

Designing the Bombshell:
Military-Industrial Materials and the Shaping of Women's Bodies
in the United States
1939–1976

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ABSTRACT

Designing the Bombshell: Military-Industrial Materials and the Shaping of Women's Bodies in the United States, 1939–1976

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This project analyses the relationship between the research and development of plastic materials for military and industrial use and their role in the shaping of women's bodies in the US, from WWII to 1976. How did changes in materials and surrounding technologies impact on the postwar fashionable, curvaceous white American 'bombshell' ideal, and vice versa? It explores how and why key actors in synthetic materials development and application, including US chemical companies, foundationwear brands and cosmetic and plastic surgeons, selected the female body as a site for employing new artificial materials and to showcase their potential uses to American and international audiences. Ultimately, the project seeks to understand the wider socio-political significance of the history and impact of plastics in the shaping of cis and trans women's bodies in the wartime and postwar US. In turn, this knowledge hopes to generate critical questions and perspectives on the use of materials and corporeal applications today.

Research focuses on three types of polymeric materials: nylon, polyurethane foam and silicone. Drawing on extensive original archival research from chemical corporations, plastic surgeons, foundationwear manufacturers, the American Medical Association, the Food and Drug Administration and legal/court collections and archives, it traces their development, actors, networks and application in the shaping of the bombshell on and under the skin. A central contribution of the research is to demonstrate how highly gendered and also racialised power structures, upheld and reflected in US military-industrial and medical networks of plastics, became inscribed upon and permanently embedded within women's bodies.

A key methodological contribution of the research is its focus on how materials' physical properties – their materiality – shape their use and meaning. It also offers a novel interdisciplinary and intersectional approach that combines design history's material- and artefact-led perspective with STS, fashion history, the history of medicine, material feminisms and critical theory of the body – traditionally dissociated but interlinked areas. It makes a key contribution to the histories of design, fashion, technology, medicine and the postwar US by articulating the granular, complex international military-industrial networks of power and disparate actors involved in the shaping of gendered bodies. *Designing the Bombshell* explores the gendered and racialised nature of plastic materials development, their legacy and relationship to ideal body image and shaping in the US today.

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Abbreviations

AMA	American Medical Association
ANT	Actor-network theory
<i>BMJ</i>	<i>British Medical Journal</i>
CGW	Corning Glass Works
DPA	DuPont Archives, Hagley Museum and Library, Wilmington, DE, US
FDA	Federal Drug Administration
GE	General Electric
GIC	Gender Identity Clinic
HCP	Herbert Conway Papers, Medical Center Archives, Weill Cornell Medicine, New York, NY, US
<i>JAMA</i>	<i>Journal of the American Medical Association</i>
JMP	Joseph Murray Papers, Harvard Center for the History of Medicine, Boston, MA, US
JPW	Jerome Pierce Webster Papers, Columbia University Health Science Library New York, NY, US
NMAH	Smithsonian National Museum of American History, Washington DC
NMAH TLC	Smithsonian National Museum of American History Trade Literature Collection, Washington, DC, US
<i>PRS</i>	<i>Plastic and Reconstructive Surgery Journal</i>
RAF	Robert Alan Franklyn Files, Series: 284 Franchises Frauds and Rackets, American Medical Association Archives, Chicago, IL, US
SHI	Science History Institute, Philadelphia, PA, US
STS	Science and Technology Studies
WWI	World War I
WWII	World War II

Introduction

In 1959, Robert Alan Franklyn, a Hollywood cosmetic surgeon, described his research for the development of ‘Surgifoam’, the plastic foam material he used for his ‘breastplasty’ operation (feminisation surgery to cosmetically augment the bustline).¹ In a number of books, Franklyn explained he was inspired by the foam he found in the seat upholstery of a captured German bomber plane in WWII, drawn to its unique spongy plastic materiality. Franklyn claimed that its lightness and resilience were unmatched by any other plastic foams commercially available in the United States (US) at the time. Franklyn eventually procured the seat and experimented with the foam’s cosmetic implantation in the female body.

Franklyn’s recollection sits at the intersection of science and technology, chemistry, design, the body, medicine and gender in the postwar US. It thus raises many important and interdisciplinary questions about the history of plastics, the practice of shaping the body and gender. As this thesis will show, his story embodies how changes in plastic material possibilities and medical technologies, both expedited through wartime demand and a socio-economic-political push for autarky, eventually impacted on the shaping of women’s bodies in the postwar period.

During the interwar period, WWII and the postwar years in the US, commentators, writers, filmmakers, artists, journalists, designers, advertisers and copywriters frequently compared women to weaponry. The fashionable heteronormative white female ideal promoted by Hollywood was increasingly sheathed in synthetics, and commonly referred to as a ‘bombshell’. This curvaceous bombshell, rooted in Hollywood culture, was exported to audiences all over the world, first embodied by the original bottle-blonde Jean Harlow, who starred in *Blonde Bombshell* (1933) and followed by countless busty icons, including Jayne Mansfield and Marilyn Monroe, as well as celebrated ‘bronze bombshell’ Vickie Henderson and Rita Hayworth, femme fatale star of *Gilda* (1946): a nuclear bomb, tested in Bikini Atoll,

¹ See Robert Alan Franklyn, *Developing Bosom Beauty* (New York: Frederick Fell, Inc., Publishers, 1959) and *Beauty Surgeon* (New York: Pyramid Royal, 1960). This thesis uses the term ‘feminisation’ for surgery and implants to refer to the practice of shaping women’s *bodies* with plastics for both cis *and* trans women, particularly for breast augmentation, as well as surgeries to enhance the buttocks and hips. It applies this term, usually exclusively used for surgically shaping trans women’s faces and bodies, in an inclusive way and to also argue that both cis *and* trans women were shaping their bodies to attain what they understood as a desirable feminine ideal. For queer and medical discussions on the use of the term feminisation surgery and who shapes these ideals see for example Cristina Richie, ‘A Queer, Feminist Bioethics Critique of Facial Feminization Surgery’ *The American Journal of Bioethics* 18.12 (2018), 33-35, and Jack Halberstam, *Female Masculinity* (Durham, NC: Duke University Press, 1998).

was named after the film and had Hayworth's photograph pinned to it. During WWII, US pilots named their bomber planes after their sweethearts and painted the sides with erotic female depictions. Conical bra designs, aggressively pointed, were named 'missile' or 'bullet', and when a highly revealing new two-piece style of women's swimwear was launched, it was called the 'bikini' after the nuclear testing site.² The 'bombshell', a term which came to denote curvaceous white cisgender women famously embodied by Hollywood stars such as Marilyn Monroe, Jane Russell and Jayne Mansfield, aligned the explosive development of military and industrial technologies capable of mass destruction with women's overt sexuality. As the research contexts section will outline, scholars of fashion, film, and American Studies have addressed the history of the 'bombshell' and her Hollywood context.³ This thesis, which originally took the bombshell as a starting point argues, however, that links between women's bodies and weaponry functioned, however, on a more than symbolic level and became materially and corporeally manifest via plastics research and development.

My research is concerned with exploring the ways in which materials and technologies advanced during a wartime push for material autarky in the US, as elsewhere, became culturally and materially inscribed upon and embedded within the gendered female body in the postwar US. I ask: what materials shaped the bombshell, and how did their materiality affect the shaping of the curvaceous ideal and its reality as experienced by women? I analyse the relationship between the research and development of synthetic materials for military and industrial use and modifications to women's bodies in the US from 1939 to 1976. I explore how and why key actors in synthetic materials' development and application, including US chemical companies, foundationwear brands and cosmetic surgeons, selected the female body as a site for employing new artificial materials and as a showcase for their exposure to American and international audiences. To do this, my thesis employs actor-network theory (ANT) and an intersectional approach to material feminist methods to analyse original archival material and explore how the bombshell's intersection

² French designer Louis Réard unveiled his 'bikini' design in France in July 1946. See Patrik Alac, *The Bikini: a Cultural History* (New York: Parkstone Press, 2002).

³ See for example Stephanie Smith 'Bombshell', in Stephanie Smith, *Household Words* (Minnesota, MN: Minnesota University Press, 2006) pp. 69 – 96; Elaine Tyler May, *Homeward Bound: American Families in the Cold War Era* (New York: Basic Books, 1988); Buszek, Maria Elena *Pin-Up Grrrls: Feminism, Sexuality, Popular Culture* (Durham, NC: Duke University Press, 2006). White blonde bombshells Marilyn Monroe and Jayne Mansfield are also discussed in Stephen Gundle *Glamour: a History* (Oxford: Oxford University Press, 2006); Carole Dyhouse *Glamour: Women, History and Feminism* (London: Zed Books, 2011).

of the body and technology functioned not just on a symbolic, representational level: the connections between weaponry and 'livingry' colonised and impacted on gendered flesh.⁴ It explores the gendered and racialised nature of plastic materials' development and legacy and their relationship to ideal body image and shaping in the US.

The thesis focuses on three types of polymeric materials – nylon, plastic foam and silicone – tracing their development, actors, networks and application in the shaping of women's bodies. Nylon, unveiled by explosives manufacturer DuPont in 1939, became the first highly technical material to be launched on the domestic women's intimate apparel market. Plastic foams made of wartime rubber substitutes were later moulded into 3D objects and used to augment women's bodies through the use of 'falsies'.⁵ Silicone, an engine lubricant developed to aid the war effort, was later used in cosmetics and relaunched in the mid-1960s for use in breast augmentation surgery. A key issue for the thesis is how polymeric materials research and development (R&D) and production, exemplified by nylon, polyurethane foam and silicone, was connected to the military-industrial complex. These polymeric materials were initially independently developed in industrial labs for commercial production, and it was only after their creation that the military increasingly took note and commissioned them for supply as the war continued.

In the thesis, I explore how DuPont and others presented a momentous vision of a future breed of glamorous white women whose wardrobes *and* bodies could be designed and crafted from materials originating in the chemist's lab. *Designing the Bombshell* explores how this rhetoric is echoed in the history of other polymeric materials created in the lab during this period. Specifically, I demonstrate how chemists, chemical company advertising and sales divisions, designers and surgeons transferred the technology from industrial and military uses to gendered fashionable and corporeal applications, first on the skin's surface via foundationwear and then within it via feminisation implants and cosmetic procedures.

⁴ American architect and design theorist Richard Buckminster Fuller coined the term 'livingry' to mean the opposite of weaponry see *Critical Path* (1st ed.) (New York: St. Martin's Press, 1981) p.xxv.

⁵ Falsies became a frequently used term in the 1940s and 1950s US to describe padded inserts (usually made of rubber, plastic foam, as well as fabric) that provided extra bolstering to enhance the appearance of size and shapeliness of the body, most commonly applied to the shaping of the breast when placed in bras, as well as less frequently of the buttocks when inserted in other foundationwear items. See also 'Falsie.' *Merriam-Webster.com Dictionary*, Merriam-Webster, <https://www.merriam-webster.com/dictionary/falsie>. Accessed 23 Jun. 2020.

The relationships connecting plastic and cosmetic surgery are another core theme. It is worth noting that in the period under study the latest developments in plastic materials were also celebrated as miracles of science. Furthermore, these surgeries increasingly benefited from plastic materials that became available as the two disciplines flourished. A wide range of polymers have found uses in biomedical applications. Before the 1930s, materials in medical applications were limited to those found naturally, such as glass, wood and metals. Advances in polymer science unlocked a greater range of previously unavailable materials. These synthetic discoveries were very different from their predecessors: they offered physical properties more closely resembling biological tissue, and found popular application as implantable biomaterials. Plastics increased in use and application, as implantable materials were also facilitated by the development of antibiotics, which decreased mortality rates, thereby increasing the demand for prostheses.⁶ Advances in surgery and medicine shaped plastics R&D: they created an ongoing demand for biomaterials, in relation to both the need for new materials and the scope of their application. Many polymeric biomaterials from this period were 'grandfathered in' with the Medical Device Regulation Act, and are still in use today.⁷

This thesis shows how in the postwar period women's bodies became increasingly malleable through the use of plastics developed within an international network of military-industrial materials R&D. It explores and consider a diverse set of actors within this network, including decisionmakers in the US military, the Federal Drug and Food Administration (FDA) and the American Medical Association (AMA), petrochemical company representatives, cosmetic and plastic surgeons, 'quacks' masquerading as medical practitioners, chemists, beauty salon workers, film directors, advertising agencies, female consumers, human flesh, actresses, sex workers, exotic dancers, journalists, go-go club owners, dermatologists, fashion designers, photographers, and Hollywood agents and producers.

My study takes as its starting point the arrival of DuPont's 'Test Tube Lady' in 1939, as harbinger of the commodified female body clothed and shaped by plastics, at an exhibit

⁶ Nina M. K. Lamba, *Polyurethanes in Biomedical Applications* (Boca Raton, FL: CRC Press, 1998), p.6.

⁷ After the passing of the Medical Device Regulation Act of 1976 materials such as silicone and urethane foam were 'grandfathered in'. This means that many polymeric materials such as silicone were transferred over into the FDA's new Medical Devices legislation even though they may have not passed some of the new formal regulatory framework for the testing of materials for human implantation. Materials such as silicone were able to circumnavigate this simply by the fact that they were already there, and their risks already identified.

viewed by over ten million visitors.⁸ I argue that her appearance marked the advent of a new age of plastics R&D in the US, closely mapping changes in material technologies onto the sheathing and shaping of the fashionable ideal female. I explore how this historical moment established a paradigm of women's bodies, polymeric materials research, science, chemistry and the lab, fashion, glamour, industry, the military and munitions companies. The existing scholarship on nylon articulates these connections; this thesis, however, seeks to explore these intersections in greater depth and in relation to other polymeric materials developed in the same period.

The thesis ends in 1976: by this point, it was becoming clear that materials initially considered to be 'inert', and therefore benign when implanted into the body, could eventually have dangerous consequences for health. In the 37 years that passed after the Test Tube Lady introduced DuPont's polymeric advancements to the public on the surface of her skin as glamorous and innovative, plastics increasingly shaped women's bodies from within, eventually resulting in the passing of a law to regulate the industry of permanent body sculpting, directly affecting millions of Americans. The introduction of the US Medical Device Regulation Act in 1976 marked a pivotal shift in US legislation on implants. Before 1976, the FDA, tasked in 1938 with regulating and overseeing medical products, had limited jurisdiction over medical devices, whose production and application had been increasing ever since.⁹ In 1976, the Medical Device Regulation Act was passed, intended to provide reasonable assurance, risk-based classification and formal safeguarding criteria for medical device safety and effectiveness.¹⁰ Regulatory pathways and procedures were introduced for new medical devices, as well as post-market requirements.¹¹ Finally, the FDA were given the authority to ban devices and thereby legally regulate what could and could not be implanted

⁸ 2,058,199 visitors were counted at the DuPont 1939 San Francisco display, 'History of Dupont Exhibits 1935 -1945 Notes on 1939 SFWF display', and 9,734,408 at the New York display, 'History of Dupont Exhibits 1935 -1945' NYWF summary report, both DPA, Accession 1410, box 58.

⁹ U.S. Food and Drug Administration, 'A History of Medical Device Regulation and Oversight in the United States', *FDA: US Food and Drug Administration*, 24 June 2019, available at: <https://www.fda.gov/medical-devices/overview-device-regulation/history-medical-device-regulation-oversight-united-states> (accessed 16 December 2019)

¹⁰ In 1970, President Nixon established the Cooper Committee, chaired by Theodore Cooper MD (then director of the National Heart and Lung Institute) to investigate the adverse effects of medical devices for human application and need for legislation. The Cooper Committee recommended the introduction of new legislation tailored to devices, which faced different issues to those of drugs and therefore demanded their own regulatory laws and classification system based on comparative risk.

¹¹ All medical devices not on the market before May 28, 1976 or that had been 'significantly modified' in order to get to the market were now subject to 'premarket approval' and 'premarket notification'. Regulatory procedures were also established for new investigational medical devices to be studied in patients (Investigational Device Exemption IDE). The act additionally resulted in several important post-market requirements including establishment, registration and listing of devices with the FDA, Good Manufacturing Practices (GMPs), and reporting of adverse events involving medical devices.

in the body. This marked the end of a largely unregulated market of actors in chemical companies, medicine and cosmetic surgery experimenting with plastic materials in the body, which had experienced rapid change and expansion in the postwar US and changes to the understanding and technical possibilities of the body as a site of auto-design; after 1976, the application of new materials in the body had to follow clear standards and regulations.

Research Questions and Intended Contributions

Taking a materials-centred approach, this thesis asks: what impact did the materiality of nylon, polyurethane foam and silicone have on decisions to use them on and with women's bodies in wartime and postwar America? Second, how and why did key actors, particularly chemical companies, choose to associate synthetic materials with the female body? Building on this question, how and why did key actors in synthetic materials research, development and use promote military-industrial related synthetic materials for use on and in women's bodies? And did the gender of actors in synthetic materials development, design or production impact outcomes, and if so, what impact did it have? A third major question concerns how material-based historical research can be used to provoke critical thinking about the use of synthetic materials in relation to bodies and gender.

Overall, the central contribution and purpose of this study is to combine a rigorous archival method with an intersectional and interdisciplinary approach to offer new perspectives on the politics of plastics and the body politic.¹² This project's findings build on plastics and postwar American design scholarship by giving in-depth consideration to the body, gender and materiality. It also expands foundational histories of cosmetic surgery by incorporating consideration of plastics' materialities and military-industrial provenances.

The contributions can be grouped into two central areas: empirical and archival findings, and contributions in the form of methods and methodology. The primary contribution of the thesis is to identify and analyse the relationship between the research and development of plastic materials for military and industrial use and their role in the shaping of women's bodies in the US, from WWII to 1976. It makes an original contribution to scholarship in gender history, history of design, history of technology, history of medicine

¹² It is important to note here that these two areas are symbiotic and cannot be imagined without each other. The research questions necessitated an interdisciplinary and intersectional approach utilising a wide range of empirical archival research. This required accessing material in multiple archives and generating and employing an appropriate critical methodological framework to underpin interpretation, analysis and arguments. The research stance underlying the work thus recognises intersectionality as key to understanding historical situations, and interdisciplinarity as crucial for analysing them effectively.

and military history in the postwar US by investigating how changes in these materials and their surrounding technologies impacted the shaping of racialised postwar gender ideals for women, and vice versa. In order to do this, it explores how and why a disparate group of key actors in synthetic materials development and application, including US chemical companies, foundationwear brands and cosmetic and plastic surgeons, selected the female body as a site for employing new artificial materials and to showcase their potential applications to American and international audiences. The empirical information and original arguments that emerged from this archival research make a major contribution to the potential public understanding of cosmetic surgery and chemical (or plastics) manufacturers in the postwar US. At the level of argument, the thesis also aims to use the archival findings to demonstrate how highly gendered and also racialised power structures, upheld and reflected in US military-industrial networks of plastics, became inscribed upon, and permanently embedded within, women's bodies.

The second key area of contribution is methodological and based on the thesis' focus on how materials' physical properties – their materiality – shape their use and meaning. The thesis models a novel interdisciplinary approach that combines design history's material- and artefact-led perspective with perspectives and questions from STS, fashion history, the history of medicine, material feminisms and critical theory of the body – traditionally dissociated but interlinked areas. By methodologically (re)connecting the history of plastics more closely with materiality, the body and corporeality, the thesis is able to provide new modes for other scholars who may seek to understand and represent the impact of materiality on women's lived experiences within uneven power structures, whether in conventionally more empirical areas like the history of medicine or more theoretical ones like material feminisms.

It should also be noted that the contribution here is not to studies of race and ethnicity, specifically, but instead to insist that bodies are racialised, just as they are gendered, and that all scholarship in social history, whether explicitly 'on' race or not, must address this.¹³ Although the thesis' focus is on gender, the racialised dimension of the bombshell cannot be ignored. As demonstrated by the inclusion of the term cisgender, the

¹³ As the introduction to the thesis will later note, intersectional black feminist theory and critical race scholarship has heavily informed this thinking. Sara Ahmed writes 'we cannot isolate the production of racial bodies from the gendering and sexualizing of bodies', 'Racialised Bodies' in Mary Evans and Ellie Lee (eds.) *Real Bodies: a Sociological Introduction* (Basingstoke: Palgrave, 2002) pp. 46-63, p. 46.

thesis intends to question and address ‘unmarked norms’ of woman.¹⁴ I do not claim a contribution to studies of race and ethnicity, however, I *am* arguing for the importance of their greater inclusion and consideration in histories of design and the fashioned body.

The three research questions and the aims for contributions to scholarship given above guided the thesis and its original archival research. In the course of my research and its grappling with these sources, however, new questions and areas of investigation opened up, for example on the complexities of material provenance and the international transfer of technology. Whilst the initial questions have held true, my primary research also indicated new areas to explore related to each specific material. DuPont’s Advertising Division papers at the Hagley Museum and Library revealed the complexity of decision-making around the Test Tube Lady and women’s agency in DuPont’s presentation of nylon on the female body. Reports documented a feedback loop between female visitors to the company’s 1939 ‘Wonder World of Chemistry’ displays and the Advertising Division, rather than a series of ‘top-down’ decisions by male executives. My research into the provenance of polyurethane foam identified primary sources at the Science History Institute (SHI) and the Library of Congress, revealing previously unstudied material on its US-military-assisted technology transfer from Germany. Military papers, including Quartermaster Reports, reveal how foam’s materiality invited corporeal interaction and was an important impetus in its appeal to touch. Polyurethane foam’s materiality later shaped women’s idealised and pathologised bodies in the interwar, wartime and postwar periods, both externally via foundationwear and internally via implants. Oral histories of competing chemists at SHI enabled me to explore in detail the military origins of silicone’s production and trouble Dow Corning’s victor narrative as ‘First in Silicones’. Surgeons’ papers and correspondence supported my mapping and exploration of Dow Corning’s Center for Aid to Medical Research and the Dow Corning Silicone Committee’s national and international network and its impact on women’s bodies.

