's Design Center, Mrs. Lourie has used her handiwork to add personal accents to her wardrobe and to her East Side apartment, otherwise furnished with Scandinavian modern and early American antiques.

"I'm a woman and I'm interested in fashion and decorating," she said. "Both clothing designs and decorating styles are becoming simpler, more architectural. I think this trend will continue, and as it does, ornamentation will become more and more the function of fabrics."

"Hand weavers like me," she added, "have almost complete freedom of design in our work because we are not subject to the pressures of quantity and time that a commercial textile designer must work with."

When the commercial textile designer sketches a design that is to be woven into a fabric, his sketch is usually turned over to a kind of draftsman who "interprets" the design to show how each thread should be woven on the loom.

The draftsman works out this detailed interlacing of warp and woof by filling in, by hand, thousands of little rectangles on point or graph paper, taking from days to weeks to do so. In the process the draftsman often changes the original design and the designer can lose creative control over his work.

With the new process, the designer works with his own sketch, displayed on a kind of television screen linked to a computer containing thousands of stored weave patterns on punch cards.

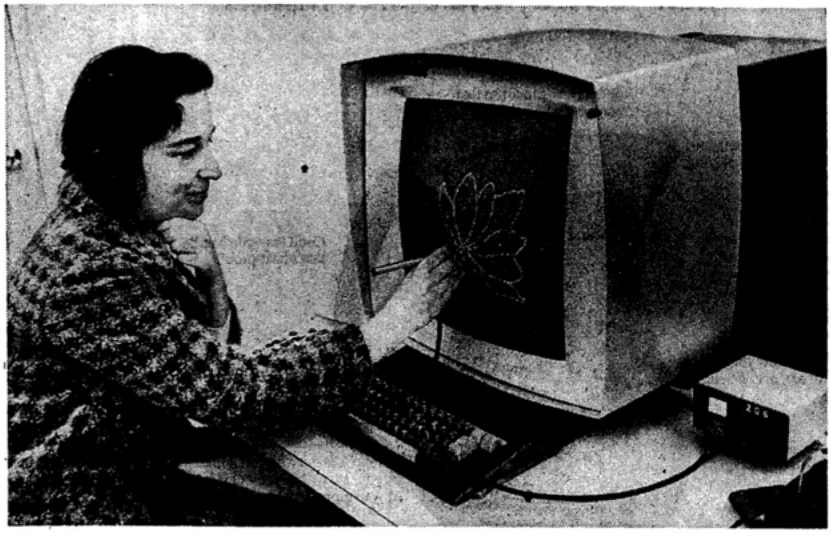
He can push a button to select a weave, and indicate on the screen the area of the design in which he wants the weave to appear. He does this with a light-sensing device called a light pen. Thus, in minutes, the designer can produce an automatic equivalent of a draftsman's point-paper graph.

This automatic drawing process, Mrs. Lourie said, will give textile designers the freedom to work out patterns in almost limitless weave varieties, to experiment and make changes as they work, and possibly to revive very complicated forms such as tapestry and petit point.

Mrs. Lourie said that except for modifications in looms themselves, the processes for making cloth have not changed much since the Egyptians invented the loom about 4,000 years ago.

One such modification was the Jacquard loom, developed in 1780, which was regulated by large perforated cards that bear a striking resemblance to, and were an inspiration and prototype of, the punch cards and tapes used in computers.

"It seemed to me that it was about time that debt to the weaving trade was paid back," Mrs. Lourie said. "It also seemed about time to bring a woman's touch to the computer age."



The New York Times (by Neal Boenzi)

"I.B.M.'s 2250 display unit is a far cry from the classic loom," Mrs. Lourie said as she demonstrated the use of the light pen. In front of her are function keys that allow designer to communicate with computer.

Figure 9
Bernadette Carey, "Quick, Compute me a Nice Tapestry", *The New York Times*, November 17, 1967.

Figure 10
IBM Advertisement*, The New York Times*, April 17, 1967

Figure 11
A mockup of IBM's Durango pavilions at the 1968 HemisFair

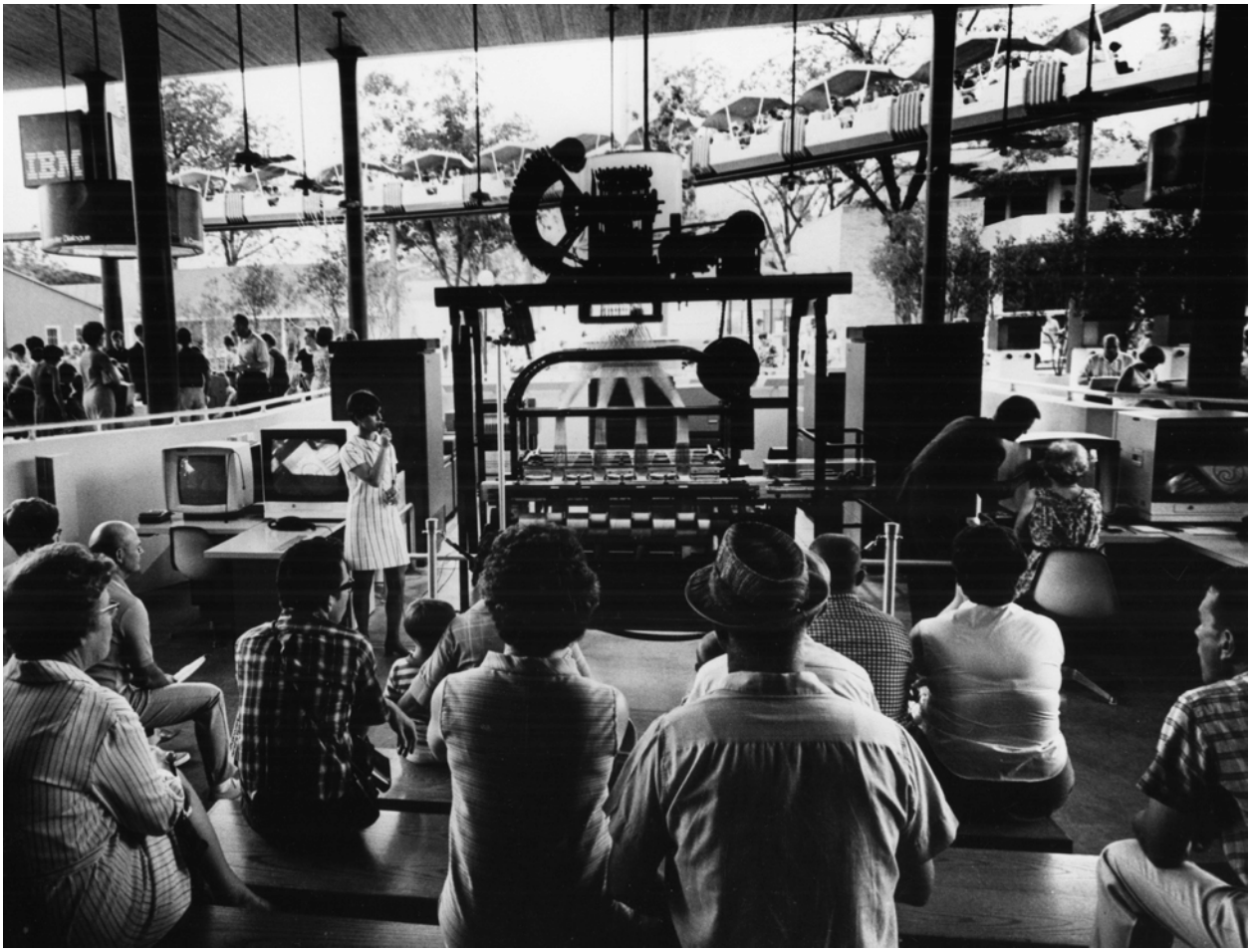


Figure 12
Photo of a demonstration of Textile Graphics at HemisFair 1968

Figure 13
IBM employee with their souvenir cloth at HemisFair 1968

Figure 14
A mockup of IBM's Lakeside pavilion at the 1968 HemisFair

Figure 15
Souvenir Cloth woven at HemisFair, photo by author

Figure 16
Installation view from the exhibition Mind Extenders, featuring a replica of Charles Babbage's Difference Engine (left) and computer-aided design woven hangings (right) by Janice Lourie. American Craft Council Library and Archives.