A greater diversity of actors than I initially imagined emerged, ranging from chemists to sex-workers, petrochemical company sales executives, beauty salon workers and medical practitioners. My initial focus on the US became more complex as stories of material development and application in Germany and Japan, for instance, and their relationship to

¹⁴ Susan Stryker *Transgender History: the Roots of Today’s Revolution* (Second Edition) (Boston, MA: Seal Press, 2017) p. 13

US trade and military intervention, shed new light on the domestic situation in the US. In particular this supported my thinking about a racialised dimension, which prompted further thought on US racialised politics of the body. In addition, trans women crystallised as an important group of actors in the story, particularly as they have largely been omitted from histories of cosmetic surgery.¹⁵ This is why I have explicitly stated in the introduction that ‘feminisation’ procedures to augment women’s bodies with plastics are undertaken by trans *and* cis women.

Research Contexts

One key research context for the thesis is renewed attention to the destabilisation of dominant identity categories as a political act towards addressing social power imbalances in the historical narrative and today. Through the thesis, the text refers to ‘cisgender’ women.¹⁶ Originally rooted in trans activism, cis is also intended to name the typically unstated or assumed privilege of being nontransgender. The concept behind the term is to ‘resist the way that “woman” or “man” can mean “nontransgender woman” or “nontransgender man” by default, unless the person’s transgender or nonbinary status is explicitly named’.¹⁷ As trans theorists including Susan Stryker have critiqued, ““woman” typically has been mobilised in ways that advance the specific class, racial, national, religious, and ideological agendas of some feminists at the expense of other women.”¹⁸ The original motivation behind the term ‘cis’ in trans activist communities was therefore one of intersectionality and to dismantle exclusionary assumptions of what ‘woman’ or ‘man’ is, in

¹⁵ For example, neither Elizabeth Haiken, *Venus Envy: A History of Cosmetic Surgery* (Baltimore, MD: Johns Hopkins University Press, 1997) nor Nora Jacobson, *Cleavage: Technology, Controversy, and the Ironies of the Man-made Breast* (New Brunswick, NJ: Rutgers University Press, 2000) include trans women in their histories of breast augmentation.

¹⁶ Cisgender, also known as cis, is a word that first came into usage in the twenty-first century. Accounts vary as to who coined the term ‘cisgender’, however, it is generally accredited to the US biologist Dana Leland Defrosse, as well as Dutch trans activist Carl Buijs, who first used the term in the mid 1990s to refer to people who feel aligned with their sex assigned at birth. Trans activist Julia Serano’s 2007 *Whipping Girl* is credited with popularising the term. The term derives from the Latin-derived prefix ‘cis-’ meaning on the same side as (i.e. the opposite of trans- which means across). See Stryker, 2017; A. Finn Enke ‘The Education of Little Cis: cisgender and the discipline of opposing bodies’ in Susan Stryker and Aren Aizura (eds.) *The Transgender Studies Reader 2* (London: Routledge, 2013) pp. 234–244; Avery Dame ‘Tracing Terminology Researching Early Uses of Cisgender’ *Perspectives on History: the News Magazine of the American Historical Association* May 22 2017 <https://www.historians.org/publications-and-directories/perspectives-on-history/may-2017/tracing-terminology-researching-early-uses-of-cisgender> [accessed 8 June 2020]; Monica Roberts ‘Cisgender Isn’t an Insult’ *TransGriot* July 10 2009 <https://transgriot.blogspot.com/2009/07/cisgender-isnt-insult.html> [accessed 8 June 2020]; Stonewall, ‘Stonewall Glossary’ <https://www.stonewall.org.uk/help-advice/faqs-and-glossary/glossary-terms#c> [accessed 8 June 2020]. It should be noted here that transgender is a word whose widespread usage has similarly only come into being in the past few decades. Just as its core definition is rooted in movement away from an assigned, unchosen gender position, its meanings are still under construction. My use of transgender therefore follows in Stryker’s definition of transgender to ‘refer to the widest imaginable range of gender-variant practices and identities.’ Stryker, 2017, p. 39.

¹⁷ Stryker, 2017, p. 13.

¹⁸ Susan Stryker, ‘(De)subjugated Knowledges: An Introduction to Transgender Studies’ in Susan Stryker and Stephen Whittle (eds.) *The Transgender Studies Reader* (London: Routledge, 2006) pp. 1-18; p. 7.

the same logic that would 'lead somebody to prefer saying "white woman" and "black woman" rather than simply using "woman" to describe a white woman (thus presenting white as the unmarked norm) and "black woman" to indicate a departure from the norm.'¹⁹ This intersectional feminist approach can be understood as in conversation with the formative work of black feminists and critical race theorists including Audre Lorde, Kimberlé Crenshaw, Patricia Hill Collins and Sirma Bilge.²⁰

However, it is important to note that the term cisgender, is as Stryker puts it, 'not without conceptual contradictions or weakness of its own'.²¹ Its rigid usage can encourage a different type of gender binary: cis versus trans.²² Furthermore, this binary can exclude some intersex people, as critiqued by scholars including intersex activist Hida Vioria.²³ Such fixed application can 'align binary and cis with the cultural politics of normativity and nonbinary and trans- with notions of transgression or radicalness, when in fact the politics of normativity and transgression cut across both cis and trans categories.'²⁴ My usage of the terms cis and trans does not seek to foster a different kind of gender binary. I recognise that all individuals are subject to 'non-consensual social gendering practices that privilege some and discriminate against others'.²⁵ Indeed, I argue in the final chapter that plastics' trans-corporeality also gave agency to women who did not neatly fit into conventional ideas of heteronormativity, regardless of sex assigned at birth. By using the terms cis and trans I do *not* seek to reinforce an alternative type of gender binary, however, as an intersectional historian and feminist, I *do* think it is important to address that the use of 'women' in the established scholarship and history tends to present a white female assigned at birth as the assumed unmarked norm and is thereby exclusionary and this demands to be unpacked,

¹⁹ Stryker, 2017, p. 13.

²⁰ See for example Audre Lorde, 'Age, Race, Class and Sex' in *Sister Outsider: Essays and Speeches* (Freedom, CA: The Crossing Press, 1984); Kimberlé Crenshaw, 'Demarginalizing the intersection of race and sex: A Black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics' *The University of Chicago Legal Forum* (1989), 139-166; Kimberlé Crenshaw, 'Beyond Racism and Misogyny: Black Feminism and 2 Live Crew' in Mari J. Matsuda and Charles Lawrence III (eds.) *Words that Wound: Critical Race Theory, Assaultive Speech, and the First Amendment* (Boulder: Westview, 1993) 111-132; Patricia Hill Collins and Sirma Bilge, *Intersectionality* (Cambridge: Polity, 2016).

²¹ Stryker, 2017, p. 13.

²² See Enke, 2013.

²³ See Hida Vioria, 'Caught in the Gender Binary Spot Intersex Erasure in Cisgender Rhetoric (18 August 2014) accessed 8 June 2020 <https://hidavioria.com/caught-in-the-gender-binary-spot-intersex-erasure-in-cisgender-rhetoric/>; Cary Gabriel Costello 'Beyond Binary Sex and Gender Ideology' in *The Oxford Handbook of the Sociology of Body and Embodiment* (January 2019) accessed 9 June 2020 <https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780190842475.001.0001/oxfordhb-9780190842475>

²⁴ Stryker, 2017, p. 13.

²⁵ Ibid, p. 14.

questioned and challenged. This 'unmarked norm' has resulted in the erasure of many groups including trans women and women of colour from history.

My use of the terms cis and trans are motivated by the need to be *inclusive* rather than binary or exclusionary. By engaging in ongoing debates within queer and trans theory, I use these terms (which are themselves in a state of flux) to revise and draw attention to exclusionary assumptions made in historic sources and scholarship. Indeed, the intention of my use of the term cis is not to sustain discriminatory and simplistic binaries but instead to destabilise them and draw attention to the fact that exclusionary assumptions in fact render women, particularly trans women and women of colour, invisible in history, effectively erasing them, which needs to be addressed, unpacked and dismantled. It is only through this ongoing work of identification and recognition that we can make an intervention and write more inclusive histories of women.

Another key context for the thesis is the scholarship on femininity and gender norms in the postwar US: the bombshell is useful here. The term bombshell to describe a woman first became popular in the US in the 1930s, embodied by Jean Harlow in the movie *Blonde Bombshell* (1933).²⁶ However, the gendered image of the bombshell acquired new currency with the arrival of the 'nuclear' age following the catastrophic events in Japan which ended WWII. During the Cold War, America's nuclear dominance was cast not only as threat but also as progress in terms of scientific advancement. As American studies scholar Elaine May (1988) has noted, in prevailing US ideology of this period female sexual potency was seen as explosive when it was outside the home with no strong male authority to control it.²⁷

Wartime work and the reduction in numbers of men available for work within the US had given women increased opportunities; their increasing sexual and economic emancipation was considered a threatening combination to patriarchal norms and traditional structures. May argues that just as nuclear power could be harnessed for the greater good, so too could the bombshell's alluring powers. Marriage and domesticity could put her power to 'good use', benefiting US Cold War society by appeasing husbands and

²⁶ Elaine Tyler May, *Homeward Bound: American Families in the Cold War Era* (New York: Basic Books, 1988), p. 106, and Stephanie Smith 'Bombshell', in Stephanie Smith, *Household Words* (Minnesota, MN: Minnesota University Press, 2006) pp. 69 – 96.

²⁷ May, 1988. For more on transwar and postwar US gender roles see Karen Anderson, *Wartime Women: Sex Roles, Family Relations and the Status for Women During World War II* (Westport, CT: Greenwood Press, 1981); Joanne Meyerowitz, 'Beyond the Feminine Mystique: A Reassessment of Postwar Mass Culture, 1946 – 1958' in *Not June Cleaver: Women and Gender in Postwar America, 1945 -1960*, ed. by Joanne Meyerowitz (Philadelphia, PA: Temple University Press, 1994), pp.229-262.

raising children according to traditional gender roles.²⁸ Asserting a sexualised, commodified female as a symbol of US freedom could tackle the threat of sexually ‘perverse’ Communism as ‘other’ to wholesome American patriarchal, capitalist values.²⁹ The bombshell trope was both a threat to patriarchal norms and a product of it. In the context of the Cold War, the conflation of the bombshell with US consumerism and democracy in the face of Communism became political. In *Cold War Modern* (2008), design historians Jane Pavitt and David Crowley argue there was a ‘doubling’ effect in Cold War culture which saw that which was a ‘threat’ also framed as ‘progress’, even desire. The threatening potential of the bombshell was thus harnessed and controlled through propaganda, Hollywood and domestication.

The bombshell, and the fashions she embodied, signalled a tension of overt sexuality and eroticism, constructed by and contained within restrictive foundationwear and white American heteronormative social norms, but one that also had the potential to disrupt them. As critical theorist Paul B. Preciado (2014), Elaine May (1988) and etymologist Stephanie Smith (2006) observe, the bombshell as a single, unmarried woman was particularly dangerous to the establishment.³⁰ Characterised by institutions such as the American Social Hygiene Association as a potential carrier of sexually transmitted diseases and linked to miscegeny, communism and careerism, she was understood as a threat to the suburban white nuclear family home.³¹ Smith’s study argues that the bombshell has an explosive potentiality under a surface that lies dormant. It embodies female sexuality as something deadly and powerful, yet also controllable and available for capitalist consumption. The vital thus becomes deadly and the deadly becomes alluringly vital, as long as it is harnessed for society’s benefit and employed to destroy the ‘other’. May’s and Smith’s discussions of the bombshell are focused on the representational. However, in this thesis I extend this by also considering the material embodiment of the term: the ways in which military materials shaped and controlled women’s bodies.

²⁸ For more on this see, for example, May, 1988; Beth L. Bailey, *From Front Porch to Back Seat: Courtship in Twentieth Century America* (Baltimore, MD: Johns Hopkins University Press, 1989).

²⁹ May, 1988 writes extensively on the perceived threat of transgressive gender roles that became politically linked to Cold War Communist Eastern ideology. See also Craig Loftin, ‘Unacceptable Mannerisms: Gender Anxieties, Homosexual Activism, and Swish in the United States, 1945-1965’ *Journal of Social History* 40 (Spring 2007): 577.

³⁰ May, 1988; Smith, 2006; Paul B. Preciado, *Pornotopia: An Essay on Playboy’s Architecture & Biopolitics* (New York: Zone Books, 2014).

³¹ See May, 1988; Preciado, 2014.

In *Reducing Bodies*, US cultural historian Elizabeth Matelski writes about changes to the healthy and fashionable ideal in the postwar US.³² Her study provides a useful example of recent work on this subject: covering well-rehearsed arguments around women's bodies relating to the influential nature of the mass media, she looks at the fashion industry, Hollywood and, less predictably, insurance companies, to better understand changes in what constituted a 'healthy' woman's body. Although her study has some interdisciplinary aspects, Matelski's primary interest is in the changing social and cultural meanings attached to the ideal female figure, which she largely explores through discussions of mass culture representations. This goes some way towards addressing sociologist Joanne Entwistle's original argument in *The Fashioned Body* (2000, 2015)³³ for the (continued) need to address the body within fashion studies, and to employ interdisciplinary methods to connect a range of scholarship, which I fully support. Matelski manages to do this to a certain extent by also considering changes in ideal weight as stipulated by US health insurance companies; however, unlike this thesis, her focus again remains on the representational rather than on the *material or corporeal*.

This thesis has also drawn on fashion histories of foundationwear that consider the material and the fashioned body. In *Uplift: the Bra in America* (2002) American fashion historian Jane Farrell-Beck and US fashion conservator Colleen Gau offer an immensely detailed chronological account of the bra: its changing design and production in the US from 1890 to 1970. This has provided an invaluable contribution to the study of the bra, an object previously neglected in serious academic study in favour of more extreme body-shaping devices such as the corset.³⁴ However, although *Uplift* provides an exhaustive account of the bra in the US, its dress history approach does not enable critical explorations of the bra within a wider cultural context, other than a linear discussion of its role within foundationwear production and fashion. Indeed, *Uplift's* wealth of statistics and primary sources specifically related to the bra, combined with a time span of almost one hundred years, do not enable much contextualisation. Another useful text for understanding the

³² Elizabeth Matelski, *Reducing Bodies: Mass Culture and the Female Figure in Postwar America* (New York: Routledge, 2017).

³³ Joanne Entwistle, *The Fashioned Body: Fashion, Dress and Modern Social Theory* (2nd edn.) (Cambridge: Polity, 2015).

³⁴ Much scholarly attention has been paid to the corset: see, for example, David Kunzle, *Fashion and Fetishism* (Totowana, NJ: Rowman and Littlefield, 1982); Valerie Steele, *The Corset: a Cultural History* (New Haven, CT: Yale University Press, 2001).

'bullet bra' is Marilyn Yalom's *A History of the Breast* (1998),³⁵ which provides a cultural history of the breast in Western society, including changing perceptions of beauty. Jill Fields³⁶ offers a more theoretical and feminism-informed approach in her historical discussion of the bra and underwear. Fields' approach is grounded in primary sources, perhaps less extensive than those of *Uplift*: it seeks to explore these from a critical perspective and thematic approach, contrasting with Farrell-Beck and Gau's chronological methods. This enabled Fields to tackle more complex socio-political explorations of the bra, such as her discussion of intimate apparel workers and union culture, as well as the corporeal, in her examination of the meaning of black lingerie and sexuality. Fields' theoretical approach, however, does not incorporate wider historiographies and primary sources, such as those of science and medicine; again, this means that my thesis makes an original contribution to knowledge. Lipi Begum's 'Bras are Not for Burning: the Bra and Young Women in Delhi and Bombay' (2018)³⁷ offers a different model of research. Her concise but critically engaged study of the bra in India explores fashion history, decolonialism, sexuality, gender and the body. This thesis combines the rigour of Farrell-Beck's and Gau's approach to primary sources with Yalom's, Fields' and Begum's cultural and theoretical thematic approaches, attending particularly to the importance of addressing the 'fashioned body' (i.e. the bodies that do the wearing) suggested by Entwistle. It employs an interdisciplinary empirical archival approach and grapples with the theoretical, material, representational, political, scientific and cultural to address plastics' physical impact on the shaping of women's bodies.

The military-industrial complex is a key theme within this thesis.³⁸ As Science and Technology Studies (STS) historian Ruth Schwartz Cowan (1997) has argued, WWII was the

³⁵ Marilyn Yalom, *A History of the Breast* (New York: Ballantine Books, 1998).

³⁶ Jill Fields, *An Intimate Affair: Women, Lingerie, and Sexuality* (Berkeley, CA: University of California Press, 2007).

³⁷ Lipi Begum, 'Bras are Not for Burning: the Bra and Young Women in Delhi and Bombay', in Lipi Begum, Rohit K. Dasgupta and Reina Lewis (eds.) *Styling South Asian Youth Cultures* (London: I.B. Tauris, 2018), pp. 202-222.

³⁸ US President Dwight D. Eisenhower is credited with coining the term 'military-industrial complex' in his 1961 Farewell Speech. For more on the historical development of the US Cold War military-industrial complex, see Katherine C. Epstein, *Torpedo: Inventing the Military-Industrial Complex in the United States and Great Britain* (Cambridge, MA: Harvard University Press, 2014); Stuart W. Leslie, *The Cold War and American Science: The Military Industrial-Academic Complex at MIT and Stanford* (New York: Columbia University Press, 1993); Carol Pursell, *The Military-Industrial Complex* (New York: Harper and Row, 1972); Pap A. Ndiaye, *Nylon and Bombs: DuPont and the March of Modern America* (Baltimore, MD: Johns Hopkins University Press, 2007); Charles J. Hitch and Roland N. McKean, *The Economics of Defense in the Nuclear Age* (Cambridge, MA: Harvard University Press, 1960); Paul A. C. Koistinen, *The Military-Industrial Complex* (Santa Barbara, CA: Praeger, 1980). Ruth Schwartz Cowan *A Social History of American Technology* (New York: Oxford University Press, 1997) frames the military-industrial complex as part of a wider historical legacy of the US government as major sponsor and agent of technological change.

first in which US scientists and engineers were almost fully mobilised for the war effort.³⁹ In 1941 President Roosevelt established the Office of Scientific Research and Development (OSRD), a new organisation which employed engineers and scientists to support the crucial role R&D was going to play in the war effort. Connections between technology, warfare, government and industrial R&D changed profoundly during WWII and the postwar years.⁴⁰ During this period these links were extended and reinforced to the point where they began to dominate all aspects of social, economic and political life in the US.

The concept of autarky (self-sufficiency and economic dependence from foreign trade) is also crucial for understanding governmental funding for technological material advancements within what was later to become known as the military-industrial complex, particularly in regards to plastics. In the interwar and WWII period, material shortages resulting from increasing destabilisation of colonial powers and political conflict increasingly attracted government support for scientific research into the synthetic creation of alternative or 'ersatz' materials in a quest for greater independence in countries including Germany and the US. This logic was also concurrent with the 1930s international embrace of autarky at the time. Material culture and environmental historian Andrea Westermann, who has written extensively on the history of plastics in Germany and their changing meanings, describes the accelerated search for synthetic replacement of materials in 1930s Nazi Germany as born of an economy of autarky and war, and one of scarcity.⁴¹ Westermann uses the term 'material autarky' to describe the political and economic motivation behind the domestic production of synthetics to replace material imports and reliance upon these in 1930s Germany, during a period of international sanctioning and wartime scarcity. The material autarky described by Westermann is also mirrored in plastics scholarship that contextualises the global push for cheaper synthetic replacements within a wider political and economic context of dwindling natural rubber resources due to demand outstripping supply, disintegration of colonial networks and international conflict.⁴²

³⁹ Cowan, 1997.

⁴⁰ Cowan, 1997; Pursell, 1972; Stuart W. Leslie, 1993.

⁴¹ Andrea Westermann, *Plastik und Politische Kultur in Westdeutschland* (Zurich: Chronos Verlag, 2007) and 'The Material Politics of Vinyl: How the State, Industry and Citizens Created and Transformed West Germany's Consumer Democracy' in Jennifer Gabrys, Gay Hawkins and Mike Michael (eds.) *Accumulation: the Material Politics of Plastic* (London: Routledge, 2013), pp. 68 – 86.

⁴² See, for example, Jeffrey Meikle, *American Plastic: a Cultural History* (New Brunswick, NJ: Rutgers UP, 1995); Susannah Handley, *Nylon: the Manmade Fashion Revolution* (London: Bloomsbury, 1999); Eli Rubin, *Synthetic Socialism: Plastics & Dictatorship in the German Democratic Republic* (Chapel Hill, NC: The University of North Carolina Press, 2008); Andrea Westermann, *Plastik und Politische Kultur in Westdeutschland* (Zurich: Chronos Verlag, 2007) and 'The Material Politics of

After WWII, autarky and the economic isolation associated with it took on another ideological meaning in the global politics of the Cold War. In this period of resurgent globalisation, autarky became more commonly associated within North American and Western European discourse with the Soviet Union's economic policy.⁴³ However, in *Red Globalization: The Political Economy of the Soviet Cold War from Stalin to Khrushchev* (2014), Cold War Studies and economics historian Oscar Sanchez-Sibony argues that narratives of Soviet autarky became actively reconstructed in the Cold War period by Western actors at the time, and retrospectively by scholars, along a bipolar ideological axis of West vs. East. Sanchez-Sibony proposes that the idea of the Soviet Union as 'autarkic to its core' in the Cold War period became a divisive construction in the west created by US economists and government officials who strove to uphold the Cold War politics of division from which they benefitted.⁴⁴ This metanarrative not only served western scholarship on totalitarianism but also informed the left, which found in Soviet autarky an alternative to exploitative capitalism and became a central ideology in building radical left wing communities. Sanchez-Sibony's position is in line with other Cold War scholars who have challenged the once established perspective that maintained the west as the central actor and the Cold War as an era of conflict and division.⁴⁵

As I shall demonstrate, industrial plastics R&D in the late 1930s (to produce nylon, polyurethane foam and silicone) became increasingly annexed by military contracts demanding near-exclusive use of the latest developments in pursuit of varying degrees of autarky. Government funding during WWII backed the rise of the military-industrial complex. Cynthia Lee Henthorn refers to this cycle 'as a strain of commercial fallout', where better living and defence became synonymous.⁴⁶ US military demand for new weapons in WWII resulted in a flood of new materials, products and technologies. The thesis will show how new materials that benefited from, and succeeded as a result of, US government

Vinyl: How the State, Industry and Citizens Created and Transformed West Germany's Consumer Democracy' in Jennifer Gabrys, Gay Hawkins and Mike Michael (eds.) *Accumulation: the Material Politics of Plastic* (London: Routledge, 2013), pp. 68 – 86.

⁴³ Oscar Sanchez-Sibony *Red Globalization: The Political Economy of the Soviet Cold War from Stalin to Khrushchev* (Cambridge: Cambridge University Press, 2014)

⁴⁴ Sanchez-Sibony, 2014, p. 4.

⁴⁵ See for example three volume Melvyn P. Leffler and Odd Arne Westad (eds.) *Cambridge History of the Cold War* (Cambridge: Cambridge University Press, 2010); *Kritika* 9, no. 4 (Fall 2008) Special Issue: 'Imagining the West in Eastern Europe and the Soviet Union'; Naomi Oreskes and John Krige (eds.), *Science and Technology in the Global Cold War* (Cambridge, MA: MIT Press, 2014).

⁴⁶ Cynthia Lee Henthorn, *From Submarines to Suburbs: Selling a Better America, 1939 - 1959* (Athens, OH: Ohio University Press, 2006), p. 221.

demand were reimagined for peacetime use in the postwar period, and examines the role women's bodies played in this reimagining.

This thesis engages with interdisciplinary scholarship that explores the relationship between military-industrial technology and bodies. Nicholas de Monchaux's (2011) and Matthew J. Hersch's (2009) scholarship on the spacesuit charts the transformation of technologies once widely available to the public into classified R&D information on materials for enhancing corporeal performance.⁴⁷ They demonstrate how gendered corporeal technologies of foundationwear were applied to the designing of the spacesuit and for R&D in the development of suitable high-performance aviation materials. Again, this shows how industrial materials such as plastics conceived in the chemist's lab were repurposed for civilian use in gendered items such as foundationwear, and that these materials and designs were then in turn reapplied to the shaping and enhancement of bodies in displays of Cold War soft power and military performance. De Monchaux and Hersch demonstrate how the seemingly disparate areas of foundationwear and highly industrial, technologically advanced materials and spacesuit R&D were interconnected. These studies of the spacesuit offer an exciting model for showing how fashion and materials R&D intersected and started to shape each other. My research contributes to further study in this area and also demonstrates how the connections between fashion and materials R&D could also be seen in cosmetic surgery.

Recent interdisciplinary histories of Cold War design and architecture have been exemplary in contextualising design within a wider cultural context.⁴⁸ They illustrate how ideological warfare was fought via competitive displays of design and domesticity between East and West. Greg Castillo (2010) and Beatriz Colomina (2006) explore the soft power of design and emerging materials and technologies in the Cold War, focusing on the power of the home. Henthorn (2006) provides an invaluable study of the rhetoric of US military-industrial peacetime (re)conversion advertising.⁴⁹ Susan E. Reid's (2008) research is particularly helpful in considering the role women's bodies played in displays of Cold War soft power. Reid explores 'the happy housewife' who 'did service in the global politics of the

⁴⁷ Nicholas de Monchaux, *Spacesuit: Fashioning Apollo* (Cambridge, MA: MIT Press, 2011); Matthew J. Hersch, 'High Fashion: The Women's Undergarment Industry and the Foundations of American Spaceflight', *Fashion Theory* 13.3 (2009), 345-370.

⁴⁸ Beatriz Colomina, Annmarie Brennan and Jeannie Kim (eds.) *Cold War Hothouses: Inventing Postwar Culture from Cockpit to Playboy* (New York: Princeton Architectural Press, 2004); Greg Castillo, *Cold War on the Home Front* (Minneapolis, MN: University of Minnesota Press, 2010); Beatriz Colomina, *Domesticity at War* (Barcelona: Actar, 2006); Preciado, 2014; Jane Pavitt and David Crowley, *Cold War Modern: Design 1945 - 1970* (London: V&A, 2008).

⁴⁹ Henthorn, 2006.

cold war as an advertisement for the benefits of ‘people’s capitalism’.⁵⁰ Despina Kakoudaki’s ‘Pin-Up: The American Secret Weapon in WWII’ (2004) provides an original study that explores the role of women’s bodies as ideological display.⁵¹ My research builds on this scholarship by adding ANT-inspired methods and extending the concept of the female body in postwar design and technology to consider the impact of military-industrial networks of power and technology and their actual impact on female flesh. The scholarship above, with its focus on design and architecture, exhibits an absence of academic and philosophical attention to the body itself as cultural artefact, particularly the female body, neglecting to explore how the military-industrial complex’s synthetic materiality and power relations became culturally inscribed upon and embedded within the female form. My research seeks to bridge this gap and argue for their interconnectedness.

The history of new materials is another important research context and within this the history of nylon is well-rehearsed.⁵² Scholarship includes US cultural historian Jeffrey Meikle’s *American Plastic* (1995), which establishes the basis for a cultural and scientific history of American plastic and includes a chapter on nylon. Compared with earlier histories of plastics, such as that by historian Harry DuBois (1972), Meikle’s approach is novel in that it contextualises scientific plastics R&D within wider American socio-political discourse. Meikle’s history does not, however, consider medical applications of plastics or the body, areas that have been largely neglected within cultural histories of plastics to date. Fashion historian Susannah Handley’s *Nylon: the Fashion Revolution* (1999) builds on Meikle’s work by charting how nylon served as a revolutionary material for fashion consumption. Her study moves beyond nylon to explore other synthetic materials that followed it, charting changing attitudes to synthetics and fashion.

Meikle’s and Handley’s archival methods and cultural discussions in their histories of plastics have been particularly foundational to my research.⁵³ The history of nylon sets up a

⁵⁰ See Susan E. Reid, “‘Our Kitchen is Just as Good’: Soviet Responses to the American Kitchen”, in Ruth Oldenziel and Karin Zachmann (eds.) *Cold War Kitchen: Americanization, Technology, and European Users* (Cambridge, MA: MIT Press, 2009), pp. 83 -111; Susan E. Reid, “‘Our Kitchen Is Just As Good’: Soviet Responses to the American National Exhibition in Moscow, 1959” in Crowley and Pavitt, 2008, pp. 154-162.

⁵¹ Despina Kakoudaki, ‘Pin-Up: The American Secret Weapon in WWII’ in Linda Williams (ed) *Porn Studies* (Durham, NC: Duke University Press, 2004), pp.335-369.

⁵² See Meikle, 1995; Handley, 1999. Ndiaye, Pap. A. *Nylon and Bombs: DuPont and the March of Modern America* (Baltimore, MD: Johns Hopkins University Press, 2007) examines DuPont’s role in the American military-industrial complex and its technological developments. David A. Hounshell and John Kenly Smith, *Science and Corporate Strategy* (New York: Cambridge University Press, 1988), discuss nylon from a business history perspective within their extensive study of DuPont. These scholars have all carried out extensive archival research at the Hagley Museum and Library.

⁵³ J. Harry DuBois, *Plastics USA* (Boston, MA: Cahners Publishing, 1972) established an initial history of plastics following a

paradigm connecting industrial materials R&D from the lab with women's bodies to the promotion and domestication of the world's first fully synthetic fibre. It also discusses nylon's shifting application from lab to glamorous intimate fashion item, to parachutes, and back again. The existing histories of nylon do not, however, address the pivotal role its launch played in the shaping of ideas around the female body and plastics. This thesis asks what happens when we start from nylon, that connects highly scientific and technological research with fashion, women's bodies (on the surface) and the military, and shift the lens to explore other materials that underwent similar developments in the postwar period?

Nylon is important to this study as it sets up these connections and establishes a discourse of women's bodies as products of the lab. Men's fantasy of creating the ideal model woman is not new, by any means.⁵⁴ The technology available after WWII, however, offered new possibilities of fantasies becoming scientific reality, as representations were, in fact, becoming material. Women's bodies and appearances could be conjured from men's test tubes, from which they emerged as a shinier, glossier, more elegant version of themselves. This PhD follows the journey this rhetoric begins to take in its materiality, first on the skin's surface and then under it.

Whilst nylon's history, and relation to the military-industrial complex, has been clearly charted in an ongoing area of scholarship, the history of plastic foams and silicones, much like the properties of the materials themselves, is less easily defined and little discussed. Although nylon was to be followed by many more 'miracle' polymeric materials developed by DuPont, such as 'Orlon' acrylic, 'Dacron' polyester and 'Lycra' spandex fibres, it was the brand name of a specific type of polymeric material, associated with one particular petrochemical company. The high level of recognition that nylon has received is in part due to the familiarity of its brand name and association with DuPont. Polyurethane foam and silicone, on the other hand, are wider categories: unlike nylon, they do not bear the name of

largely chronological approach. This was later followed by Stephen Fenichel's popular history *Plastic: the Making of a Synthetic Century* (New York: Harper Publishing, 1996). Meikle (1995) and Handley (1999) both use archival methods. Penny Sparke's edited volume *The Plastics Age: from Bakelite to Beanbags and Beyond* (Woodstock: Overlook Books, 1993) offers an essential selection of interdisciplinary texts for understanding the history of plastics and their wider cultural impact.

⁵⁴ The history of the cultural fantasy of 'artificial' women created by men is well documented in Julie Wosk's *My Fair Ladies: Female Robots, Androids and Other Artificial Eves* (New Brunswick, NJ: Rutgers University Press, 2015) which includes many Western examples of women as created by man and prevalent ideologies, including Pygmalion, in representations in literature, film and art.

a singular synthetic patent licensed by one particular chemical company, and are thus more challenging to chart.⁵⁵

Given its interdisciplinary narrative, this thesis also benefits from and contributes to a number of other fields. These include histories of plastics in Western design history studies of specific objects.⁵⁶ Design historian Alison Clarke's extensive Smithsonian archival scholarship on Tupperware and its exploration of gender and plastic has also been particularly formative to this thesis.⁵⁷ Other critical histories of postwar US society and culture through a design history lens have also been useful.⁵⁸ Cultural and business histories of petrochemical companies are also cited.⁵⁹

Over the past decade, the history of Germany's chemical industry, including its plastics, has seen growing academic interest, addressing its wider political context.⁶⁰ Some of these studies have revisited this history to explicitly ask critical questions around politics, materialism and petroculturalism. Political aesthetics scholar Esther Leslie's 2005 study asks 'is it possible to tell history from the standpoint of matter?'.⁶¹ Leslie's conceptual and

⁵⁵ Examples of specific branded compositions of plastic foams do not come up in fashion history scholarship, but do feature in medical history scholarship, such as that on Ivalon and Surgifoam: see, for example Nora Jacobson, *Cleavage: Technology, Controversy, and the Ironies of the Man-made Breast* (New Brunswick, NJ: Rutgers University Press, 2000).

⁵⁶ Surfboards: Peter Neushul and Peter Westwick, 'Blowing Foam and Blowing Minds' in David Kaiser and W. Patrick McCray, eds., *Groovy Science: Knowledge, Innovation and American Counterculture* (Chicago, IL: Chicago University Press, 2016), pp. 51-69. Foundationwear: Jane Ferrel-Beck and Colleen Gau *Uplift: The Bra in America* (Philadelphia, PA: University of Pennsylvania Press, 2002); Jill Fields, *An Intimate Affair: Women, Lingerie, and Sexuality* (Berkeley, CA: University of California Press, 2007). Foundationwear and mannequins: Marianne Thesander *The Feminine Ideal* (London: Reaktion Books, 1997). Womb chair: Mildred Friedman, 'From Futurama to Motorama', in Brooke Kamin Rapaport and Kevin L. Stayton, eds., *Vital Forms: American Art and Design in the Atomic Age 1940-1960* (New York: Brooklyn Museum of Art, 2002); Cammie McAtee, 'Taking Comfort in the Age of Anxiety: Eero Saarinen's Womb Chair' in Robin Schuldenfrei (ed.) *Atomic Dwelling: Anxiety, Domesticity, and Postwar Architecture* (London: Routledge, 2012), pp. 3-25. Spacesuit: Nicholas de Monchaux, *Spacesuit: Fashioning Apollo* (Cambridge, MA: MIT Press, 2011); Matthew J. Hersch, 'High Fashion: The Women's Undergarment Industry and the Foundations of American Spaceflight', *Fashion Theory*, 13.3 (2009), 345-370.

⁵⁷ Alison Clarke, *Tupperware: the Promise of Plastic in 1950s America* (Washington, D.C.: Smithsonian Institution Press, 1999).

⁵⁸ Wendy Kaplan, ed. *California Design, 1930-1965: Living in a Modern Way* (Boston, MA: MIT Press, 2011); Jane Pavitt, 'The Future is Possibly Past: The Anxious Spaces of Gaetano Pesce' in Robin Schuldenfrei (ed.) *Atomic Dwelling: Anxiety, Domesticity, and Postwar Architecture* (London: Routledge, 2012) 26-44; Rapaport and Stayton, 2002; Pavitt and Crowley, 2008.

⁵⁹ Earl Warrick, *40 Years of Firsts: the Recollections of a Dow Corning Pioneer* (New York: McGraw Hill, 1990); Dan J. Forrestal, *Faith, Hope & \$5,000: the Story of Monsanto* (New York: Simon & Schuster, 1977); Ndiaye, 2007; Hounshell and Kenly Smith, 1988.

⁶⁰ See for example, Esther Leslie, 2006; Andrea Westermann, 'The Material Politics of Vinyl: How the State, Industry and Citizens Created and Transformed West Germany's Consumer Democracy' in Jennifer Gabrys, Gay Hawkins and Mike Michael (eds.) *Accumulation: the Material Politics of Plastic* (London: Routledge, 2013), pp. 68 – 86; Kathryn Steen, *The American Synthetic Organic Chemicals Industry: War and Politics 1910 – 1930* (Oakland, CA: University of North California Press, 2014). In addition to focusing on the political, Jennifer Gabrys, Gay Hawkins and Mike Michael's *Accumulation: the Material Politics of Plastics* offers exciting materials-centred and critical theory-driven research on plastics that also considers the Anthropocene. The material turn has not just affected philosophy but also some academic scholarship, as exemplified by Esther Leslie's recent writing at the intersections of art history, history of science, and critical theory, as well as Daniel Miller, 'Materiality: an Introduction' in *Materiality* (Durham, NC: Duke University Press, 2005), pp. 1 – 50, and Christopher Wilk, *Plywood: a Material Story* (London: Thames and Hudson/V&A, 2017).

⁶¹ Esther Leslie, 2006, p. 24.

philosophical exploration of the 'dark poetics' of synthetics and its reliance upon viscous primordial oil has inspired my own methods, which put matter and materiality at the centre of my research.⁶² However, unlike Leslie I employ an empirical approach to archival research and use this to critically explore the relationship between plastics R&D and the shaping of women's bodies. Similarly, environmental and material culture historian Andrea Westermann's work on plastics in Germany uses archival methods to offer insightful case studies of vinyl as a model for thinking about how material properties impact on politics.⁶³ In her scholarship on plastic and political culture in West Germany, Westermann explores how political processes are embodied in materials and artefacts, arguing that 'materials are artefacts of a special kind'.⁶⁴

Designing the Bombshell seeks to put matter and meaning at the centre of its study, giving materials the same agency and importance as artefacts are traditionally given in the study of design history. Westermann writes: 'Once put in place, artefacts transform both the built environment and the social order according to certain political preferences. Due to their materiality, artefacts and infrastructure tend to cement the power relations that led to their implementation.'⁶⁵ Westermann proposes that the social impact of materials might best be captured by studying their properties and the changing meanings attached to these properties. If we apply Westermann's thinking on how the materiality of artefacts and infrastructure bolster the 'power relations that led to their implementation'⁶⁶ to the redevelopment of highly technological materials born of autarky for use on and in the female body in the Cold War, it becomes increasingly evident that materials such as plastic foams and silicones, and their highly transformative materialities, artefacts and infrastructure, were gendered. This in turn served to cement the power relations that resulted in their application, expanding into and colonising the female body with the same industrial materials used in wartime, housing and transportation. Taking inspiration from these multidisciplinary and innovative approaches to material politics, I ask similar material-centred questions in my research and apply them to the gendered nature of synthetic materials development, and its application and use on and in women's bodies.

⁶² For more on viscous thinking see Freddie Mason *The Viscous: Slime, Stickiness, Fondling, Mixtures* (Goleta, CA: Punctum, 2020).

⁶³ Westermann, 2013; Westermann, 2007.

⁶⁴ Westermann, 2013, p.81.

⁶⁵ Ibid.

⁶⁶ Ibid.

Plastics are an essential part of the history and development of cosmetic surgery, and yet they are largely unexplored in cosmetic surgery scholarship.⁶⁷ Likewise, the history of cosmetic surgery and the emergence of bodies shaped cosmetically by plastics does not figure in histories of plastics.⁶⁸ My research argues, however, that plastic materialities were gendered and often anthropomorphised into idealised female forms, shaped by male chemists and surgeons. Interestingly, discussions of the etymology of plastic and its power to give form does feature in histories of plastics and cosmetic surgery; however, the links between the two histories are left largely unexplored. There is a striking absence of consideration of plastic's role in the shaping of corporeal ideals. How did changes in technology impact on the shaping of fashionable body ideals and vice versa? My work seeks to bridge this gap and offer a model for research that draws on empirical methods, an interdisciplinary approach to scholarship, and a critical framework for thinking about the provenance of materials, their materialities and their legacy in the shaping of gendered bodies today.

This thesis engages with a range of scholarship on the history of cosmetic surgery, covering disciplines such as the history of medicine, American studies, cultural and historical studies and gender studies. Plastic surgery developed rapidly as a medical discipline in the US and Europe in WWI, a response to the casualties of modern warfare.⁶⁹ Trench warfare, which left the body protected but the head exposed, the introduction of steel helmets and advancements in medical technology, such as plastic surgery, antibiotics and post-operative care, meant reduced soldier mortality but an increase in disfigured faces.

Medical historians Elizabeth Haiken (1997) and Sander L. Gilman (1999) have written foundational works on the history of cosmetic surgery, charting its development as distinct from plastic surgery.⁷⁰ Earlier scholarship in this area largely focused on charting histories of

⁶⁷ Serlin and Haiken's scholarship are exceptions. In *Replaceable You: Engineering the Body in Postwar America* (Chicago, IL: Chicago University Press, 2004) David Serlin briefly considers changes in technology including the materials available. Haiken, 1997, does touch on this and acknowledges the role of the history of plastics in 'Modern Miracles: The Development of Cosmetic Prosthetics' in Katherine Ott, David Serlin and Stephen Mihm, eds., *Artificial Parts, Practical Lives: Modern Histories of Prosthetics* (New York: New York University Press, 2002), pp. 102-118; this has proven helpful in my research and is something I build on.

⁶⁸ See for example Meikle, 1995; Handley, 1999; Sparke, 1993; Westermann, 2013; Gabrys, Hawkins and Michael, 2013.

⁶⁹ David Serlin, 2004; Haiken, 1997; Gilman, 1999.

⁷⁰ Sixteenth century texts date reconstructive rhinoplasty as far as back as 1000 A.D. Early rhinoplasty was used to repair nose and forehead fighting injuries, as well as to remove visible symptoms of syphilis. However, it was not until WWI that plastic surgery attracted increased attention and respect as a response to changes in modern warfare. Plastic surgery is used to reconstruct facial and body deformities due to congenital and acquired etiologies. Cosmetic surgery initially developed as a sub-discipline dealing predominately with aesthetics. As scholars including Gilman and Haiken note,

developments and progress in medicine and surgical procedures, without contextualising this within wider cultural discourse.⁷¹ Haiken and Gilman, however, made a major contribution to the understanding of cosmetic surgery by addressing this wider cultural context, encompassing issues relating to race and ethnicity, class, sexuality and gender. There is also significant feminist scholarship on cosmetic surgery rooted in sociology that concerns issues around agency and women's experience.⁷² Much of this work also focuses on silicone implants, which is why I have focused my discussion of silicone on the use of free silicone shots to shape women's bodies, rather than solely on implants as 'contained objects'. Not only has this area been less examined; it has also allowed me to find new ways of thinking around materials and their properties in relation to the body.

Although Haiken and Gilman foreground psychological aspects of cosmetic surgery, they make a number of points essential to its cultural context. They argue that the body as site of social spectacle is key to understanding Western developments in the field, since the exposed face is the focus of daily interactions. Haiken, Gilman and others argue that in the early twentieth century, changes in the US from a rural to urban culture, caused by industrialisation, urbanisation and immigration, also led to changes in presentation of the self and the creation of individual identities. Identity was no longer grounded purely in locale and family but also in self-presentation. This is a familiar narrative that also runs through the history of fashion, and yet key texts on the history of cosmetic surgery do not reference or consider this, and vice versa.⁷³ Haiken, Gilman, and more recently critical

cosmetic surgery, perhaps because it is understood as 'elective', is therefore seen as a less 'serious' discipline and is associated with commercial activity, unlike traditional Western understandings of medicine and plastic surgery.

⁷¹ See for example Blair O. Rogers 'A Chronologic History of Cosmetic Surgery*' (*presented at meeting of the section on Historical Medicine, September 14 1969) *Bulletin of New York Academy of Medicine*, 47.3 (March 1971), 265-302; Richard Hardaway Meade, 'Plastic Surgery', in Richard Hardaway Meade, *An Introduction to the History of General Surgery* (London: W.B. Saunders Co. Ltd., 1968).

⁷² For scholars who deal with cosmetic surgery and issues around agency, trauma and feminism, see Kathryn Poly Morgan 'Women and the Knife: Cosmetic Surgery and the Colonisation of Women's Bodies', *Hypatia*, 6.3 (Fall 1991), 25-53; Cressida J. Heyes and Meredith Jones, eds. *Cosmetic Surgery; a Feminist Primer* (London: Routledge, 2009), particularly Kathy Davis, 'Revisiting Feminist Debates on Cosmetic Surgery: Some Reflections on Suffering, Agency and Embodied Difference', pp. 35-49, and Suzanne Fraser, 'Agency Made Over? Cosmetic Surgery and Femininity in Women's Magazines and Makeover Television', pp. 99-116; Virginia L. Blum, *Flesh Wounds: The Culture of Cosmetic Surgery* (Berkeley: University of California Press, 2003); John A. Byrne, *Informed Consent* (New York: McGraw-Hill, 1997); Jacobson; Susan Zimmermann, *Silicone Survivors: Women's Experience with Breast Implants* (Philadelphia, PA: Temple University Press, 1998). Cultural histories of the breast can also be found in Yalom, 1998, and Anne Balsamo, *Technologies of the Gendered Body* (Durham, NC: Duke University Press, 1995).