Figure 17
Installation view from the exhibition *Mind Extenders*, featuring "Quad III" computer generated wood sculpture (left) by Robert Mallary; and computer-aided design woven hangings (right) by Janice Lourie. American Craft Council Library and Archives.

Figures for Chapter 3

Figure 1
Wendell Castle at work on “Enclosed Reclining Environment for One,” (1970).
American Craft Council Library

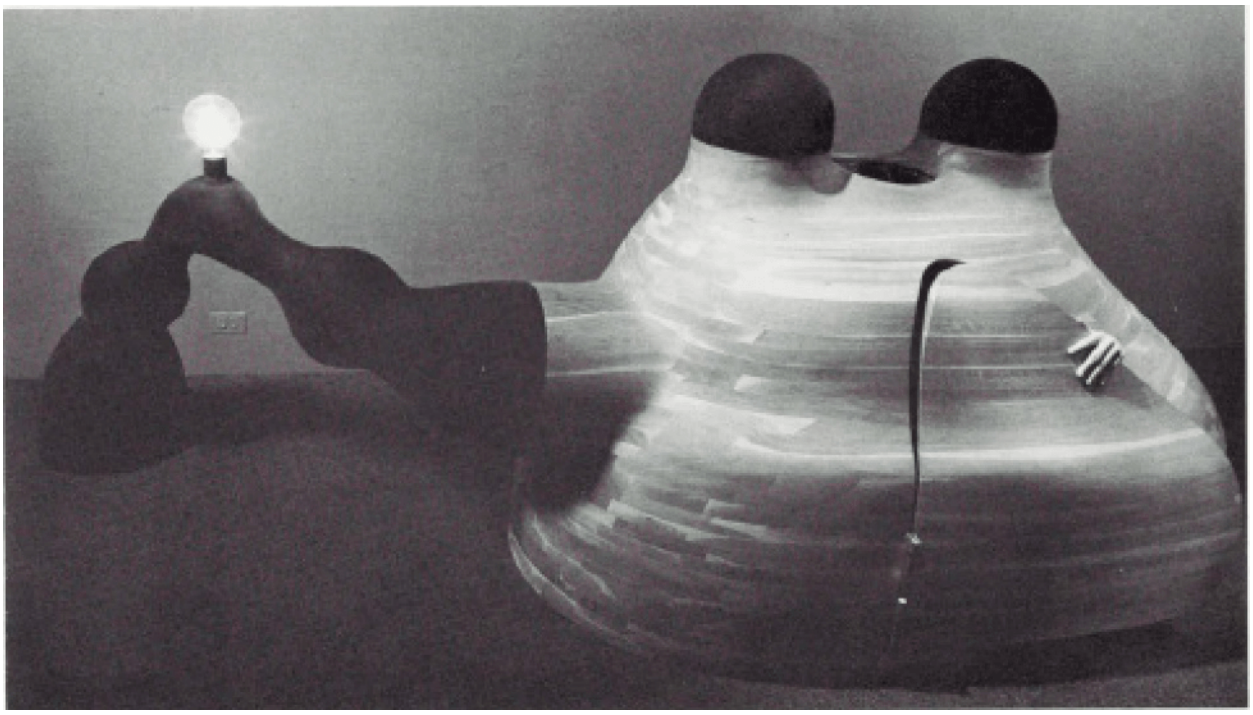


Figure 2
Installation image of "Enclosed Environment for One" in *Contemplation Environments* at the Museum of Contemporary Crafts (New York) 1970.
American Craft Council Library

Figure 3
Wendell Castle pictured with “Scribe Stool” in “Worth Thinking About,” House and Garden, (October, 1962)

Figure 4
Wendell Castle, “Desk,” (1967). Photography by Dirk Bakker.
Courtesy of Wendell Castle and The Detroit Institute of Arts/The Bridgeman Art Library.