⁷³ See for example Elizabeth Wilson 'The History of Fashion' pp. 16 – 46 and 'Fashion and City Life' pp.134-154 in Elizabeth Wilson, *Adorned in Dreams: Fashion and Modernity* (London: I.B. Tauris, 2003); Valerie Steele, *Paris Fashion: a Cultural History* (London: Bloomsbury, 1998); Joanne Entwistle, *The Fashioned Body: Fashion, Dress and Modern Social Theory* (2nd edn.) (Cambridge: Polity, 2015) particularly Chapter Four: 'Fashion and Identity', pp. 112-139; Susan B. Kaiser, *Fashion and Cultural Studies* (Oxford: Berg, 2012); Andy Bennett, 'Fashion', in *Culture and Everyday Life* (London: Sage, 2005), pp. 95 - 116.

historian David Serlin (2004), note that identity became increasingly rooted in self-presentation. Developments in cosmetic surgery meant the face and body could be shaped acquisitively, and promised social mobility and self-actualisation.⁷⁴

These scholars highlight how changes in media representation affected cosmetic surgery's reception in popular culture, arguing for its roots in consumer culture and its unique context within the American Dream of social mobility. Within the historiography of cosmetic surgery there is a general consensus that in the US postwar period popular newspapers, magazines and journals celebrated medical materials as offshoots of military R&D.⁷⁵ These life-saving and life-extending technologies included stainless steel, dialysis machines, plastics, blood plasma, substitute bladders, respirators, sulpha drugs and transplant banks for blood, eyes, organs and skin. Newspapers, magazines, radio, television and documentaries often covered these accounts with enthusiasm, promising that human bodies could be fixed, repaired, replaced and improved, with catchy headlines such as 'Spare Parts for the Human Machine'.⁷⁶ Medical science came to embody a postwar utopian idea of progress without conflict.⁷⁷

Like Haiken, Gilman, and Serlin, I also engage with issues of cosmetic surgery and race. Inspired by this new culture of creating identities, surgeons stressed the importance of outward appearance as shaped by 'clear normative standards' to attain social and economic goals. Gilman and Haiken consider race and ethnicity within cosmetic surgery, arguing that its beauty ideals rested on 'Caucasian', 'Anglo-Saxon' traditions and standards. Cosmetic surgeons and their patients negotiated and conceptualised race and ethnicity, ultimately situating the process within 'the larger context of the American project of creating race'.⁷⁸ Haiken contextualises cosmetic surgery and changing attitudes within US history, examining the effacement of individual ethnicity (for example Italian, Eastern European and Jewish groups) and assimilation to US 'whiteness' and its aesthetic of Nordic European corporeal traits. She argues that cosmetic surgery had a unique context in the US, promising social mobility in relation to gaining acceptance by concealing ethnicity. Histories of 'whiteness' by

⁷⁴ See for example Haiken, 1997, p. 7; Serlin, 2004, p. 4.

⁷⁵ Serlin, 2004, p. 4.

⁷⁶ See for example John Wallace, 'Spare Parts for the Human Machine', *The Baltimore Sun*, September 2 1953, p. 6.

⁷⁷ See also Serlin, 2004.

⁷⁸ Haiken, 1997, p. 11.

Nell Irvin Painter (2011) and Richard Dyer (1997) have also been important to my discussion of the racialised nature of the white bombshell ideal.⁷⁹

In addition to addressing cultural history and related issues such as race and ethnicity and gender, this thesis endeavours to consider cosmetic surgery within the context of Cold War America and its technological advancements. Serlin's *Replaceable You: Engineering the Body in Postwar America* moves Haiken and Gilman's scholarship into a more conceptual / theoretical space, paying particular attention to technology, the body and Cold War America. Serlin's intersectional approach draws on histories of the body, gender and sexuality, as well as American cultural history, informed by analytical frameworks from Cold War culture studies, as well as disability and queer studies. This offers new perspectives on Gilman and Haiken's important foundational work and adds a wider theoretical and critical underpinning to the study of bodies as constructed by changes in Cold War technologies in ways that are particularly relevant to my study. Serlin's method is distinctive for its challenge to the way research is presented, with vignettes that present overlaps and examples of patterns specific to the postwar US.⁸⁰ This approach informs the structure of my thesis, which presents snapshots of materials, their military-industrial provenance and legacy of technology transfer to the body. Unlike Serlin, however, I employ a materials-centred approach and draw extensively on archives.

As a design historian and material culture scholar, working with these histories I have found that a materials-centred approach is largely absent from cosmetic surgery histories: they lack a full account of materiality and its relationship to corporeal applications. For example, although Serlin writes on the 'miracles of postwar medicine' he does not link this to the 'miracle' rhetoric of postwar plastics. A history of design / material culture approach is less common in the cited scholarship on cosmetic surgery but can be found in historian Kristen Gardner's (2002) study of pre-silicone breast prosthesis patents in which she considers the material culture of breast cancer patients – objects that are ephemeral (in the sense of both thrown away and / or not having survived due to degradation) and therefore

⁷⁹ Nell Irvin Painter, *The History of White People* (New York: W.W. Norton and Company, 2011); Richard Dyer, *White* (London: Sage, 1997).

⁸⁰ Serlin explores the body in postwar America as reimagined via medical and technical interventions and their representation in popular news stories such as the Hiroshima Maidens, former US GI Christine Jorgensen's gender confirmation surgery and Harlem Renaissance performer Gladys Bentley's course of hormones.

absent from archives and collections.⁸¹ Adrienne Berney (2001) employs a similar design-historical approach in her work and the interdisciplinary methods this demands.⁸² Her study of breast pumps provides a concise and refreshing consideration of how streamlining design and technology impacted on the female body, concealing mechanical and bodily function in design. Berney goes beyond fashion to draw on sources in medicine and technology, arguing for the body itself as a designed artefact; this thesis takes a similar approach. Likewise, cultural historian Anne Balsamo's *Technologies of the Gendered Body: Reading Cyborg Women* (1996) and Nora Jacobson's *Cleavage : Technology, Controversy and the Ironies of the Man-Made Breast* (2000) offer a critical framework for thinking about technology and the shaping of gendered bodies.⁸³ Balsamo argues for the importance of the study of the material body in relation to technology and provides a strong theoretical model of research.

Histories of plastic and cosmetic surgery do not, however, describe in detail how the development of plastic materials coincided with medical advancements.⁸⁴ New polymeric materials such as nylon, polyurethane foam and silicone, believed to be chemically inert, could be sterilised at high temperatures, and initially appeared to be accepted by the body, with few immediate signs of 'foreign body reaction'. Furthermore, plastic materials, such as nylons and foams, briefly introduced to US female consumers before WWII, were now finally available on the consumer market and featured increasingly in foundationwear and shapewear, signalling a new age of high-tech yet affordable glamour. This thesis will show how, during and after WWII petrochemical companies promised female consumers a brighter, better future of glamorous plastic abundance with unlimited access to synthetic materials that had been rationed in wartime.

I build on the historiography of plastics and cosmetic surgery to explicitly argue that changes in plastics technologies and their individual materialities impacted on the shaping of the design of the ideal curvaceous female. R&D in plastics and advances in medical procedures resulted in a proliferation of cosmetic procedures utilising plastics that offered to

⁸¹ Kristen E. Gardner, 'From Cotton to Silicone: Breast Prostheses before 1950' in Katherine Ott, David Serlin and Stephen Mihm (eds.) *Artificial Parts, Practical Lives: Modern Histories of Prosthetics* (New York: New York University Press, 2002), pp. 171 – 198.

⁸² Adrienne Berney, 'Streamlining Breasts: the Exaltation of Form and Disguise of Function in 1930s Ideals', *Journal of Design History*, 14. 4 'Technology and The Body' (2001), 327-342.

⁸³ Jacobson, 2000; Balsamo, 1995.

⁸⁴ Elizabeth Haiken, in 'Modern Miracles: The Development of Cosmetic Prosthetics' in Katherine Ott, David Serlin and Stephen Mihm, *Artificial Parts, Practical Lives: Modern Histories of Prosthetics* (New York: New York University Press, 2002), pp. 102-118, provides an overview of some of the materials development but this does not go into much detail.

shape the female body. Advances in plastics *and* cosmetic surgery were expedited by the demands of warfare. R&D in materials shaped the design of the curvaceous bombshell, and the demands of the bombshell figure in turn impacted on plastics R&D and its search for new and viable commercial markets in the postwar period.

Research Methodology

This thesis seeks to demonstrate how the military-industrial provenance of these materials is significant in thinking through their later corporeal applications in relation to gender and biopolitics. The approach to archives is inherently intersectional in the breadth of sources and archives it demands and the theories it engages with. I draw on a wide range of archival materials and artefacts collections, ranging from foundationwear companies, plastics companies, surgeons' papers, chemists' papers and oral histories to military reports and records, legal documentation and regulatory structures, including the FDA and the AMA. Archives consulted can be grouped into five central kinds: structural/administrative, medical, fashion/foundationwear, corporate and scientific/chemical. Nearly all the archives are located in the US. I was able to access them there as a number of competitive fellowship awards in the US supported my research from 2016-2020. The UK AHRC International Placement Scheme provided a six-month placement with the Smithsonian, based at the Medicine and Science Division of the National Museum of American History (NMAH), supervised by prosthetics historian Katherine Ott and military historian Margaret Vining in the Armed Forces Division. During this period I visited other relevant archives, including the AMA Archive and Cook County Court Archive in Chicago, the Weill Cornell Medical Center Archives in New York, the Johns Hopkins Medical Archives in Baltimore, the Harvard Center for the History of Medicine in Boston and the Library of Congress and National Archives in Washington, DC. I also spent four months in total at the Hagley Museum and Library's Center for the History of Business and Technology in Wilmington, including one month as a Henry Belin DuPont Fellow and three months as their Henry Belin DuPont Dissertation Fellow, and two months in Philadelphia at SHI as their Doan Fellow. This period allowed me to work extensively with archives and collections in the US, as well as the expert curators and archivists of these resources.

Foundationwear archival materials and artefacts were drawn from curator Kristina Haugland's Collection and NMAH's Maidenform, Jantzen and Sumner Hosiery corporate

papers and collections.⁸⁵ I also purchased and consulted Frederick's of Hollywood catalogues from the 1950s to the mid-1960s; the Hagley kindly also purchased some to add to their library and NMAH holds some files on Frederick's.

Surgeons' papers were sourced from a number of archives. I consulted the papers of the members of the Dow Corning Silicone Committee whose papers on silicone are accessible in archives. These are Joseph Murray (held at Harvard Medical Archives) and Milton T. Edgerton (held at Johns Hopkins Medical Archives). A third member, Dicran Goulian, left no papers; however, Herbert Conway (Weill Cornell Medical Archives), with whom he worked closely, did. Edgerton was involved in the John Money Gender Identity Clinic at Johns Hopkins, the first official gender confirmation surgery in the US; I also consulted these papers for references to silicones and polyurethane foams. The Jerome Pierce Webster Library and Papers of Plastic Surgery at Columbia Medical University provided useful material on cosmetic surgery. Ocularist Walter Spohn's papers at NMAH include promotional materials on prostheses and further training courses for surgeons.

A number of structural/administrative institutions' archives were consulted in relation to the regulation of materials. These include the AMA Archive's Department of Investigation Records, Breast, Bust Developers correspondence 1956-68 and Franchises Frauds and Rackets: files on cosmetic surgeon Robert Alan Franklyn. The FDA provided me with papers and files on silicone and transcripts of dockets. I consulted the Chicago Circuit Court Archive for papers relating to the Hal J. Ellison case of illegal silicone injections. At the National Archives I studied military records on silicone. At the Library of Congress, I worked with the papers of Quartermaster General Georges Doriot, who headed the Quartermaster Corps and commissioned reports on Germany's plastics industry.

At SHI, I consulted a number of papers and collections relating to chemical engineers' work on plastics. Walter Gloor's papers contain the original Quartermaster Report and photographs of his commissioned intelligence trip to Germany at the close of WWII. The papers of Joseph Labovsky, assistant to nylon inventor Wallace Carothers, provided useful information on nylon. Oral histories of chemists Eugene Rochow, James Franklin Hyde and Oliver Hayden helped complicate the Dow Corning victor story of being 'first in silicones'.

⁸⁵ Fashion and textiles curator Kristina Haugland, based at the Philadelphia Museum of Art, has a private collection of foundationwear and generously arranged for me to view and study it.

Corporate papers and trade literature of companies including DuPont, Dow Corning and Mobay were consulted at a number of archives. These include the Smithsonian Trade Literature Library, NMAH Archives Center, SHI and the Hagley. Histories of plastics were further sourced from introductions to scientific guides to plastics for chemists and engineers located at various US institutions.⁸⁶

Fellowships in the US also allowed me to present and receive feedback from Americanist (i.e. specialist) scholars in multiple disciplines (Science and Technology Studies (STS), History of Medicine, Armed Forces History, Fashion History, American Studies, Critical Race Studies, Decolonialism, Queer Studies). This transatlantic research context enabled me to gain feedback from both US- and UK-based academics. Time spent in the US was particularly pertinent to my research in relation to critical race studies and ongoing political debates around race and ethnicity in the US. My UK History of Design context and base at the RCA/V&A meant I was able to contribute more of an interdisciplinary approach and offer different perspectives to the material by introducing critical theory on materiality (which appears less commonly discussed in the US outside of critical studies / philosophy departments, and is also perhaps more unusual in US Design History research).⁸⁷ Given the focus on medical history in the thesis, a deep interrogation of US Design History was less relevant.

Conceptual Frameworks

The interdisciplinary method this thesis takes to primary and secondary sources is intersectional; it draws on plastics, materiality, the body, design, medicine, science and technology to show how these areas are interconnected. It explores the gendered and racialised nature of plastic materials development and their legacy and relationship to ideal body image and shaping in the US today. The focus is on *materials* and *archival findings* rather than on theory, but theory underpins its approach. Inspired by Gilles Deleuze and Félix Guattari's 'rhizomatic' concept of thinking across a 'streaming, spiralling, zigzagging,

⁸⁶ Kurt Frisch and James Saunders, *Plastic Foams in Two Parts: Part I* (New York: Marcel Dekker, 1972); R. Crawford, *Plastics and Rubber: Engineering Design and Applications* (London: Mechanical Engineering Publications Ltd, 1985); 'Urethane Plastics – Polymers of Tomorrow' *Industrial and Engineering Chemistry* 48 (September 1956):1383-91; Walter Noll, *Chemie und Technologie der Silicone* (Weinheim: Verlag Chemie, 1968); R. N. Meals and F. M. Lewis, *Silicones* (New York: Chapman & Hall, 1959)

⁸⁷ Design History as taught in the US is perhaps less engaged with critical theory as it is in the History of Design programme at the Royal College of Art. Although recent consideration has been given to engagement with key critical concepts within design, such as race and ethnicity, disability and gender, this remains an area that demands further and ongoing scholarship. Isabelle Held 'Reviewed work: *Design History Beyond the Canon*, ed. by Jennifer Kaufmann-Buhler, Victoria Rose Pass, Christopher S. Wilson, London & New York: Bloomsbury, 2019' *Design Issues*,36. 2 (Spring 2020), 97 -99.

snaking, feverish line', it engages with materialities and ANT-inspired methods to offer an innovative model for using archival material and theory to ask critical questions within the History of Design.⁸⁸ A number of critical theories and thinking on the body have been instrumental to my research.

Materials gathered from archives were analysed using history of design / material / visual culture methods and ANT, as well as critical theory on the body and material. ANT, in combination with critical theory, has enabled me to explore the interconnectedness of the many factors that shaped plastics R&D and women's bodies in the postwar US.⁸⁹ The agency given to non-human forces within ANT has also proven particularly helpful to my consideration of materiality and the body. Like ANT, this thesis argues that humans are agents in technological systems but so, too, are the technologies, and by extension the institutions in which technologies are developed (this includes equipment, materials and apparatus, known as 'assemblages'), in and with which humans do their work, as well as the non-human agents contributing to the system.

Latour's early research on the production of knowledge in scientific laboratories challenged traditional understandings of science that presented humans as actors with agency who used devices and instruments of observation for recording particular objects seen as inert matter.⁹⁰ Rather than perpetuate or accept an ontology that presents human culture as superior to passive nature, Latour argues it is necessary to untangle these assemblages to better understand how knowledge is produced and how environments shape its production. Similarly, this thesis seeks to argue that bodies do not simply 'exist': they too are constructed and shaped, artefacts and witnesses of the time in which they are made, sculpted by surrounding socio-political structures and environments. It is important to revisit the sites, networks and actors which produced bodies in this period, and continue to produce them today.

⁸⁸ Gilles Deleuze and Félix Guattari *A Thousand Plateaus: Capitalism and Schizophrenia*, B. Massumi (trans.) New York: Columbia University Press, 1987 [1980]), p. 499, in Anneke Smelik 'Bodies-Without-Organs in the Folds of Fashion' in *Thinking Through Fashion: a Guide to Key Theorists* (London: I.B. Taurus, 2016) 165 – 183, 166.

⁸⁹ Joanne Entwistle's recent concise guide to (and argument for) using ANT in Fashion Studies has been helpful in my research. See Joanne Entwistle, 'Bruno Latour: Actor-Network-Theory and Fashion' in *Thinking Through Fashion: a Guide to Key Theorists* (London: I.B. Taurus, 2016), pp. 269-284. See also Alexandra Howson, *The Body in Society* (Second edn.) (London: Polity, 2013).

⁹⁰ Bruno Latour and Steve Woolgar, *Laboratory Life: the Social Construction of Scientific Facts* (Princeton, NJ: Princeton University Press, 1979); Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Milton Keynes: Open University, 1987).

ANT is particularly relevant, as the discovery of plastics and their research and redevelopment is likewise rooted in the laboratory, the birthplace of Latour's ANT.⁹¹ Early plastics discourse rests on the epistemological concept of the nature-culture divide, a philosophical binary concept that derives from and through René Descartes, the Enlightenment and Modernist thinking. Mindy-body dualism has particularly influenced thinking on the nature-culture divide: it ontologically privileges mind over body, viewing the two as distinct from each other. The mind is still often privileged over the body in the humanities today.⁹² As scholars including Entwistle have argued, women are more closely associated with the body: the ways in which women are required to monitor and condition their bodies is very different from most men's lived experience.⁹³ Entwistle reasons that this identification of women with the (fashioned) body is perhaps also why fashion studies as a discipline, commonly associated with women, has a long tradition of being ridiculed and not being taken seriously. The gendered privileging of the mind over the body is evident when surveying the history of nylon. Although it touches on the female body's role in the promotion of nylon, this is in a superficial, surface-oriented way; it offers no in-depth consideration of the female body in terms of its physical corporeality, lived experience and the way it was anthropomorphised and shaped into malleable plastic materialities, such as the Test Tube Lady. Binary schools of thought dependent upon 'otherness' remained rampant in synthetics labs throughout the development of plastics. These draw a sharp distinction between human and non-human actors, and between the social and natural world.

Haraway's thinking is instrumental in examining the impact gender has on the shaping of scientific knowledge, and builds on Latour's thinking. Haraway argues: 'Bodies then, are not born; they are made. Bodies have been as thoroughly denaturalised as sign, context and time.'⁹⁴ Just as science is an artefact that is culturally shaped and designed by technologies and the societal structures that control, implement and regulate these technologies, so is the body. This particularly helps to answer my research question 'Did the gender of actors in

⁹¹ Latour and Woolgar, 1979; Latour, 1987.

⁹² This critique is also made by scholars of the body, see Howson, 2013; Entwistle, *The Fashioned Body*, 2015. American anthropologist Sherry Ortner famously critiques such gendered binaries in 'Is Female to Male as Nature is to Culture?' *Feminist Studies* 1.2 (Autumn 1972), 5-31.

⁹³ Entwistle, *The Fashioned Body*, 2015.

⁹⁴ Donna Haraway, *Simians, Cyborgs and Women: the Reinvention of Nature* (London: Free Association Books, 1991), p. 208.

synthetic materials development, design or production impact on outcomes, and if so, what impact did it have?'. Haraway rethinks the interconnectedness of technologies, particularly of the military and industry, and the role they play in shaping bodies, as well as positions, and thereby subjects/subjectivities.

Haraway's discussion of technology and gender centres on the cyborg, 'a hybrid creature, composed of organism and machine.'⁹⁵ Haraway's cyborgs are 'post-[WWII] hybrid entities'⁹⁶ made possible by changes in technologies expedited by US military-fuelled R&D. The cyborg, then, is a figure not entirely dissimilar from the postwar 'bombshell', her body also shaped by a proliferation of technological change after WWII. 'The cyborg is a condensed image of both imagination and material reality, the two joined centers structuring any possibility of historical Transformation.'⁹⁷ The thesis argues that the 'bombshell' became a postwar material reality, her flesh permanently enhanced with the now surplus synthetics produced by the same companies that manufactured munitions and military materials. The body of the 'bombshell' was an assemblage of postwar networks of plastics and a representation of new scientific and technical possibilities, the embodiment of new materials and changing attitudes to the body as a site of auto-design and improvement.

Haraway encourages us to be vigilant and observant of the biopower produced in science and technology, particularly as it reproduces social powers of structures within the scientific realm whilst dangerously claiming to be a 'neutral' site of knowledge production.⁹⁸ The cyborg and its high-tech culture can, however, challenge these forms of antagonistic dualism. Haraway's cyborg, beyond the binary of gender, can offer a positive and liberating threat to dualisms of oppression, and by extension so, too, can versions of the 'bombshell'. As this thesis demonstrates, plastics were created in what Haraway describes as the traditions of

“Western” science and politics - the tradition of racist, male-dominant capitalism; the tradition of progress; the tradition of the appropriation of nature as resource for the

⁹⁵ Ibid., p. 1.

⁹⁶ Ibid.

⁹⁷ Ibid., p. 150.

⁹⁸ Michel Foucault's thinking on biopolitics made an influential contribution to discourse on the body in culture and is largely attributed with the revival of this term. However, subsequent theorists and scholars have built on his reflections to further examine how particular body practices reflect the workings of power that are particularly relevant to my thesis. Donna Haraway is one such thinker, as is Paul B. Preciado.

production of culture; the tradition of the reproduction of the self from the reflection of the other - the relation between organism and machine has been a border war.⁹⁹

Plastics R&D by chemical companies and government agencies was driven by utopian/dystopian dreams of material autarky. Chemical companies and journalists promoted plastics as a new frontier.¹⁰⁰ Their discovery hinged upon a materials-centred colonial quest for malleable, pliable materials, not dissimilar to the viewing of women's bodies as natural materials to be crafted, championed and disciplined by man. Borders collapse, creating infinite possibilities for the production of new subjects and objects at the intersections of the natural and the artificial. Indeed, Alaimo has noted that 'feminist cultural studies have embraced the cyborg as a social and technological *construct* but have ignored, for the most part, the matter of the cyborg, a materiality which is as biological as it is technological, both fleshy and wired'. This thesis addresses the technological and corporeal fleshiness of the cyborg.¹⁰¹

Preciado, inspired by Haraway's approach to the cyborg, argues that gender was constructed as a commodity after WWII via biopolitical military-industrial complexes and networks encompassing medicine and new media in the age of digitisation. In the Cold War era, gender and what Preciado calls 'pharmacopornographic masculinity and femininity' became increasingly materially inscribed in the body politic; they were constructed and shaped via representations (e.g. pornography) and material interventions (e.g. the pill, gender confirmation surgery).¹⁰²

Preciado offers a unique embodied perspective on materiality. In the tradition of drug-induced spontaneous prose, or 'drug literature', Preciado consumes the drug he is writing about.¹⁰³ He writes on the history of testosterone and the 'pharmacopornographic regime' it

⁹⁹ Haraway, 1991, p.150.

¹⁰⁰ See for example, Dow Corning 'Tall Tales and Fabulous Facts: Dow Corning Silicone News, New Frontier Edition' (1953) SHI, 'Synthetica' map in *Fortune* October 1940, 92 – 93.

¹⁰¹ Stacy Alaimo, *Bodily Natures: Science, Environment and the Material Self* (Bloomington, IN: Indiana University Press, 2010), p. 7.

¹⁰² Preciado appears to draw on Haraway's writing on the cyborg as a part-digital, part-corporeal subject and the way it is plugged into the nonhuman computer aspect – 'Modern states, multinational corporations, military power, welfare state apparatuses, satellite systems, political processes, fabrication of our imaginations, labour-control systems, medical constructions of our bodies, commercial pornography, the international division of labour, and religious evangelism depend intimately upon electronics. Microelectronics is the technical basis of simulacra; that is, of copies without originals.' (Haraway, 1991, p. 165).

¹⁰³ For drug literature see Thomas D. Quincey, 'Confessions of an English Opium Eater' (*London Magazine*, 1821); William S. Burroughs *Junkie* (New York: Ace Books, 1953); Jack Kerouac, *On The Road* (New York: Viking Press, 1957); Aldous Huxley, *The Doors of Perception* (London: Chatto & Windus, 1954); Timothy Leary, Ralph Metzner and Richard Alpert, *The*

hails from: 'T' shapes his subjectivity, propelling his thoughts. Preciado (assigned female at birth) embodies Haraway's theory by demonstrating that the body and gender can essentially be 'hacked into' via materiality, and by doing so create new subjectivities. He acknowledges the hybrid, interdisciplinary nature of his writing and its potential for auto-design; 'some will read this as a manual for gender bioterrorism on a molecular scale'.¹⁰⁴ Preciado's visceral experience invites the reader to consider an active, immersive approach to Haraway's 'techno-bio-power' revision of Foucault's 'bio-power'.¹⁰⁵ The writing style itself is lubricated by a product of the pharmacopornographic era that he ingests (testosterone via silicone gel) and that transforms him in the process.

In terms of my interest in the materialities of plastics and how these became anthropomorphised into human flesh, both symbolically and materially, Preciado's visceral, colloidal account offers many exciting philosophical intersections. In addition to an active ingestion manual / journal, Preciado presents us with 'an account of theoretical junctions, molecules, affects'.¹⁰⁶ Preciado takes us back into the experimental chemistry lab, a site of male dominance, engaging with these highly gendered technologies and structures (also of drug-induced prose and manifesto writing) to create a new queer subjectivity and an innovative way of thinking about the history of bodily production discourse. His writing queers the lab and its technologies, gliding swiftly from autobiographical sexual anecdotes to wider philosophical explorations of the interconnectedness of the 'sex-gender industrial complex', his play on the military-industrial complex, which is particularly relevant to my study. Preciado offers a philosophical interrogation of a series of snapshots of the postwar 'sex-gender industrial complex' to illustrate how this amalgamation forms the pharmacopornographic regime. For me, like scholars such as Preciado, Serlin, Colomina and Haraway, the interwar, WWII and postwar era is pivotal in the history of Western bodies and gender and their intersection with technology, the military and industry.

As queer and feminist theorists of posthumanism, Preciado and Haraway stress that the body underwent great changes after WWII. The body, particularly gender, and by extension sexuality, was shaped by the legacy of military-industrial research. This thesis is indebted to

Psychedelic Experience: A Manual Based on the Tibetan Book of the Dead (New York: University Books, 1964); Tom Wolfe, *The Electric Kool-Aid Acid Test* (New York: Farrar Straus & Giroux, 1968).

¹⁰⁴ Preciado, 2013, p. 12.

¹⁰⁵ Paul B. Preciado, *Testo Junkie: Sex, Drugs, and Biopolitics in the Pharmacopornographic Era* (New York: Feminist Press, 2013), p. 44.

¹⁰⁶ *Ibid.*, p.12.

Haraway's and Preciado's philosophical reflections on gender and the military-industrial complex, combining them with ANT, history of design and material culture studies and an empirical approach to original archival material to show how this approach can help further illustrate the interconnectedness of military-industrial materials R&D on the shaping of cis and trans women's bodies in the postwar period as evidenced in materials and artefacts.

'The body' is an integral part of the history of plastics, and yet critical theory on corporeality is absent in the scholarship on plastics.¹⁰⁷ Conversely, although cosmetic surgery and history of medicine scholars Gilman and Haiken address issues around race and ethnicity, they do not consider materiality.¹⁰⁸ Feminist scholars such as Balsamo writing on cosmetic surgery do address critical theory. However, unlike Meikle, Handley, Gilman and Haiken, they do not employ archival methods, but rather focus on representation.¹⁰⁹ In contrast, Preciado explores the body, gender and its intersections with postwar technologies, though there is no underpinning with archival methods or rigorous historical approach to primary sources and evidence.¹¹⁰ This thesis seeks to combine the empirical methods demanded in Design History with an exploration of critical theory of the body and materiality, addressing and exploring the tensions between representation and reality in the material and corporeal, to better understand the changing meanings attached to plastics and their properties in relation to the shaping of women's bodies.

Each polymer is chosen as a material vignette to illuminate how plastics, petrochemical and munitions companies and women's bodies were interconnected from 1939 to 1976. This approach is inspired by Serlin's and Preciado's presentations of discrete episodes that are interlinked. The three material case studies I present are held together by the nature of the materials and women's bodies, and although there are some overlaps each study offers a different focus of theme and range of actors and geographies. Together these chapters will present a deeper interpretation of women's bodies and the military-industrial materials R&D that impacted upon them.

Each material demonstrates different parallel and overlapping instances of plastics development and their impact on the female body. Each offers a different materiality,

¹⁰⁷ Meikle, 1995; Handley, 1999.

¹⁰⁸ Gilman, 1999; Haiken, 1997.

¹⁰⁹ Balsamo; Jacobson, 2000; Kathy Davis, *Reshaping the Female Body: the Dilemma of Cosmetic Surgery* (New York: Routledge, 1995); Blum, 2003.

¹¹⁰ Preciado, 2013; Preciado, 2014.

initially sheathing and eventually penetrating consecutive corporeal layers as it progressively gets closer to the 'realistic' simulation of human flesh. My contribution is primarily of historical and archival material, rather than an in-depth analysis of theory. I felt a pressing need to collect these histories and present them, as there is a lack of truly interdisciplinary scholarship in this area, because to date there is a lack of history on the development of foam and silicone as military-industrial *materials*.

Material feminists Stacy Alaimo and Susan Hekman (2008) also stress the urgent need to 'talk about [women's] bodies and the materiality they inhabit'.¹¹¹ Feminist theory and feminist cultural studies on 'the body' have flourished in recent decades.¹¹² Much of this work, however, continues to focus on analytical discourse and presentations, rather than actual materiality.¹¹³ This 'textual universe' feels detached from 'lived materiality and the often obdurate substance and unexpected agencies of corporeality'.¹¹⁴ Emerging material feminisms are increasingly informed by the physicality of the body.¹¹⁵ My thesis places materials and women's bodies at the centre of its research, addressing materiality, and corporeal interactions with this, throughout.

Alaimo and Hekman critique feminist scholarship that focuses exclusively on representations, ideology and discourse, as this ignores 'lived experience, corporeal practice, and biological substance'.¹¹⁶ This exclusionary approach, they argue, means it is highly challenging for feminism to 'engage with medicine or science in innovative or productive ways' and results in 'the well-worn path of critique'.¹¹⁷ As scholars such as Haraway have argued from the 1980s onwards, for feminist discourse to progress from the postmodern philosophical deconstruction of gendered dichotomies inherent in Western languages, thinking and structures via semiotic analysis, it is essential to incorporate a more inclusive

¹¹¹ Stacy Alaimo and Susan Hekman, 'Introduction: Emerging Models of Materiality in Feminist Theory' in Alaimo & Hekman (eds.) *Material Feminisms* (Bloomington, IN: Indiana University Press, 2008), pp. 1-19.

¹¹² Most notably Elizabeth Grosz' *Volatile Bodies: Toward a Corporeal Feminism* (Bloomington, IN: Indiana University Press, 1994) stimulating writing on corporeal feminism and Balsamo's (1997) study of technologies of the gendered body, both of whom argue for the importance of the body as cultural artefact. Howson (2013), also does this. For feminist studies of cosmetic surgery and the body see footnote 72.

¹¹³ See for example Matelski's *Reducing Bodies* (2017) on the malleability of the female body and feminine body ideals as shaped by 'the persuasive power' of the mass media and cosmetic culture. Matelski argues in the postwar period three major cultural factors shaped the ideal attractive, feminine, and healthy woman in the US: the fashion industry, Hollywood and insurance companies. However, I would argue that changes in material and medical technologies were also crucial in giving form to the fashionable hourglass silhouette.

¹¹⁴ Alaimo and Hekman, 2008, p.15.

¹¹⁵ Alaimo, 2010; Mel Y. Chen, *Animacies: Biopolitics, Racial Mattering, and Queer Affect* (Durham, NC: Duke University Press, 2012).

¹¹⁶ Alaimo and Hekman, 2008, p. 4.

¹¹⁷ Ibid.

consideration of corporeality and materiality. The need for discursive critique and rearticulation in feminist scholarship and politics remains important; however, it cannot continue to discount ‘lived, material bodies and evolving corporeal practices’.¹¹⁸ A new school of feminist thought, as collected in *Material Feminisms*, posits, however, ‘that we need a way to talk about the materiality of the body itself as an active, sometimes recalcitrant force.’¹¹⁹ *Designing the Bombshell* is indebted to, and influenced throughout, by this school of thought, particularly in terms of the agency of materiality and bodies. Wherever possible I address women’s lived experience, as well as the corporeal practice of shaping the body on its surface and within it and the impact of biological substance, in the body and outside of it, interacting with plastics. By placing materiality and materials provenance at the centre of my study, I can ask critical questions and provide new perspectives that challenge scholarship that is primarily concerned with representations. This is not to say that representations are not valuable and important to my discussion of the tensions and relationships between plastics and women’s bodies. However, using material feminist thinking as a tool to navigate materials and corporeality enables this study to go deeper than the purely representational, surface level, making a unique contribution – especially to analyses of common material. Matelski (2017), for example, deals with issues around the female figure but employs a very different approach to mine. By focusing on representations, she uncritically retells the story of Franklyn’s discovery of foam in a Nazi bomber plane and the racist othering US origin story that silicone injections stemmed from post-WWII Japan when female sex workers catered to the ‘*occupationaire*’ – another key moment in this thesis. Matelski, whose focus is on ‘social and cultural meanings’, does not ask questions about where these materials came from or how they have ended up being used in the ‘fashioned body’, thereby largely repeating arguments in established feminist literature on the topic.¹²⁰

Designing the Bombshell seeks to contribute to material feminisms’ ongoing efforts to find a way to talk about women’s bodies and the materiality they inhabit. Critical theory and discourse is helpful in terms of unlocking new ways of thinking. However, I engage more

¹¹⁸ Ibid.

¹¹⁹ Ibid, 4.

¹²⁰ See footnote 72.

closely and empirically with the messiness of plastic materials R&D and the military and industrial to domestic transfer, and their impact on gendered corporealities.

This PhD uses empirical, material elements in its discussion of how gender is constructed using plastic materials. It is led by materials and their materiality, and it is this very approach that has opened up new areas of research and unlocked previously unexplored archival material. Materials shaped the body, and the body shaped materials that sought to emulate it. Materials were increasingly being researched and developed to better copy and simulate the feel of flesh, and in turn bodies were increasingly being shaped by these materials. I show how these materials were gendered and anthropomorphised into the female form in order to domesticate, glamorise and/or sexualise them.

As discussed in the historiography, plastics have attracted significant material-centric philosophical thinking recently, offering new departures from Barthes' groundbreaking 1957 essay on the topic.¹²¹ This includes the writing of philosopher Heather Davis (a former Elizabeth Grosz student), who is drawn to the intimacy of our relationship with plastics and the many forms it takes in our daily interactions. She employs a philosophical approach to explore what I term the 'dark poetics' of petrochemicals and oil and Western culture's continued petrocapiatist exploitation of primordial materials. Davis draws on queer theory to envisage a future 'plastisphere' free from the 'nihilistic, apocalyptic or masculinist techno fantasies of the future that will only lead to the continued reproduction of the social order as we know it'.¹²² In Davis' thinking on 'the queer futurity of plastic', Western borders between object and subject are disputed and new subjectivities created, forging queer alternative kinships.¹²³ Similarly, Esther Leslie employs a philosophical materials-centric approach to synthetics, the 'poetics of coal' and the relationship between nature, art and chemistry. Leslie seeks to present history from the standpoint of matter. These approaches have been useful in thinking about the dark poetics of plastics and their relation to primordial oil and petrocapiatist. My thesis uses these readings as theoretical and analytical frameworks for investigating and illustrating empirical archival evidence to

¹²¹ See 'Plastic', in Roland Barthes, *Mythologies* (London: Vintage Books, 2009); Catherine Malabou, *Plasticity at the Dusk of Writing: Dialectic, Destruction, Deconstruction* (translated by Carolyn Shread) (New York: Columbia University Press, 2009); Brenna Bhandar and Jonathan Goldberg-Hiller, (eds.) *Plastic Materialities: Politics, Legality, And Metamorphosis In The Work Of Catherine Malabou* (Durham, NC and London: Duke University Press, 2015); Peter Sloterdijk, *Foams: Spheres III* (South Pasadena, CA: Semiotexte, 2016).

¹²² Heather Davis, 'Plastic Geology' in Gabriele Mackert and Paul Petritsch *Mensch macht Natur / Humans Make Nature: Landschaft im Anthropozän / Landscapes of the Anthropocene* (Berlin: De Gruyter, 2016) pp. 220-231, 231.

¹²³ Heather Davis, 'Toxic Progeny: The Plastisphere and Other Queer Futures' *philoSOPHIA*, 5.2 (2015), 231-250.

illuminate how theory can be applied to archival material in order to generate critical questions around our use of plastics in relation to the body, historically and today. It is important to note here that given the interdisciplinarity and the significance of the themes of the thesis it suggests many potential future further research directions; however, these have not been included due to the limitations of scope and word count.

Thesis Structure

The thesis is organised as three sections: nylon, polyurethane foam and silicone. Following a chronological thematic approach, each section focuses on a particular material in relation to R&D and women's bodies, progressively exploring key actors, gender, the body and agency in each section. The section on nylon is contained in one chapter, as there is a well-rehearsed body of literature on its history. Sections on foam and silicone have two chapters, since there is no similar body of literature on their provenance and development, and it is important to develop this literature for foam and silicone in order to better understand their later application to women's bodies.

Chapter One, on nylon, engages with primary and secondary sources to present the established rhetoric and literature around petrochemical / explosives companies and the female body in relation to nylon, a conceptual thread that runs throughout this thesis. It uses archival material to argue that DuPont's 1939 San Francisco Golden Gate International Exposition and New York World's Fair 'Wonder World of Chemistry' displays acted as test labs for ideas around nylon, revealing how women's corporealities and lived experiences with nylon became key to the successful introduction of this new high-tech material. It shows how the white Test Tube Lady became a 'living symbol' of a new age of designing the female body, both on the skin's surface and within it, contextualising this within wider cultural discourse around eugenics at the time.

The two chapters of the second section explore plastic foam, which offers a different materiality: lightweight, fluffy, pliable, spongy, compressible, filled with interconnected air pockets, it 'breathes', becomes lifelike and is anthropomorphised.

Chapter Two, the first of these, traces polyurethane foam's expansion from Germany into US industry, military, transportation, furniture and textiles padding. It uses original archival material to show how plastic experts working for the US military documented Germany's advances in this field upon entering the country at the close of WWII. The US military's plastics experts recommended the transfer of this technology to the US for further

R&D. Technical information on plastic foams was distributed amongst companies and industry in the US in the hope that they would become more competent in this area, as well as building up the plastics industry. The chapter argues that polyurethane foam's unique materiality invited touch and corporeal interaction. Polyurethane foam and its US transfer to the US via military intelligence can be understood as part of a 'Plastics Race'. In the postwar period polyurethane foam's agentic materiality became anthropomorphised into female flesh and gendered.

Chapter Three discusses polyurethane foam's corporeal application in foundationwear and falsies. Polyurethane foam's soft materiality and seemingly endless offering of moulded forms meant it could easily be sharpened to a point, and gave shape to the conical ideal bustline. Working closely from archival sources the chapter demonstrates how cosmetic surgeons were also attracted to polyurethane foam's soft pliable materiality; they found it could be sterilised at high temperatures without crumbling. Plastic and cosmetic surgeons praised its tactile resemblance to human flesh and the body's 'acceptance' of the material. I show that surgeons selected foam's bounce-back materiality to craft implants with which to permanently pad the female form. Carving these objects from slabs of polyurethane, surgeons interchangeably likened their relationship to plastics and female flesh to that of a sculptor. The chapter illustrates the close resemblance between these implants and foundationwear worn externally on the skin's surface. Foam shows us how an amalgamation of changes in technology, including various instances of technology transfer, materials R&D and developments in medicine, as well as shifting attitudes to the body as a site of consumer improvement made possible by plastics, enabled the female body to be padded to attain the fashionable bombshell ideal, both inside and out. I argue that the materials available impacted on the shaping of the fashionable silhouette, and that reciprocally the fashionable silhouette impacted on materials R&D and their applications on and in the female body. Foam became flesh and flesh became foam, as cosmetic surgeons such as Franklyn claimed their services would make foundationwear and the bra obsolete.

The final section, Chapters Four and Five, addresses silicone. Silicone offered a new kind of inert and 'othered' fluidity. Chapter Four draws on archival materials, including oral histories by chemists working on its early development, to chart how a type of silicone fluid, developed by US chemists at Dow Corning as an engine lubricant to aid the war effort, propelled US bomber planes to the higher altitudes needed to reach Japan post-Pearl

Harbour. I use archival material to show how silicone, no longer needed as a military lubricant after the war, was launched by Dow Corning in the public market in 1945 and found new applications.

Chapter Five examines sources that include original surgeons' papers, court papers, FDA papers and AMA papers. I show how by the mid-1950s silicone was increasingly being used by licensed surgeons and individuals practising without medical licences in the shaping of cis and trans women's bodies through injections, and later as implants. This account complicates and troubles the often repeated racist US-centric narrative of silicone vats 'disappearing from Japanese harbours' that interchangeably praises silicone as an 'all-American wonder invention' and then others it as 'adulterated' by 'the Japanese' with sesame and mineral oils, or as something distasteful that is pursued by sex-workers and trans women, particularly trans women of colour. Silicone's visceral materiality, supposed inertness and the immediacy of its injection into the body changed the landscape of cosmetic surgery irreversibly. The final development of a synthetic material originally developed to expedite war needs, silicone continues to circulate in the shaping of cis and trans bodies today, both legally through implants and illegally through an underground market of free silicone shots. This chapter explores how silicone's viscous materiality was conveniently othered and racialised by various actors, slipping through cracks and caught in the cogs of the FDA's bureaucracy. Conversely, silicone, fluid and 'other' in its identity, became a means of creating new subjectivities that went beyond the confines of gender-normativity.

Chapter One: Nylon and the Test Tube Lady, 1939

In the November 1939 issue of *National Geographic*, Fredrick Simpich, Assistant Editor, reporting on DuPont's display at the New York World's Fair marvelled:

'at a fashion show, we saw a girl clad from head to foot in artificial materials.

Everything she wore was made from synthetic stuffs created by chemists. [...] Only the girl herself was natural – natural flesh and bone wrapped in her own waterproof skin. There she stood, a startling symbol of this new artificial world risen so fast since the World War'.¹

For readers today, familiar with the 'space age of fashion', she hardly looks scientific/artificial, but more like a fashionable woman in the late 1930s. Crowned 'a Living Symbol of the Chemical Age' (see Figure 1), from the tip of her cellophane hat to the tops of her nylon-encased varnished toes this white female figure, also known as the 'Test Tube Lady', or 'Miss Chemistry', provided a Venus-like vision of the man-made woman of the future. In this chapter I will argue that her appearance marked the advent of a new age of plastics R&D in the US, closely mapping changes in material technologies to the sheathing and shaping of the fashionable ideal female. In this gendered binary of mind-body dualism, chemists (male, mind) improved upon nature (female, body).