Figure 5
Wendell Castle at work on “Enclosed Reclining Environment for One”, (1970)
American Craft Council Library

Figure 6
"Condoid Bench and Back" English walnut by George Nakashima (foreground) and "Bathseba's Bedspread" stitching and applique by Alma W. Lesch (on wall) and on view as part *of Objects: USA* on view at the Museum of Contemporary Crafts (New York) 1972
American Craft Council Library

Figure 7
Wendell Castle, "*Baker Dining Chair",* (1966)

Figure 8
Wendell Castle, “Chest of Drawers”, (1962) installation image from *Fantasy Furniture* held at the Museum of Contemporary Crafts, New York City, January 21 through March 20, 1966.
American Craft Council Library

Figure 9
Wendell Castle, “Blanket Chest” (1963) installation image from *Fantasy Furniture* held at the Museum of Contemporary Crafts, New York City, January 21 through March 20, 1966.

American Craft Council Library

Figure 10
Wendell Castle, "Library Sculpture" (1965) installation image from *Fantasy Furniture* held at the Museum of Contemporary Crafts, New York City, January 21 through March 20, 1966.
American Craft Council Library

Figure 11
Wendell Castle, Baker Dinning Room Set, (1967). Photograph included in *Craft Horizons,* September, 1968.

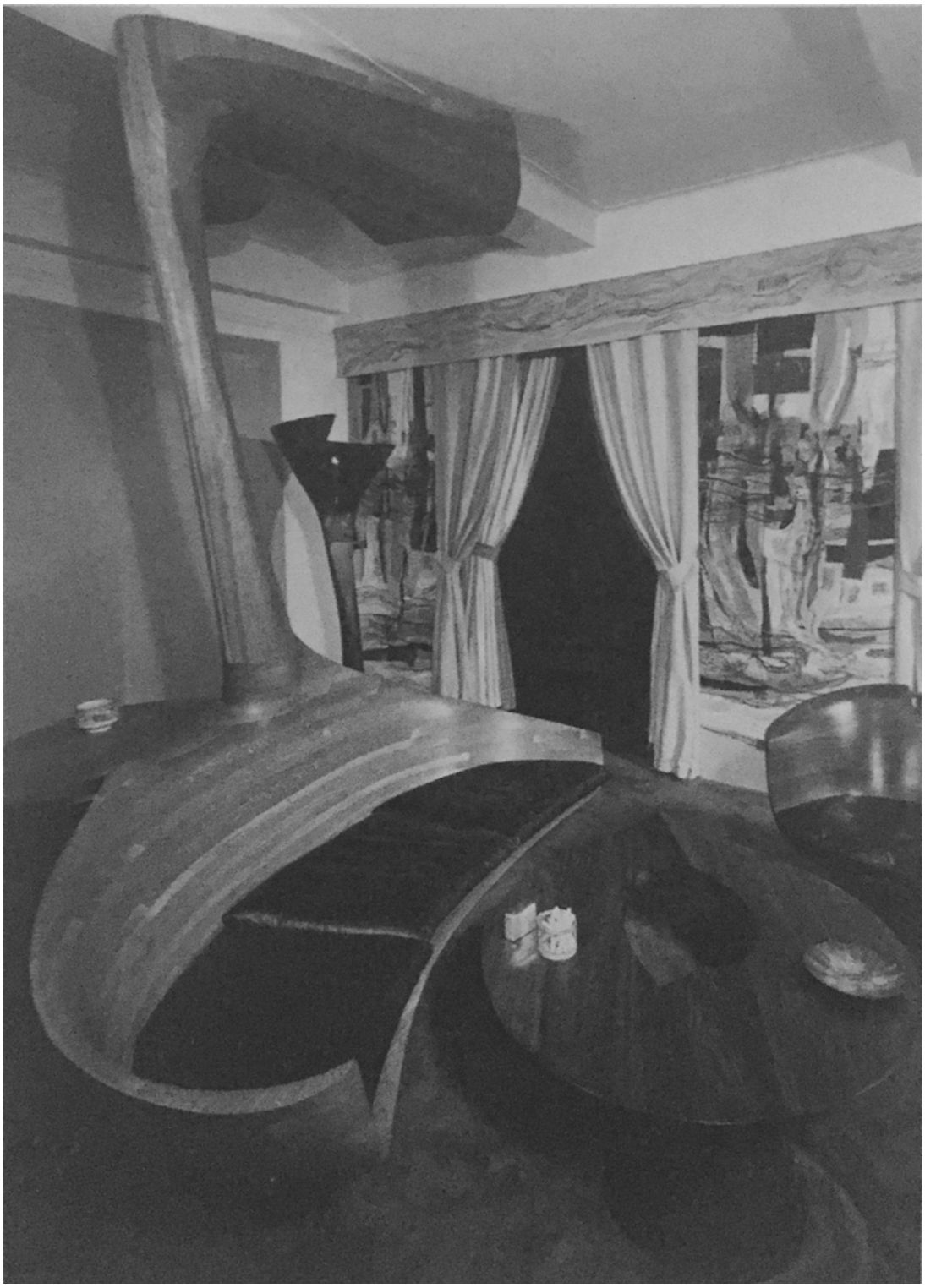


Figure 12
Wendell Castle, Lee Nordness Living Room Set, (1967).

Figure 13
Protest Sign, photo included in Burt Shavitz, "Fighting to Save the Earth from Man", *Time*, (February 2, 1970)

Figure 14
USCO, "Contemplative Sounds" (1969) in *Contemplation Environments* at the Museum of Contemporary Crafts (New York) 1970.
American Craft Council Library

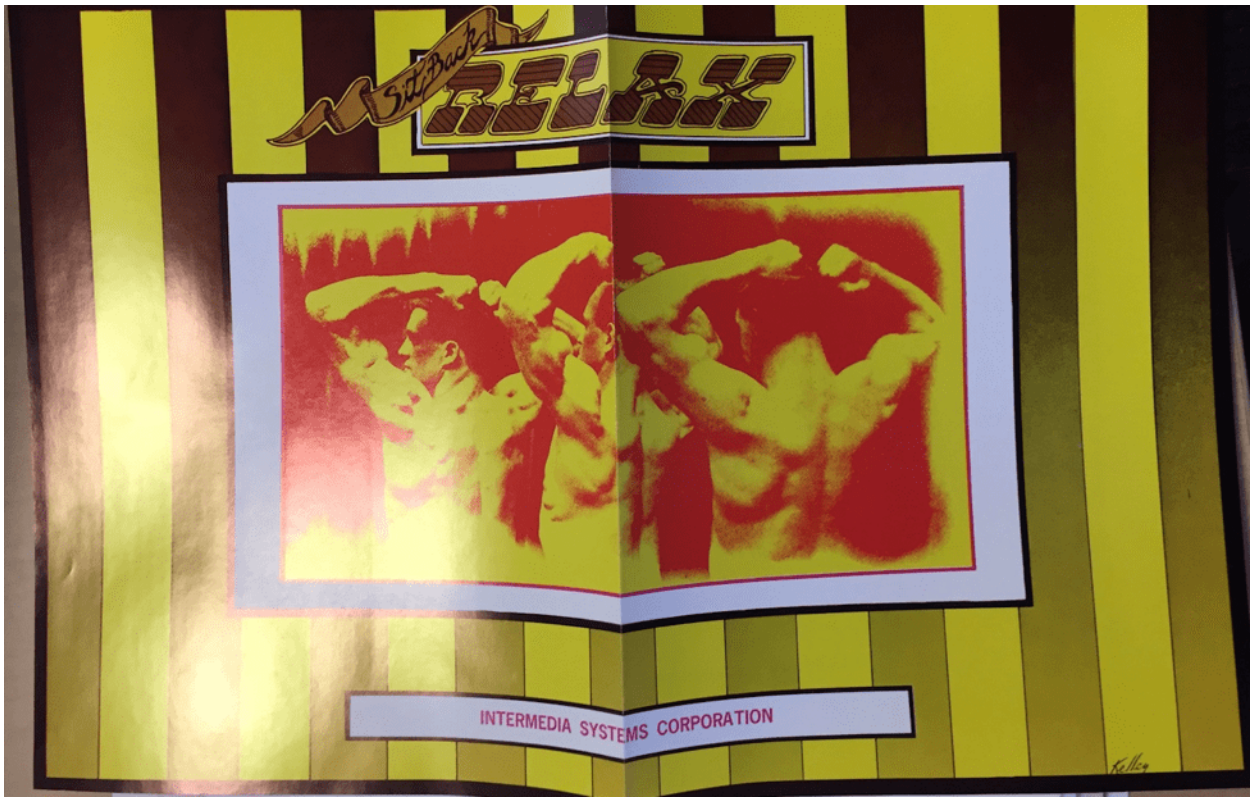


Figure 15
Intermedia Systems Corporation Brochure.
American Craft Council Library