¹ Frederick Simpich, 'Chemists Make a New World: Creating Hitherto Unknown Raw Materials, Science Disrupts Old Trade Routes and Revamps the World of Industry', *National Geographic Magazine*, LXXVI. 5 (November 1939), 601.



Figure 1: 'A Living Symbol of the Chemical Age', National Geographic, 1939

The year 1939 was pivotal in the history of materials and consumer culture: DuPont, at that time the world's largest explosives manufacturer, presented its 'Wonder World of Chemistry' exhibit at the 1939 Golden Gate International Exposition in San Francisco and New York World's Fair that unveiled nylon to the public.² As mentioned in the Introduction, the history of nylon has been well rehearsed and charted from different perspectives by

² A version of the 'Wonder World of Chemistry' exhibit was first displayed in 1936 at the Texas Centennial Exposition, which focused on agriculture and chemistry, stressing DuPont's 'healthy' relationship with nature. For more information on this see Hagley archives and Susannah Handley, *Nylon: the Manmade Fashion Revolution* (London: Bloomsbury, 1999), p.38.

Hounshell and Smith, Meikle, Handley and Ndiaye, so this chapter will not review nylon's invention in detail.³

As Handley has observed, in the early 1930s a set of circumstances guaranteed the success of Wallace Carother's new polymer fibre, originally known as 'Fiber 66'.⁴ First, DuPont was experiencing a public relations crisis due to claims that it had excessively profited from selling chemicals that the US Government needed in WWI, and wanted to reinvent its image. Secondly, as outlined in the Introduction, the American government and corporations had identified a pressing need for America to push for material autarky and develop synthetic alternatives to imported goods and materials. This chapter will begin by examining these circumstances and will build on this to present an in-depth analysis of a third integral factor in the success of Carother's first fully polymeric fibre, namely the significance of the role of the female body in the promotion and commercial success of nylon.

Important to this exploration are DuPont's company archives and the Gordon Kline papers at the Hagley Museum and Library, the Dupont Nylon Collection and Trade Literature Collection at the Smithsonian National Museum of American History (NMAH), and the Josef Labovsky (assistant to Carothers) and Wallace Carothers Collections at the Science History Institute (SHI).⁵ This chapter largely draws on papers from DuPont's Advertising Department (DPAD) at the Hagley, which kept extensive notes and reports on nylon's presentation at the San Francisco International Exposition and New York World's Fair in 1939. I have chosen to focus on these sources as they give invaluable insight into the public's first reactions to nylon and its materiality, particularly from female visitors. These papers also complicate established narratives suggesting that DuPont took a top-down approach to presenting nylon in relation to women's bodies.⁶ As I will show, their advertising department closely

³ David A. Hounshell and John Kenly Smith, *Science and Corporate Strategy* (Cambridge: Cambridge University Press, 1988); Jeffrey Meikle, *American Plastic: a Cultural History*; (New Brunswick, NJ: Rutgers University Press, 1995); Handley, 1999; Pap. A Ndiaye, *Nylon and Bombs: DuPont and the March of Modern America* (Baltimore: Johns Hopkins University Press, 2007).

⁴ Handley, 1999, 34.

⁵ Wallace Carothers invented nylon whilst working at DuPont's Experimental Station Laboratory just outside of Wilmington, Delaware. The Hagley Museum and Library, on the grounds of DuPont's first manufacturing site, holds archival materials relating to nylon's promotion and consumer testing. SHI, in neighbouring Philadelphia, holds the papers of the chemists Carothers and Labovsky, as well as early experimental nylon artefacts. It is worth noting that much of nylon's archival legacy remains on the mid-Atlantic East Coast; this is significant as it shows the context of nylon's research and development within the biggest explosives manufacturer in the US at the time and DuPont's military-industrial legacy in the area. Nylon and explosives had some common ingredients, such as tar derived from coal.

⁶ Handley, 1999.

monitored female visitor reception and adjusted their display accordingly in the hope of gaining greater interest and support, in turn complicating arguments around agency and women's bodies. These sources reveal the public and industry's first interactions with this material and the narrative DuPont chose to weave about it.

This chapter seeks to add to scholarship of nylon by incorporating discussions of gendered corporeality and materiality, focusing more closely on the role of the female body in the launch of the new fibre and arguing for its significance in the acceptance, domestication and glamorisation of plastics. Unlike Meikle (1995) and Handley's (1999) scholarship on nylon and its presentation, this chapter also draws on critical thinking on the body and gender. The chapter examines Miss Chemistry within the gendered binary thinking of mind-body dualism.⁷ As American anthropologist and feminist thinker Sherry Ortner established, in her foundational article 'Is Female to Male as Nature is to Culture?', (1972) women's bodies are seen as 'closer to nature', which is particularly significant in this chapter's discussion of chemistry and the lab as a gendered site of material transformation.⁸ The chapter considers mind-body dualism and the forms of oppression this legitimises, as discussed by feminist scholar Donna Haraway in her exploration of the cyborg.⁹ It also builds on the scholarship on nylon's history by situating the creation of the Test Tube Lady within a wider cultural context and discourse of streamline design and eugenicist thinking, drawing on primary and secondary sources to address issues around race and ethnicity.

Nylon was the world's first fully synthetic fibre, and its 1939 presentation on the female body is key to understanding changing attitudes towards synthetic materials and their proximity to the female body. While Miss Chemistry is one image created for an exhibit, it is indicative for us because she represents how changing material technologies were promoted and domesticated in relation to the gendered body. The vision of Miss Chemistry conjured from a test tube, sheathed from head to toe in layers of plastics and

⁷ There are three aspects which are crucial in understanding the Cartesian Dualism, also known as mind-body dualism (Alexandra Howson, *The Body in Society* (Cambridge: Polity Press, 2013)). First, the mind and body are entirely separate. Second, the mind is privileged over the body, where the latter resembles a machine or an object in which the self is located. Third, thought is performed by the mind, making it the producer of the self via cognitive rationalisation. For Haraway's discussion of Western traditions of dualisms and 'the other', see 'A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century' in Donna Haraway, *Simians, Cyborgs, and Women: the Reinvention of Nature* (London: Free Association Books, 1991), pp. 149 – 182.

⁸ Sherry B. Ortner, 'Is Female to Male as Nature to Culture?', *Feminist Studies*, 1.2 (Autumn 1972), 5 – 31.

⁹ Haraway, 1991.

stitched together with nylon sutures, saw the new synthetic materials anthropomorphised into the female body.

DuPont needed a better public image: by the mid-1930s it was finding it difficult to manage its public perception. At the close of WWI, DuPont, who had supplied the US military in the first war involving chemicals, reported a steep rise in profits.¹⁰ This was to haunt them in 1934 when the US Senate Munitions Investigating Committee, headed by Republican politician Gerald P. Nye, accused the company of wartime profiteering and of continuing its influence in the international munitions industry. DuPont's President, Lamont du Pont II, was known for defending the company's lack of concern for public opinion.¹¹ Unlike companies such as General Motors, which sold products directly to the consumer, DuPont dealt exclusively with raw materials for other companies, so he felt public relations was less important. In 1934, he came under personal attack during the Nye Committee Hearings, in which Nye claimed that DuPont and other companies, referred to by contemporary journalists as 'merchants of death', had profiteered from WWI by overcharging the US military for powder and explosives.¹² Nye suggested DuPont's increase in profits after WWI from \$5 million to \$60 million was evidence of profiteering. The charge was covered extensively in the press and Lamont's lax approach to public relations was revised.

DuPont consequently employed the services of Bruce Barton, founding member of Batten, Barton, Durstine & Osborn (BBDO), still a major advertising agency today. Known as 'the most famous advertising man in America at the time', Barton was to take a different approach to DuPont's marketing, focusing on public regard and recognition.¹³ He found that even though 98 per cent of DuPont's business came from 'peacetime' products, the public thought of DuPont as 'the powder people'.¹⁴ In 1935, Barton and his agency launched DuPont's memorable slogan 'Better Things for Better Living... Through Chemistry', stressing the company's domestic role and chemistry's contribution to civilisation with an increasing

¹⁰ For more on this see Hounshell and Smith, 1988; Handley, 1999, p. 34; 'Merchants of Death' news file in DPA, Acc. 1410, Box 36; 'The DuPont Company and Munitions', report to Stockholders and Employees of E. I. DuPont de Nemours and Company, DPA, Acc. 1410, Box 52.

¹¹ Meikle, 1997, p. 133.

¹² 'Merchants of Death' was a term first used in 1930s US investigative journalism to describe munitions companies who profited from war. For more see *Forum* 92 (July 1934), 32-33; Public Affairs Department files regarding DuPont's new slogan contain tear sheets of the cartoon, DPA, Acc.1410, Box 36; Hounshell and Smith, 1988; Handley, 1999.

¹³ Handley, 1999, p. 34.

¹⁴ Meikle, 1995, p. 133; Handley, 1999, p. 34.

range of life-improving consumer goods. Barton secured a budget of \$650,000 to reinvent the company's image, which included sponsoring *Cavalcade of America*, a radio series.¹⁵ The programmes, which began with the new DuPont slogan, were dedicated to a patriotic narrative of humanitarian progress through technological advances, interspersed with tales of life-enhancing wonders invented by DuPont's chemists. Public-facing exhibits were a central part of bringing Barton's message of 'Better Things for Better Living... Through Chemistry' to a wider audience.

DuPont's 'The Wonder World of Chemistry' exhibit premiered at The Texas Centennial Exhibition of 1936 and focused on agricultural raw materials, showing how these were converted into chemical products. DuPont's rhetoric communicated that their chemists were 'improving upon nature', the company, in turn, providing consumer goods to improve consumers' lives: some 1.5 million visitors attended.¹⁶ This was to mark a turning point in DuPont's approach to communication, which would increasingly engage with the public through event displays and advertising. Manufacturing a highly technical product was no longer enough for DuPont: this burgeoning range of materials needed to be 'explained' and contextualised to the consumer in order to recuperate the company's image. DuPont actively sought to reverse its 'merchants of death' image, striving to create a vision of heroic improvers of civilian everyday life – for example solving practical day-to-day problems such as insect infestations and needs such as medical equipment and waterproof clothing. These explanations needed to be innovative, fun and increasingly spectacular to make materials R&D more relatable, accessible and desirable. DuPont's Texas presentation demonstrated that chemical manufacturers were becoming the direct link between the laboratory and the consumer.

In October 1938, after a decade of R&D, 'nylon', the generic name chosen for materials of the synthetic polyamide type (formerly known as 'Fiber 66'), was formally announced to the public. By autumn 1938 nylon toothbrush bristles were being sold in toothbrushes across the US, and in January 1939 nylon fishing lines were introduced. Shortly afterwards, construction began on a large-scale plant for the commercial manufacture of nylon polymer and yarn at Seaford, Delaware. In February 1939, women's nylon stockings were revealed to the public for the first time at the 1939 San Francisco Golden Gate

¹⁵ Meikle, 1995, p. 133; Handley, 1999, p. 34.

¹⁶ Handley, 1999, p. 38.

International Exposition.¹⁷ They were to become key in nylon's success story. Unlike Fiber 66, toothbrush bristle (which replaced pig bristles) and fishing lines, nylon offered a sensual materiality and became associated with the female anatomy, feminising and glamorising it as desirable.

DuPont at the 1939 Fairs

In 1939, on the eve of WWII, DuPont presented a reworking of its 1936 Texas Wonder World of Chemistry exhibit at the 1939 San Francisco Exposition and the New York World's Fair. In February 1939, nylon stockings were introduced to the public for the first time at the San Francisco exposition,¹⁸ and 2,058,199 visitors saw DuPont's 'Wonder World of Chemistry' between 18 February and 29 October 1939.¹⁹ The 1939 New York 'Wonder World of Chemistry' display had 9,734,408 visitors between its opening on 30 April to 31 October 1939 and 11 May to 27 October 1940.²⁰ DuPont invested heavily in this display, which consisted of 36,222 square feet of production and distribution and cost over \$500,000.²¹ Visitors to DuPont's display were welcomed by what the press release called a '100-foot tower typifying the spirit of chemical research' referencing abstract chemistry apparatus and a neon 'Wonder World of Chemistry' sign (seen in the background of Figures 9 and 15).²² It featured 'use of colour, active liquids in circulation and changing lights to achieve the spectacular effect sought'.²³ The massive scale demonstrates DuPont's dedication to its new public-facing image.

Once inside, visitors saw a large-scale painted mural by American artist John W. McCoy, measuring over 30 feet high: it displayed chemistry's transformative powers and anthropomorphised chemistry into a white male (See Figure 2). Light radiates from this muscular figure, referencing classical sculpture. Crowned with a laurel wreath, he references Apollo, one of the twelve Olympian gods, the classical Greek and Roman deity of Sun, the god of prophecy and divination, associated with oracles, knowledge, healing, care

¹⁷ 'Nylon: Versatile Product of DuPont Chemistry', DuPont Nylon Division, 1941, NMAH TLC

¹⁸ Ibid.

¹⁹ 'History of Dupont Exhibits 1935 -1945' Notes on 1939 SFWF display, DPA, Acc. 1410, Box 58 & 59.

²⁰ Ibid.

²¹ The structure, designed by Walter Dorwin Teague with Robert J. Harper, associate, and A.M. Erickson, engineer, featured an exhibition space to hold 50,000 at maximum capacity. DPAD, April 22 1940, NY world's fair folder; Public Affairs Department History Files, DPA, Acc. 1410, Box 44.

²² 'News for Publication' Monday March 14 1938, NY World's Fair folder, Public Affairs Department History Files, DPA, Acc. 1410, Box 44.

²³ Ibid.

of herds and flocks and protection of the young.²⁴ The mural's banner proclaims: 'BETTER THINGS FOR BETTER LIVING THROUGH CHEMISTRY'. On the left, a white family, hunched, barefoot, in drab clothing and offering natural raw materials, are transformed on the right into a thriving group in clean, modern outfits, standing tall and looking towards the future, an industrial backdrop looming behind them. The message is clear: DuPont's goal is to transform and save Mother Nature and to light up and improve ordinary families' everyday lives, removing their heavy burden and making life brighter, lighter, cleaner and easier. A press release declared that 'the figures are painted on an heroic scale' and celebrate 'the significance of the chemist in industry, transportation, agriculture, mining and other fields'.²⁵ At this stage we can see that the focus is on what chemistry can do to transform family life through raw materials rather than specifically on transformation of women.

²⁴ Jenny March, *Cassell Dictionary of Classical Mythology* (London: Cassell, 2000), pp. 57 – 60.

²⁵ 'News for Publication' Monday March 14 1938, DPA. This mural is in the style of heroic Soviet, Mexican and American 1930s mural art. California-born John W. McCoy, a Cornell University Fine Arts graduate, was based in Wilmington and briefly worked for the DuPont company. His paintings are in the collections of local museums, including the Brandywine River Museum and Delaware Art Museum, as well as the Santa Barbara Museum of Art.



Figure 2: 'Better Things for Better Living... Through Chemistry' Mural by John W. McCoy, 1939

Plastics presented at the 1939 exhibits promised a utopian future filled with an abundance of exciting, shiny new goods. This DuPont advertisement for the 1939 New York Fair, published in the 'Woman's Forum' section of the *New York Herald Tribune* again promises a brighter future (Figure 3). In the context of the recent end of the Great Depression and the outbreak of WWII in Europe, DuPont announced, 'The world of tomorrow... a new world and a new material: NYLON'. Visitors could depart from this world and enter a novel uncharted future realm, a timely escape in such dark times. In copy targeted at a female readership, the chemist becomes a mythical paternal guiding figure who can safely navigate these new spaces and protect his wards, appealing to the family, the domestic and the everyday, thereby humanising DuPont's image.

'Where to tomorrow, Mr. Chemist?

And the chemist answers: "to a thousand untouched shores. To a land of tomorrow where rain won't wet your clothes, where everyone gets his vitamins, where fire won't

burn your home, where insects won't steal your wealth, where life is easier, happier, and more complete in ways that can't even be dreamed of today."

How soon, Mr. Chemist? And the chemist answers: "just as soon as I can make it come true. I build for the tomorrow that will be yours, and your children's and your grandchildren's. And when each of these tomorrows becomes a today - there will still be tomorrows to work for!"

Such is the spirit and the meaning of the DuPont pledge: 'Better Things for Better Living ... Through Chemistry.'²⁶

²⁶ 'DuPont Announces for the World of Tomorrow... a new word and a new material, NYLON', DuPont advertisement for the 1939 New York World's Fair, *New York Herald Tribune*, Sunday 30 October, SHI, Joseph Labovsky Collection, DuPont Advertisement, 2004.543.207.

* * *

Du Pont Announces for the World of Tomorrow... *a new word and a new material*

NYLON

NO BETTER EXAMPLE of the facts of research could be found than this—as you see a MILLION that a year had to be spent by Du Pont for the research leading to present, no include those still on hand, in the fact that Du Pont will spend \$20,000,000 on a plant employing approximately 1,000 people.

Nylon is the greatest man-made material devised scientifically as synthetic fibers—forming synthetic fibers having a particular chemical structure. Available from ends, it will wear and stretch and the possible ability to be dyed in various colors and in various shapes, such as articles, films, etc.

This is the answer of the synthetic materials. In the development of a group of Du Pont chemists have been successful for years. Nylon, though it springs from synthetic materials, has their own in abundance, can be finished into fabrics possessing a beautiful luster, strong as steel, delicate as the skin of a spider's web, yet more durable than any of the best of them.

For example, with "Elasta" fabric made from nylon and other materials, most other forms of this new product will reach the public in a matter of a few months, in progress.

Out of continued research in synthetic chemistry has come this development, as will others, to add to the holding of the World of Tomorrow.

Jobs...Jobs...

Such water important study comes from the contribution—no from other chemical developments. From these facts of chemical research spring jobs for the men who build plants and machinery—jobs for the men who make the new material—jobs for the men who convert it into consumer articles for everyday living. This science study adds man to his search for better living.

The Past Gives a Clue to the Future

During the past ten years, Du Pont developments have included (among many other synthetic materials) products such as acetone, in their.

Manufacturing "Cellulose" cellulose film, in general form.

Higher Wages...Lower Prices

Since 1925, the Du Pont has developed scores of new products. Today the Du Pont employs more people than in 1925, in its high wages, and sells its goods in greater quantities and at lower prices. Last year, forty percent of Du Pont's entire sales was on twelve lines of products developed or improved since 1925.

Therefore, before the result of our experiments, their contribution to better living, are a promise of things to come—a promise for the World of Tomorrow and for those who will inherit it.

Your Preview of a Better World

At the New York World's Fair, Du Pont's "World of Tomorrow" exhibit will present some of the most spectacular chemical developments there will be shown, for the first time, many of the synthetic processes used in the development and manufacture of Du Pont products. How these will look together in the future will be part of what nobody would have dared to anticipate in better living and more continuous employment for everyone.

Where in Tomorrow, Mr. Chemist?

And the chemical process—"A Chemical Controlled Chain." It is a kind of insurance where you won't see your clothes, when everyone gets his vitamins, when the world's best food comes, when better roads and better roads, when life is made, happy, and more complete in more than just a year to the world of today?

How soon, Mr. Chemist? And the chemical process? And to more of a new world in more time? Hold for the moment that will be yours, and your children's and your grandchildren's, and when such of these developments become a habit—what will still be necessary to work for?

Such is the spirit and the meaning of the Du Pont slogan: "Better Things for Better Living...Through Chemistry."




 Since 1802
 E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware

BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY

* * *

Figure 3: DuPont advertisement for the 1939 New York World's Fair, *New York Herald Tribune*, 30 October 1939

Such comparisons between plastics and an uncharted or 'untouched' paradise were frequent in US petrochemical companies' promotional material in this period, continuing well into the postwar period and offering escape from the ravages of war and later the threat of atomic warfare.²⁷ Popular publications promoted polymers with a similar geographical rhetoric. *Fortune* magazine's October 1940 issue, featuring nylon and countless other synthetic materials on a map called 'Synthetica: a new Continent of Plastics' is discussed by Handley (1999) and Meikle (1997). Meikle notes that 'the map of Synthetica

²⁷ See for example 'Tall Tales and Fabulous Facts: Dow Corning Silicone News, New Frontier Edition' (1953), SHI, and Dow Chemical Company, 'Technology of Peace' (1946), NMAH TLC. See also Cynthia Lee Henthorn, *From Submarines to Suburbs: Selling a Better America, 1939 – 1959* (Athens, OH: Ohio University Press, 2006).

firmly rooted plastic in the extractive materials culture of the past'.²⁸ The cartographic approach is different from one focusing on 'organic chemistry's promise to free the human race from geographic accidents of scarcity and supply.'²⁹ Instead we see the visual tropes of empire and colonialism. WWII was increasingly clarifying the limits of colonial economic systems, fuelling the US (and Germany's) desire for material autarky. Plastics were endowed with the power to give the US (and Germany) freedom from this system.

Building on Meikle's observations, and drawing on Haraway's feminist thinking on Western scientific dualisms, it can be argued that plastics, discovered recently in the experimental laboratory, cannot be imagined without evoking Western colonial and patriarchal tropes of domination of the unknown other. The continent's outline, which appears to reference that of South America, connotes 'the tropics, civilisation's colonial preserves exploited for ivory, rubber, gutta-percha, copal and other natural resins and substances.'³⁰ This cartography presents 'plastic as the product of a heavy industrial process whose development followed that of the founding and growth of civilisations, a process that lent itself, finally to human control'.³¹ In this narrative, plastics, just like natural resources, foreign lands and bodies of the other, could be tamed and disciplined through chemistry, creating 'Better things for Better Living...'

Among other things, this taming brought DuPont's R&D from the lab to the public, which was key to the company's commercial success. Walter Dorwin Teague's copy pitch for DuPont's promotional booklet references this, stating:

'DuPont has been so engrossed in its marvellous technological developments that it has had relatively little opportunity to acquaint the "man in the street" with its startling contributions to human progress and welfare through chemistry. DuPont's preoccupation with its scientific advances is true of other large corporations, many of which, however, now realise the need of taking the public behind the scenes of their activities.'³²

²⁸ Meikle, 1997, p. 66.