Figure 16
Objects: USA exhibit installation view, 1969 / unidentified photographer.
Lee Nordness business records and papers, circa 1931-1992, bulk 1954-1984. Archives of American Art, Smithsonian Institution**.**

Figure 17
Receptionist at Castle desk in lobby.
Lee Nordness business records and papers, circa 1931-1992; 1.2: Artist's Files, circa 1938-1985.
Archives of American Art, Smithsonian Institution**.**

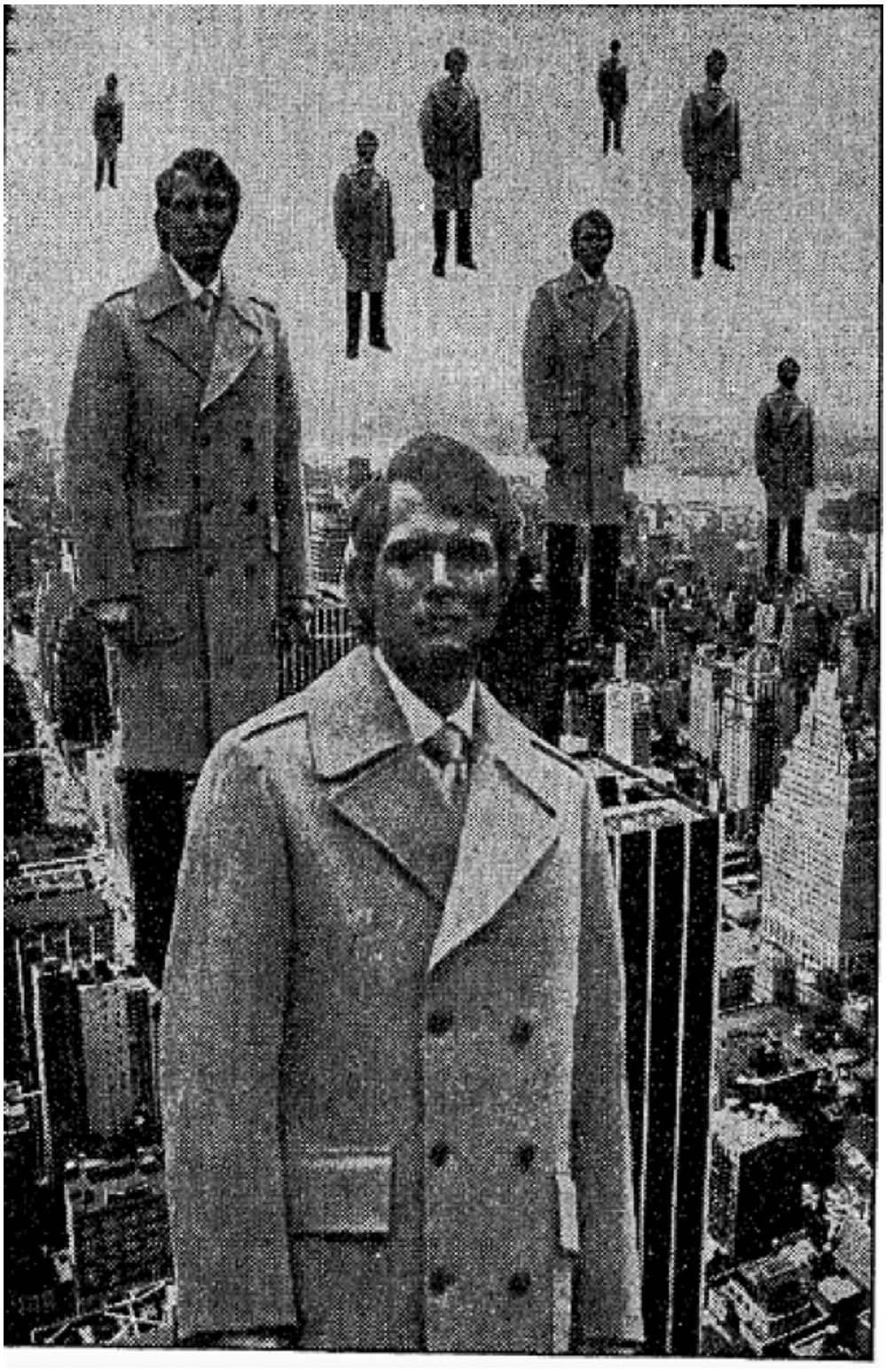


Figure 18
"Executive Blues: The Failure of the Successful," *The New York Times*, (June 3, 1973)