²⁹ Meikle, 1997.

³⁰ Meikle, 1997, p. 66. For more on colonialism and exploitation see John Tully, 'A Victorian Ecological Disaster: Imperialism, the Telegraph, and Gutta-Percha', *Journal of World History* 20.4 (December 2009), 559 - 579; Daniel R. Headrick, *Humans versus Nature: a Global Environmental History* (Oxford: Oxford University Press, 2020).

³¹ Meikle, 1997, p. 66.

³² DPAD, April 22 1940, NY world's fair folder, DPA, Public Affairs Department History Files, Acc. 1410, Box 44.

Teague stressed increasing scientific competition, emphasising DuPont's need to educate the public about its developments. Displays were designed to be increasingly interactive, and included the staged re-creation of a chemical laboratory. Here 'chemists' in lab coats performed experiments and explained the derivation of products in common use from raw materials and their refinement for use in factories, shops and homes.

DuPont's Advertising Department (DPAD) consciously created a carefully constructed 'Wonder World of Chemistry' for the public. Teague's 'lab' design consisted of an elevated laboratory platform from which visitors could see experiments with different materials recreated by chemists (referred to as 'lecturers' by DPAD).³³ Placed on a pedestal above the crowd, amid displays of natural resources and the workers who sourced them, 'chemists' performed experiments. These 'chemists' were largely college students, recruited for the summer and trained in giving information. Indeed, these white male 'chemists' were in fact 'actors', known as 'lecturers' by DPAD, and chosen for their appearance and their ability to attract audiences. They had no prior knowledge of DuPont's activity, relying instead on exact scripts from DPAD.³⁴ Their enthusiasm was said to mirror that of the audiences they were presenting to:

'Few if any of [the secure staff], had any great amount of experience in the handling and operation of laboratory equipment, testing devices, sound apparatus and various mechanical devices that they were expected to utilize in telling the story of DuPont to the public. They were as amazed by the story they had to tell as the public they were supposed to tell it to.'³⁵

³³ 'Show Business', *DuPont Better Living Magazine*, (July-August 1952), DPA.

³⁴ DPAD's aesthetic control over the 1939 'Wonder World of Chemistry' shows and publicity can be seen in a promotional photograph of a lab performance: the original male lecturer's face has had an image of another (supposedly more handsome?) man superimposed on it. See 'Nylon hosiery demonstration at 1939 New York World's Fair', DPA, AVD_2004268_P00001520, P-00001520, DuPont Company External Affairs Department photograph file (Acc. 2004.268)

³⁵ 'Summary of maintenance operations, DuPont "Wonder World of Chemistry" exhibit, November 18th 1939', NYWF 1939, WC Wall, Maintenance Manager. DPA, 'New York World's Fair Weekly Reports 1939'. Series II, Part 2, Box 35,

Early reports by lecturers reveal that some budget adjustments needed to be made for lab equipment breakages in the first weeks, as the young men in lab coats did not know how to handle these items, and accidents were frequent.³⁶

The show was deemed a success, and at weekends visitor figures peaked at over 100,000. In order to accommodate the numbers, lectures were cut down from 30 to 15 minutes, with 86 male and female staff at the peak. This was DuPont's largest and most ambitious exhibit to date. Material in DuPont's archives shows that visitor numbers exceeded prediction: the DuPont press office presented this as 'demonstrating an increasing public interest in new chemical developments.'³⁷ DuPont's decision to present a research lab to the public was aimed first at increasing knowledge of its products and second at helping to dispel its 'merchants of death' image. In keeping with their efforts to dissociate themselves from explosives and the spoils of war, the display on munitions was partially obscured from view, with one small column dedicated to it.³⁸

I would argue that the lab also functioned on a third, hidden level: that of a lab for experimenting and testing ideas on the public about materials emerging from it. As papers at the Hagley reveal, DPAD invested much time, effort, and resources into monitoring visitors to their 1939 display. Lecturers wrote daily reports: weekly reports of a selection of their observations were sent to DPAD in Wilmington. DPAD then made changes to improve the display accordingly, in order to appeal to a wider audience. What is so interesting about this material is that DPAD responded particularly to female visitors' expressed views and wove these ideas about nylon into their own PR and narrative.

As the weeks passed, DuPont's exhibit staff and advertising department soon discovered that nylon was consistently the most visited part of the display.³⁹ In an early weekly report from New York, an exhibition supervisor reflected: 'When the exhibit first opened, it was expected that we would get a fair number of questions on munitions. These have not developed. The great battle cry is: "how soon can we buy nylon hose?"'.⁴⁰ Teague's

³⁶ W. H. Uffelman, 'Summary of Exhibit Operations DuPont "Wonder World of Chemistry" Exhibit, November 18 1939', NYWF 1939, DPAD, 'Exhibit Section: NYWF Exhibit 1939, DPA, Records of E. I. DuPont de Nemours Series II Part 2, Acc. 641, Final Report 1939' folder, Box 35 (NYWF weekly reports 1939).

³⁷ Press release, November 22 1940, DPA, Acc. 410, Box 44.

³⁸ See Teague blueprints and promotional images at DuPont Company exhibits c. 1939 -1941, DPA, Acc. 77.242.

³⁹ See 'Lecturers Reports' New York World's Fair Weekly Reports 1939, DPA, DuPont Advertising, Series II, Part 2, Box 35.

⁴⁰ W.M. A. Hart, 'Report for week of July 2-8 1939', DuPont Advertising, Series II, Part 2, Box 35, New York World's Fair Weekly Reports 1939, Weekly reports, July 1939, DPA, Advertising department, Exhibit Section, New York World's Fair exhibit (1939). Questions around DuPont's capacity to make munitions were only being asked after the start of WWII in September 1939. Strategically there was only a small display dedicated to DuPont's munitions, and some concerned

original blueprints and sketches, press shots of the display and lecturers' reports all reveal that neither DuPont nor Teague had anticipated this interest. Had they not considered women visitors in advance? Lecturer John Book commented on 22 July 1939 that 'it would be a good idea to have [nylon] products lettered in large letters over the first section such as neoprene and other products in the second section are pointed out.'⁴¹ Indeed, the original exhibit design featured other materials such as Lucite – a clear plastic that DPAD believed would grab the public's attention thanks to its novel shiny and transparent materiality. Lucite was presented in applications for dentistry and as heels for shoes; however, this did not succeed in capturing the attention and imagination of the audience in the way that nylon did. No one at DuPont could have predicted the spectacular rise in interest in nylon generated by journalists, nor the timely opportunity that the Japanese silk boycott presented.

Nylon and Nationalism: the 1937 Silk Boycott and Autarky

As well as the change in public perception brought about by these journalists and new public relations activities, the fairs helped to improve DuPont's public image, particularly in relation to its new polymeric materials. DuPont was given a further boost by nylon and the solution it offered to the Japanese silk boycott that first began in 1937. America and Japan were locked in economic and political conflict and, as scholars have described, women's hosiery played a perhaps unexpectedly important part in this.⁴² Ninety per cent of America's raw silk was sourced from Japan, with imports totalling \$100 million in 1938; 75 per cent of this was used for stocking (hose) production.⁴³

WWI had already shown the US the importance of material autarky. At that time Germany remained a key technological hub, excelling in organic chemistry, dye production, pharmaceuticals and countless other products that ensured their industrial monopoly.⁴⁴ Other imports included iodine and rubber, as well as nitrates, fundamental for making

visitors asked if they could still make munitions in the light of current events. See New York World's Fair Weekly Reports 1939, DPA, DuPont Advertising, Series II, Part 2, Box 35

⁴¹ John Boyko, Lecturers' reports, shift A, July 22 1939, New York World's Fair Weekly Reports 1939, DPA, DuPont Advertising, Series II, Part 2, Box 35

⁴² Hounshell and Smith, 1988; Meikle, 1997; Handley, 1999; Ndiaye, 2007 and Lawrence B. Glickman, "'Make Lisle the Style": The Politics of Fashion in the Japanese Silk Boycott, 1937-1940', *Journal of Social History*, 38.3 (Spring 2005), 573-608.

⁴³ '\$10,000,000 Plant to Make Synthetic Yarn; Major Blow to Japan's Silk Trade Seen', *New York Times*, 21 October 1938. In 1938, 1.55 million pairs of stockings were sold in the US every day, totalling an annual expenditure of \$475 million.

⁴⁴ See Kathryn Steen, *The American Synthetic Organic Chemicals Industry: War and Politics, 1910-1930* (Chapel Hill, NC: The University of North Carolina Press, 2014); Douglas M. O'Reagan, *Taking Nazi Technology: Allied Exploitation of German Science After the Second World War* (Baltimore, MD: Johns Hopkins University Press, 2019).

explosives and fibres; fertilisers were imported from Chile. Politicians considered that obtaining material independence was a matter of security and survival for the US and its industry. DuPont clearly recognised this need and demonstrated its allegiance to the US government, commenting later:

‘until this country could build up its own resources, its needs could be met only at the whim of a foreign power... such things were irritating in peace, for they forced the country to pay a sort of ransom to attain the living standard it desired. And in war this dependence on foreign technology could well prove fatal.’⁴⁵

WWI had left a legacy of anxiety in the US about achieving and maintaining technological prowess, and doing so in ways that were not complicated by dependency on foreign imports, and the importance of material autarky was emphasised.

The Hagley, NMAH and SHI hold extensive archives of news reports welcoming the advent of nylon as a timely invention that could secure US independence from Japanese silk imports.⁴⁶ Historian Lawrence Glickman notes the US movement to boycott Japanese goods first began in August 1937.⁴⁷ In July 1937, the Second Sino-Japanese War broke out, following Japan’s decades-long imperialist strategy of military and political expansion.⁴⁸ By October 1937 a public opinion poll in the US indicated one per cent support for Japan; 59 per cent supported China, with the remaining 40 per cent having no opinion.⁴⁹ This public view intensified after Japan began its undeclared war against China in July 1937 and Chinese representatives lobbied the US. Unlike the continuing but less successful boycott of Nazi Germany, which did not single out a particular product, the anti-silk campaign connected military imperialism with one particular import.⁵⁰ While raising awareness of a wide range of

⁴⁵ *DuPont: the Autobiography of an American Enterprise* (Wilmington, DE: E.I. DuPont De Nemours & Co. Inc., 1952), p. 92., NMAH TLC.

⁴⁶ See for example ‘History of Nylon scrapbook’, DPA, Acc.1410; Box 36; 2004.543.014; Joseph Labovsky Collection, SHI; NMAH DuPont Nylon Collection, NMAH.AC.0007.

⁴⁷ Lawrence B. Glickman, ‘“Make Lisle the Style”: The Politics of Fashion in the Japanese Silk Boycott, 1937-1940’, *Journal of Social History*, 38.3 (Spring 2005), 573-608. For more information on US/Japanese relations see Jon Thares Davidann, ‘“A Certain Presentiment of Fatal Danger”: The Sino-Japanese War and U.S.-Japanese Relations, 1937–1939’ in *Cultural Diplomacy in U.S.-Japanese Relations, 1919–1941* (New York: Palgrave Macmillan, 2007), pp. 179-204.

⁴⁸ Key events here include the invasion of Manchuria, China, in 1931 and Japan’s 1933 withdrawal from the League of Nations. See Davidann, 2007.

⁴⁹ See Gallup public opinion poll results in Davidann, 2007, p.180. Glickman, 2005, writes that Americans, influenced by the romantic writings of Pearl Buck and contemporaries, had become sympathetic to the Chinese cause in the 1930s. Pearl Buck (born 1892), the daughter of missionaries, spent much of her life in Zhenjiang, China, before returning to the US in 1934. Buck’s novel *The Good Earth* (1931) was the best-selling fiction title in the US in 1931 and 1932.

⁵⁰ Glickman, 2005, p.579.

Japanese imports that consumers should avoid, and thus introducing a boycott of Japan's manufactured goods, campaigners believed that raw silk was the 'lifeline' of the Japanese war effort, the central export of an economy constructed on textiles and the US's 'most economically significant' import from Japan.⁵¹

A diverse range of US groups, including the American Federation of Labor, Congress of Industrial Organizations, YMCAs, students, Chinese Americans, veterans, consumer groups, manufacturers associations, celebrities, progressive women's groups, and liberal and leftist organisations campaigned for the boycott of Japanese silk.⁵² Glickman shows how their promotional material emphasised the 'unwitting culpability' of the US public – predominantly women, who purchased an average of 10 to 15 pairs of stockings a year – leading them to believe they were financing war crimes through their consumption of Japanese products. Campaign material featured provocative titles, such as 'Did your stockings kill babies?'⁵³ Simultaneously, the American Federation of Hosiery Workers, an industrial union, protested against the boycott, arguing that the principles of both ethical consumption and fashion trends instead required the continued purchase of silk in order to prevent the loss of their US jobs: many hosiery workers were already facing unemployment. Though the silk boycott was far-reaching, aided by press coverage of women's stockinged legs, consumers seemed to have heeded the calls of the hosiery workers.

A journalist writing for the *New York World Telegram* viewed the discovery of nylon as 'having the utmost social and economic significance... it won't be so difficult to popularise a boycott of Japanese silk when women can obtain stockings from DuPont's mechanical silkworm that are not only equally attractive but wear longer.'⁵⁴ Nylon's launch to the general public offered a 'home-grown' synthetic alternative to silk imports, simultaneously securing employment for the country's hosiery workers.

Lecturer reports from the 1939 fairs show that DuPont did not explicitly present its nylon stockings as a way of boycotting Japanese silk. However, visitors frequently politicised 'nylons' as a way of exerting economic sanctions on Japan and attached this meaning to the nylons themselves. A lecturer observed: 'most women who have asked me about [nylon] "can't wait" for these stockings to be put on the market and consider it their patriotic duty

⁵¹ Ibid.

⁵² Ibid.

⁵³ Ibid.

⁵⁴ Raymond Clapper, 'Artificial Silk Worm Developed by DuPont', *New York World Telegram*, 17 January 1939.

to buy them in preference to Japanese silk.⁵⁵ Many female visitors endowed nylon with a powerful agency: the potential for nylon to impact on Japan's economy and military capability/expansionary ability.

In contrast to its soft materiality, the language of the political discourse about nylon often took an aggressive tone. One lecturer noted, '[every day] I get [...] at least half a dozen people who say I'd like to see us *knock* Japan out of business' and another, 'many [visitors to the exhibit] have been expressing considerable joy at the idea of *hurting* Japan through replacements of her silk markets with nylon'.⁵⁶ References to nylon inflicting pain on Japan are frequent in lecturers' notes, even taking on militarised language of ammunition and liberation.

'Wistful thinking, potentially realised, seizes a great many women upon hearing of nylon. And if that person is politically minded, they usually see in Nylon a powerful weapon for freeing the Far East and Western United States from the Japanese military caste.'⁵⁷

In this context, nylon became an ideological, highly politicised weapon in the WWII arsenal of the US.⁵⁸

On the eve of WWII, nylon became increasingly desirable and was endowed with the power to retaliate against Japan, its consumption becoming a combative act. A lecturer noted of a female retailer: 'in nylon she saw freedom from Japanese silk'; it could liberate her from the fetters of consuming an imported material from an enemy country.⁵⁹ Lecturers' reports reveal that nylon's timely unveiling to the public appealed to the public's emotions, and it was hoped this would translate into sales. Two female buyers from Macy's

⁵⁵ Cummins Speakman Jr., 'Supervisor's report June 18 -24 1939, Thomas W. Witherspoon report'), DuPont Advertising, Series II, Part 2, Box 35, New York World's Fair Weekly Reports 1939, Weekly reports, June 1939, DPA, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939)

⁵⁶ Arthur Simon, 'Lecturers' reports shift B, July 22 1939' and Leonard Waller 14 September 1940, DPA, Advertising Department, New York World's Fair Weekly Reports 1939, Weekly reports, July 1939, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35.

⁵⁷ Brooks K. Johnson, 'Lecturers reports shift B, July 22 1939', DPA, New York World's Fair Weekly Reports 1939, Weekly reports, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35.

⁵⁸ It is noteworthy that DuPont's live display of Japanese beetle extermination in their pesticides section was a well-attended section of the display, and can be understood as another means of performing and consuming the infliction of pain on Japan. For more on Japanese beetle extermination see Paul Sampson, 'Report for week of July 2- 8 1939', DPA, New York World's Fair Weekly Reports 1939, Weekly reports, July 1939, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35. For more on the economic complexities of US-Japanese relations in the run-up to Pearl Harbor, see Susie J Pak, 'Complex International Alliances: Japan', in *Gentlemen Bankers: the World of J P Morgan* (Boston, MA: Harvard UP, 2014), pp. 160-191.

⁵⁹ Mrs. Bernice Dinwiddie, owner of the largest dress shop in Berkeley cited by Brooks K. Johnson, 'Lecturers' reports shift B', July 22 1939, DPA, New York World's Fair Weekly Reports 1939, Weekly reports, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35.

commented, 'the patriotic feelings of the American people will be an important factor in the sale of nylon'.⁶⁰ Purchasing nylons became a fashionable political act and was understood as such by visitors to the display. One lecturer observed:

'It is especially interesting that many of the persons to whom I talked about nylon immediately think of the Japanese silk business and express the hope that nylon will replace foreign silk. One lady displayed a cotton-clad leg, said she would not wear silk stockings and groaned when I told her that we expected nylon hose to be on the market in about six months. Several other persons have asked me where they can buy nylon now.'⁶¹

There was an urgency in wanting to purchase nylon stockings for political reasons, however, full-scale commercial production was still in its infancy. Some female consumers saw their boycotting of silk and adoption of cotton as a burdensome patriotic act of selflessness and were growing impatient waiting for DuPont's synthetic alternative to hit the market.⁶² The lecturer continues, 'personally, I never make any reference to Japan when discussing nylon, but stress the beauty and strength of the fiber or fabric and mention its uses besides stockings. However, this patriotism is apparently second only to nylon's wearing qualities'.⁶³ Nylons provided a viable alternative to silk that legitimised the consumption of a novelty during times of economic uncertainty as a political act; it legitimised the purchase of a feminine luxury (gendered as what some might see as wasteful and frivolous) which was also a staple, since stockings were expected for gendered performance.

DuPont's advertising department also understood the importance of appealing to the American public's politics and emotions, promoting its offerings through nationalist sentiment. *A New World Through Chemistry* (1939), a promotional film by DuPont produced to coincide with their exhibits, compares its chemical advancements with those of Europe.

⁶⁰ Irwin Heimer, 'Lecturers Reports, Shift A', July 22 1939, DPA, New York World's Fair Weekly Reports 1939, Weekly reports, July 1939, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35.

⁶¹ N.M. Walling, 'Lecturers reports shift A, Week ending July 8th 1939', DPA, New York World's Fair Weekly Reports 1939, Weekly reports, July 1939, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35.

⁶² For more on the silk boycott as political activism see Glickman, 2005.

⁶³ N.M. Walling, 'Lecturers' reports shift A, Week ending July 8th 1939', DPA, New York World's Fair Weekly Reports 1939, Weekly reports, July 1939, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35.

This film, available on loan from the DuPont Motion Picture Bureau, Wilmington, Delaware, was in 'active demand by service clubs, educational institutions, church organizations and other groups'.⁶⁴ It celebrated supposed American intellectual superiority and the US explosives manufacturers' role in contributing to America's world-leading position in plastics, boasting:

'[Synthetics] made of coal, air, water well mixed with brain. The brains of American scientists who in the brief period between 1914 and the present have brought America scientific achievements from second place, failing Europe, to first place, leading the world. A position it is not likely to soon if ever to relinquish.'⁶⁵

In DuPont's eugenicist-toned reordering of the world, American brains were a key ingredient in the chemical composition by which natural matter was transformed into non-natural matter.⁶⁶

As time passed, lecturers noted that fewer visitors were asking about nylons and that now an occasional enquiry would relate to DuPont's capacity as an arms manufacturer. As we have noted, DuPont's 'Wonder World of Chemistry' acted as a testing lab for changing ideas around new materials such as nylon. Under DPAD's watchful eyes, new material identities, such as that of 'Fiber 66' (only recently named nylon), could still be formed to accommodate the public's desires. By May 1940, DuPont's Public Relations Department shifted the focus of the New York exhibit rhetoric in press releases to correspond to increased global conflict. DuPont Public Relations Department's Charles M. Hackett's press release promised glamour and advancements in material autarky, announcing: 'progress of the chemical industry toward making America self-sufficient was depicted tonight at a

⁶⁴ 'Our Motion Picture Library', in *DuPont Magazine*, 35.7-8 (p. 24). Screenings also include specialist groups including engineers' groups, women's lunch clubs, farmers' clubs and cleaners' associations. See 'Mrs. Yarrington on Rotary Program' *The Florence Herald* (Florence, Alabama) (Friday 19 Apr 1946), p 6; 'Shriners See Picture' *Chattanooga Daily Times* (Chattanooga, Tennessee) (Saturday 30 Jan 1943), p. 2; 'Cleaners Meeting Held Here Sunday', *The Bristol Herald Courier* (Bristol, Tennessee) (Monday 1 Sep 1941), p. 3; 'Facts for Farmers' *The McIntosh County Democrat* (Checotah, Oklahoma), Thursday 29 Jun 1944), p.2; 'DuPont Company's Varied Products Shown in Film' *The Morning News* (Wilmington, Delaware) (Wednesday 24 Jul 1940), p.14.

⁶⁵ *A New World Through Chemistry* (1939) DPA, DuPont Company films and commercials (Acc. 1995.300) Hagley ID FILM_1995300_FC121.

⁶⁶ It is interesting to think of this in relation to cultural theorist and philosopher Catherine Malabou's writing on the plasticity of the brain. See Brenna Bhandar and Jonathan Goldberg-Hiller, *Plastic Materialities: Politics, Legality, and Metamorphosis in the Work of Catherine Malabou* (Durham, NC: Duke University Press, 2015).

special 'dress rehearsal' showing of the DuPont Company's New York World's Fair exhibit'.⁶⁷ Over a hundred representatives from newspapers, magazines and trade publications attended the preview on the eve of its opening. In his press release, Hackett further contextualised DuPont's offerings within a battle scenario:

'warfare has broken out in many parts of the world since the fair opened last year [...] These conflicts emphasise the change which has taken place during the past quarter century in American industry. Displays indicated an economic security and industrial independence sharply contrasting with the precarious reliance on foreign sources of supply in 1914-1918.'⁶⁸

DuPont was keen to present itself as a key contributor to the achievement of economic independence and material autarky, demonstrating this very clearly at their exhibits.