Figure 19
Wendell Castle, *Crossroads*, 2014. Photography by Bill Orcutt.
Courtesy of Wendell Castle and Friedman.

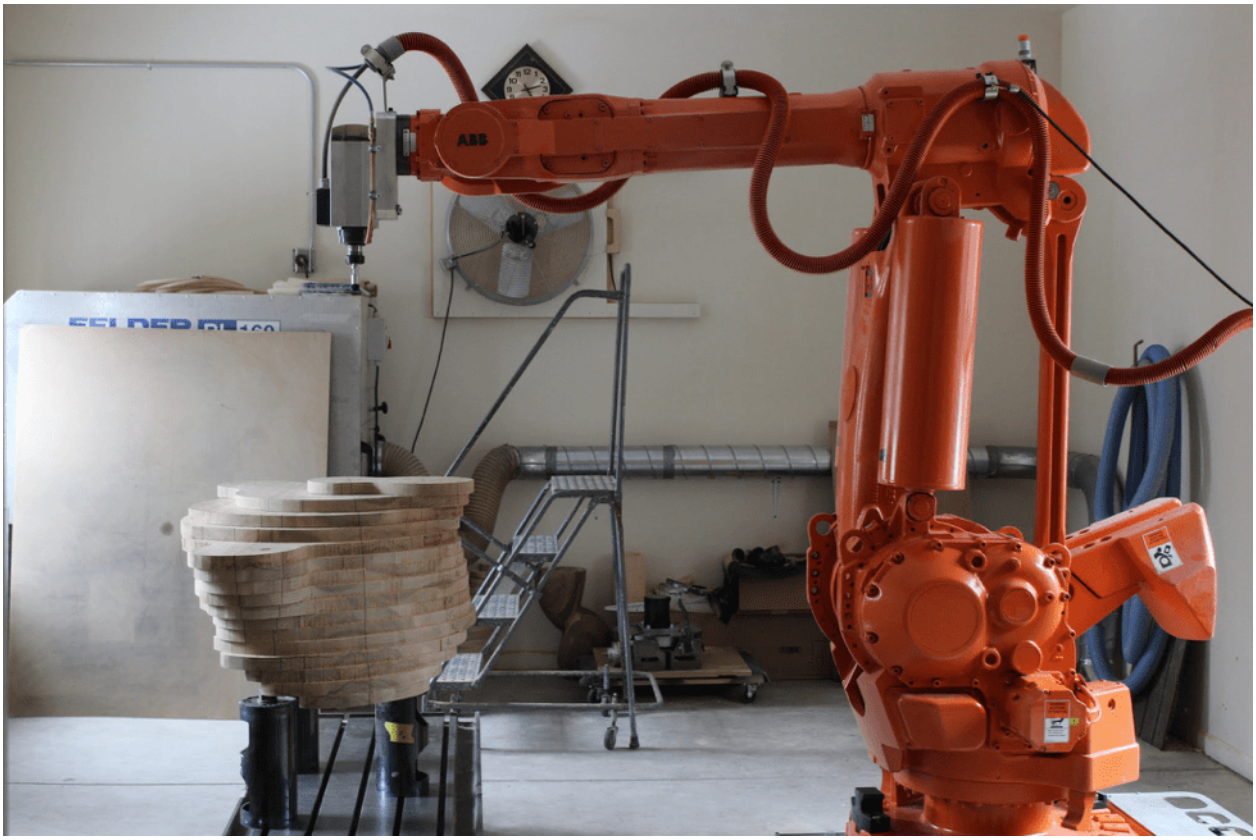


Figure 20
CNC machine fit with a router as it prepares *Long Night* for milling.
Courtesy of Amy Cheatle. Photography by Amy Cheatle.