Once the fairs had taken place, in 1939 DPAD's recognition of women consumers and the market that women represented grew rapidly: new analysis of the primary material (lecturers' reports) indicates that nylon in relation to women consumers, women's bodies and women's garments was left largely unconsidered by male designers and DPAD.⁶⁹ Furthermore, I would argue that the greater impact of nylon on the public imagination was in large part due to the deployment of the female body, which also played a major role in assuaging concerns around this new invention and its proximity to the female body.

Handley claims that 'DuPont's image was totally metamorphosed in the public's perception after the introduction of nylon – no longer behind munitions, instead it was a company behind lovely legs'.⁷⁰ Lecturers' reports, however, reveal that chemical technologies were still deemed by some cautious female consumers to be potentially poisonous or harmful to the body. For example, enquiries and concerns around nylon allergies were not uncommon. One lecturer recorded a female visitor had suffered from 'three cases of allergy which a doctor had explained to her did not come from the yarn, but

⁶⁷ Charles M Hackett, DuPont Public Relations Department, 'Telegram to Watson Davis, Science Service, Washington D.C., New York May 10 1940', DPA, 1410, Folder NYWF 1939-1940, Box 44.

⁶⁸ Ibid.

⁶⁹ Teague's blueprints show there was space left for a catwalk; however, as we shall see, the nature of the shows was yet to be determined as the exhibit opened. See Teague blueprints and promotional images, DPA, DuPont Company exhibits c. 1939 – 1941. Acc. 77.242

⁷⁰ Handley, 1999, p. 40.

from the dyes'.⁷¹ Chemical dyes used for nylon stockings could irritate the skin. Some female visitors were sceptical of the chemical aspects of nylon, comparing them to snakes when wet, claiming they were poisonous, contained dyes that irritated skin, prevented perspiration from pores, could dirty legs since they were made from coal, and felt metallic, as they were made in the lab.⁷² Another female visitor, apparently nervous of nylon's context as an invention by a munitions manufacturer, was worried nylons could explode.⁷³ In spite of DuPont's efforts to distract from their role as explosives manufacturers, the NYE Committee Hearing, five years previously, was clearly still on some visitors' minds. This visitor connected nylon's materiality to DuPont's role as munitions manufacturer and questioned the efficacy of this new material's safety if produced by the same company or in the same factory. Lecturers gendered and ridiculed her enquiry. However, her unease around DuPont's involvement with munitions was echoed by other visitors.

In July 1939, W.R. Ellis and G.H. Donovan noted that 'there have been few questions about DuPont and munitions. This week, however, a question about how so many different products would spring from the manufacture of powder was asked.'⁷⁴ DuPont were keen to display the variety of products they offered, extolling their motto of 'Better Things for Better Living... Through Chemistry', however, in the aftermath of the Nye hearings, they did not go into detail on how these new and exciting synthetic materials could arguably be linked to their context as munitions manufacturer.

Mystery and confusion surrounded the production of nylon, a new type of material that appeared to be magically conjured from natural elements by an explosives company. A female visitor was suspicious that nylon stockings were derived from coal, air and '[...] acids taken from corpses', claiming she knew the person who was employed to harvest the macabre ingredient.⁷⁵ The experience of wearing nylon also remained a mystery until

⁷¹ W. Uffelman, 'Report of the week September 1 - September 7 1940, Addressed to W.A. HART Advertising Department Wilmington, Delaware, Final NYWF reports', DPA, Acc. 641, Records of E.I. DuPont de Nemours & co., Series II, Part 2, Advertising department, NYWF weekly reports 1940.

⁷² Final NYWF reports, DPA, Acc. 641, Records of E.I. DuPont de Nemours & co. Series II, Part 2, Advertising Department, World's fair exhibit - weekly reports 1940; Leonard Waller report 9-7-40. Meikle, 1997, p. 147, also summarises these observations.

⁷³ Norman Walling, 'notes 14 September 1940' in 'Final NYWF reports', DPA, Acc. 641, Records of E.I. DuPont de Nemours & co. Series II, Part 2, DPAD NYWF exhibit - weekly reports 1940.

⁷⁴ Weekly reports, July 1939, DPAD, Exhibit Section, NYWF exhibit (1939); W.R. Ellis and G.H. Donovan Report for week of July 9 - 15, W.M. Hart. DPA, Advertising Department, New York World's Fair Weekly Reports 1939, Series II, Part 2, Box 35.

⁷⁵ Meikle, 1997, writes about DuPont's loss of control of the pre-release publicity for nylon; this concern is also evident in the company's papers at the Hagley. Some newspapers discussed the patent's use of cadaverine - a naturally occurring

production increased. Articles circulated about nylons melting in bus exhausts and this was also reflected in some comments to the lecturers.⁷⁶

Women's experiences were recorded by male lecturers, and often reveal misogynist bias and belittling of their embodied experiences. A lecturer noting that 'several women found [nylons] to be cold and were afraid they would be too cold for winter wear' dismisses their experiences.⁷⁷

'We decided that was due to imagination and could easily be explained away. Women always have to have something to complain about anyway, and the minute they find out something is made from coal, air, and water they think there must be a draught somewhere.'⁷⁸

This highlights the underlying gender divide between female consumer and male lecturer performing as chemist. The lecturer asserts himself as more knowledgeable on nylon, when in fact he is performing the role of chemist and is unlikely to have carried out stocking tests himself. In keeping with dominant gender roles of 1930s America, male lecturers considered women unfit to understand the complexity and superiority of science, dismissing their corporeal interactions with the material. Instead the mind and 'logic' champions the body, matter, and embodied female experience. In cases of alarm such as these the lecturers, however, report the visitors left 'convinced that nylon hose are not as dangerous as [previously] thought.'⁷⁹ I would argue that the introduction of live female demonstrators also played a major part in this.

Nylon, Miss Mitton and Gender

According to company reports, the New York fair was the first time that the company introduced live female demonstrators, in response to the demand for nylon. In the DuPont display there was a clear division of labour, consistent with US gender roles of the time:

chemical found in animal and human corpses; however, what was meant in the patent was in fact the cadaverine found in sticky black tar when coal is melted. See news reports in DuPont Advertising Department Series II, Part 2, Box 58, e.g. 'Ladies' Hose and History', *Chicago Tribune* (September 26, 1938) and 'Synthetic Silk May Hurt Japan', *Buffalo Evening News* (September 26, 1938). See also Meikle, 1997, p.140.

⁷⁶ Greenfield 'Report for week - May 19-25 1940' May 26 1940, DPA, Series II, part 2, Box 35; Waller 'Report for week - October 6 - 1, October 13 1940', DPA, Advertising Department, Series II, Part 2.

⁷⁷ 'W. Uffelman, 'Report of the week September 1 - September 7 1940', Addressed to W.A. HART advertising department Wilmington, Delaware, Final NYWF reports 1940, DPA, Acc. 641, Records of E.I. DuPont de Nemours & co., Series II, Part 2.

⁷⁸ Ibid.

⁷⁹ Ibid.

men wore white lab coats and women wore the materials developed in the labs. Men were represented in an active, dominant role as scientists and chemists; women were represented in a passive role as nylon-clad models. In her writing on the cyborg, Donna Haraway observes that definite dualisms have dominated Western philosophical traditions and are integral to the domination of those constituted as 'other' (women, people of colour, nature, workers, animals), i.e. those whose function is to 'mirror the self'.⁸⁰ Certainly, the live female body was presented at DuPont's display as 'other' to the male scientist: another natural material to be improved upon by science. In her foundational writing on the gendered nature/culture divide, Sherry Ortner reflects that 'woman is seen as "closer to nature" than men, men being seen as more unequivocally occupying the high ground of "culture"', or in this case specifically science, as part of 'culture'.⁸¹

Prior to the first live model performance on 24 June 1939, male and female visitors to DuPont's display were likely to have heard of nylon and its potential in hosiery, as this had already been announced in October 1938. However, the general public had not yet been able to experience the materiality of nylon for the first time, insofar as they had only heard of it in the press and on DuPont's sponsored *Cavalcade of America* show. Stories circulated in the press of nylons being 'run-proof' and 'strong as steel', adding to the hype of an invincible supernatural material.⁸² Reflecting on nylon's unexpected popularity, one lecturer wrote:

'We recommend that we continue to supply nylon hose to the girls on the floor free of charge. Showing the nylon hose is an important part of their work as many came to this building specifically to see nylon. It seems inadequate to have to tell a woman who has gotten as far as the loom that she will have to go back to the Information Desk for a look at nylon.'⁸³

Here Paul Sampson is referring to the fact that in June 1939, female visitors wanting to see nylon stockings would have been referred back to the information desk at the entrance to see the receptionist and her stockings, as at this point there were none available to see at

⁸⁰ Haraway, 1991, p. 177.

⁸¹ Ortner, 1972, p.24.

⁸² See, for example 'New Hosiery Held Strong as Steel' *New York Times* (October 28 1938); see also news clippings in DPAD Series II, Part 2, Box 58,59.

⁸³ Paul Sampson, 'Report for week of June 18 1939 attention of W.M.A. Hart - report by Paul Sampson', DPA, Advertising Department, New York World's Fair Weekly Reports 1939, Series II, Part 2, Box 35.

first hand on display except on the receptionist: according to Sampson, prior to his report female actors needed to purchase their own nylon stockings. However, efforts were soon made to ensure all exhibit staff were wearing them and were provided with stockings free of charge, presumably due to feedback from female visitors requesting a closer corporeal inspection of nylons.

New analysis of the lecturers' reports shows there was a feedback loop between marketing and presentation. Live reports from the ground led to new innovations in terms of demonstration and presentation. This is crucial to our understanding of nylon's public launch and the role of women's bodies within this. Including a live female model in the show was a relatively spontaneous decision and came in response to reports such as Sampson's. DuPont had originally installed a display featuring a mechanical pair of hands endlessly tugging back and forth at a pair of nylons, designed to demonstrate their longevity and ability to hold their shape (see Figure 4). DuPont had previously relied on mannequins, for example in miniature form, such as at the New York Science Display of 1937 (see Figure 5) and, as some early photographs reveal, initially at the 1939 San Francisco Exposition.⁸⁴ Katherine Mitton, a white female, originally employed as a receptionist, was soon promoted to nylon hose demonstrator.⁸⁵ This shows that DPAD listened to feedback from its female visitors who wanted to see nylons on the female body and reacted spontaneously by changing Mitton's role from that of receptionist to that of 'Miss Chemistry'.

⁸⁴ 'Mannequins dressed in Rayon at early rendition of Golden Gate International Exposition, San Francisco, 1939' in 'Outline for Extension of Wonderworld of Chemistry Usefulness by Means of a Travelling Exhibit', DPA, 77.242.4-5.

⁸⁵ 'We are shy one receptionist since Miss Mitton is acting as model' Weekly reports, July 1939, Advertising department, Exhibit Section, New York World's Fair exhibit (1939) TWW Report July 1 - 8 1939 p.1. Katherine Mitton's name is omitted from the writing of Meikle, 1997, and Handley, 1999, on nylon. Mitton's story provides a valuable perspective on how nylon's popularity at the show depended on the role of the live female body. For more on the display of women's bodies within contemporary industrial expos and the concept of 'promosexuality' see Li Cornfeld, 'Babes in Tech Land: Expo as Capitalist Technology's Erotic Body', *Feminist Media Studies*, 18.2 (2018), 205-220.



Figure 4: DuPont's Mechanical Hands on Display (see background) at the 1939 San Francisco Exposition

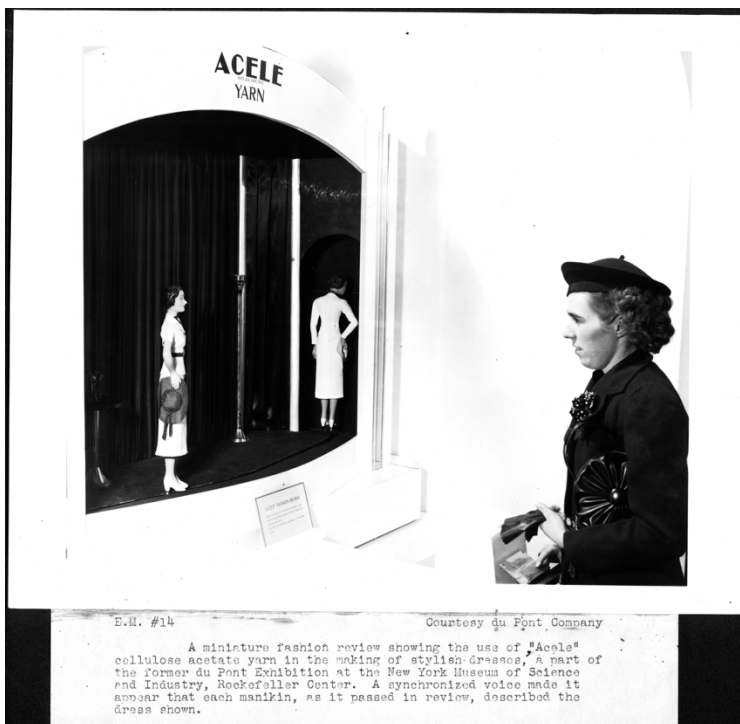


Figure 5: Mannequins at the DuPont Exhibition, New York Museum of Science and Industry, 1937

It is helpful to also consider how DPAD represented material developments in relation to gender. Miss Mitton, staged as Miss Chemistry, was the local 'girl next door', transformed by the glamour and seduction of new materials into an aspirational utopian figure. Everything Miss Chemistry wore could be 'conjured from air and coal', instantly transformed

as if by magic. One journalist commented on the nylon knickers on display in Mitton's midst; 'the magic of soft panties from lumps of coal [...] seems akin to the wizardry of ancient alchemy'.⁸⁶ There is a tension here between realism and materiality offered by the tangible and material versus the illusory alienation from touch and the body provided by mechanical hands and mannequins. Mitton's inclusion shows us that incorporating live female bodies within DuPont's 'Wonder World of Chemistry' display was not a top-down advance decision made by men such as Teague, Barton, or DPAD employees enacting science on the female body, but rather a more nuanced and complex multidirectional process with both male and female agents contributing to the display of the female body within this scientific context. A report reflects:

'On the research section, a very successful addition has been made. Miss Katherine Mitton takes part in the nylon demonstration, on a special platform built for the purpose, seven feet above the floor. As Miss Mitton steps up on to the platform, the lecturer calls attention to the fact that she is "dressed by chemistry from head to toe", and mentions her nylon hose, "Acele" rayon dress, "Lucite" plastic ornaments, hat coated with "Plastacele" plastic, and shoes with "Cellophane" bows and "Pyraheel" coated heels.'⁸⁷

The reports evidence how members of the public were anxious to obtain their own pair of stockings and enjoyed having a member of the display team marked out as the nylon spokesperson. Mitton brought the product of science to life, appearing on a raised platform in a 'lab' before descending to the crowds dressed in its prizes and available to answer their questions. She noted that 'the chief questions on the stockings are still "when will they be on the market?" and "how much will they be?"'⁸⁸ Mitton made DuPont's fibre developments increasingly accessible to the audience by taking them out, or 'down', from the lab whilst parading them on her body and engaging with visitors. Some women asked to touch Mitton's leg to feel what nylon was like on the skin. Others were keen to quiz her on

⁸⁶ Frederick Simpich, 'Chemists Make a New World: creating hitherto unknown raw materials, science disrupts old trade routes and revamps the world of industry', *National Geographic Magazine*, 76.5 (November 1939), 601-40 (p. 602).

⁸⁷ Nylon model introduced June 24 1939, 'Supervisor's report - B.S. Nicholson', Attention of Paul Sampson office, DPA, New York World's Fair Weekly Reports 1939, Weekly reports, June 1939, Advertising department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35.

⁸⁸ Ibid.

her experiences of wearing nylons – what do they feel like? Are they less prone to runs? Do they keep you warm?⁸⁹ No longer something intangible, conjured from coal, air, and tar, nylon could be touched and its silky-soft materiality represented in an interactive exhibit with live female bodies, unlike the previous DuPont displays that had employed mechanical mannequins.

Materiality and touch played a vital role in nylon's promotion and success. Lecturers' reports reveal there was a demand for nylon samples, and that this was repeatedly relayed back to DPAD. As we know, Mitton's performance was a success; however, the lecturers were always looking to further improve their show and give the audience further satisfaction.

'Interest in nylon has increased noticeably since the introduction of Miss Mitton as demonstrator. Frequently after Miss Mitton leaves the platform, she is surrounded by women who want further details about nylon stockings; even ask to feel the stocking on her leg. Which gives me a chance to repeat what I said in last week's report, namely, that the word-of-mouth advertising we could secure by allowing people to feel the stocking would be incalculable.'⁹⁰

Lecturers noted a consistently high interest in nylon's materiality. Visitors had *heard* about nylon in the run-up to its presentation at the 1939 fairs. They had *seen* nylon in imagery promoting the sensuality of touch, such as in this promotional still from *A New World Through Chemistry* (1939) (Figure 6). Now they wanted to see and *feel* nylon for themselves.

⁸⁹ See FAQs from reports; 'FINAL NYWF reports', DPA, Advertising Department, New York World's Fair exhibit - weekly reports 1940, Leonard Waller report 9-7-40, Acc. 641, Records of E.I. DuPont de Nemours & co., Series II, Part 2.

⁹⁰ C.E. Speakman, cited in 'B S Nicholson report, June 25 - July 1 1939', DPA, New York World's Fair Weekly Reports 1939, Weekly reports, June 1939, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35.

Touch is a powerful sense to be considered and yet it has largely been omitted from the scholarship on nylon.⁹¹ DuPont's promise of new materials left visitors wanting to touch and physically engage with these new innovations and form their own discerning opinions.⁹² Touch in these circumstances can also be understood as the ultimate test of success or



Figure 6: Still from *A New World Through Chemistry*, 1939

⁹¹ Handley, 1999; Meikle, 1995.

⁹² For scholarship on touch and textiles see Regina Lee Blaszczyk, 'The Synthetics Revolution and the Senses', Research Seminar Paper 189 at the Hagley Center for the History of Business, Technology and Society, April 25 2019; D. C. Johnson and H. B. Foster (eds.) *Dress Sense: Emotional and Sensory Experiences of the Body and Clothes* (Oxford, New York: Berg, 2007); Anna Moran and Sorcha O'Brien (eds.) *Love Objects: Emotion, Design and Material Culture* (London: Bloomsbury Academic, 2014); L. Negrin, 'Maurice Merleau-Ponty: The Corporeal Experience of Fashion', in Agnes Rocamora and Anneke Smelik (eds.), *Thinking Through Fashion: a Guide to Key Theorists* (London, New York: I.B. Tauris, 2016); Alice Kettle and Lesley Millar (eds) *The Erotic Cloth: Seduction and Fetishism in Textiles* (London: Bloomsbury, 2018); Constance Classen, *The Deepest Sense: a Cultural History of Touch* (Champaign, IL: University of Illinois Press, 2012); Juliet Ash, *Dress Behind Bars: Prison Clothing as Criminality* (London: I.B. Tauris, 2009).

failure. DPAD soon discovered touch could not be replaced by 'grey' or trade literature. It is important to stress, however, that nylon and its materiality of course appealed to all genders. As one lecturer observed, 'it seems the people want a sample of one of the products they can see being made and are not satisfied with our information folders as souvenirs.'⁹³ To visitors a sample of a nylon stocking would be the ultimate token of a visit to DuPont's 'Wonder World of Chemistry' and the plastic utopia it promised.

One lecturer noted: 'the request that we turn down most often is "can I feel that 'nylon' stocking?" A close second is "where can I see the stocking at close view?"'⁹⁴ Dissatisfaction at being unable to experience the material in a tactile way ran high, with many lecturers noting, 'most people are disappointed in that they can't handle a nylon stocking'.⁹⁵ Indeed, it must have been an anti-climax to visit the DuPont display and see nylons stretched endlessly by mechanical hands behind glass or worn by Mitton but not to be able to perform such haptic tests and interact with the materials oneself. How was one supposed to know if they were 'real' or not? What they felt like to touch and how they moved when handled?

Lecturer Herbert S. Chason recognised the publicity dangers of not allowing visitors to touch the stockings. 'The obvious reaction to the frustration of not being able to see the stocking closer is the raising of doubt in the visitors' mind of the success of the stocking.'⁹⁶ If, as the press had reported, nylons would be as 'strong as steel' and 'sheer as cobwebs', then this could surely only be tested by touch and interacting with the material itself.⁹⁷ Chason noted such doubt could easily be avoided, by providing a sample of nylon cloth and a nylon stocking in a translucent box. Unlike nylon stockings, nylon cloth was in less danger of being damaged by touch, so he suggested 'the cloth would be removed so that people could feel it and the stocking could be kept in the box to prevent it from being pulled by

⁹³ 'Supervisor's report June 18 -24 1939, Thomas W. Witherspoon report', DPA, New York World's Fair Weekly Reports 1939, Weekly reports, June 1939, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35, p. 3.

⁹⁴ Herbert S. Chason, cited in 'Report for week of July 9 - 15 WM Hart', DPA, New York World's Fair Weekly Reports 1939, Weekly reports, July 1939, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35.

⁹⁵ John Boyko, 'Lecturers' reports, shift A, July 22 1939', DPA, New York World's Fair Weekly Reports 1939, Weekly reports, July 1939, Advertising Department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35.

⁹⁶ Chason, cited in 'Report for Week of July 9 - 15 WM Hart', DPA, New York World's Fair Weekly Reports, 1939.

⁹⁷ See, for example 'New Hosiery Held Strong as Steel' *New York Times* (October 28 1938); see also news clippings in DPAD Series II, Part 2, Box 58,59.

over-anxious women.⁹⁸ Touch and ‘hysteria’ over nylon are gendered in the reports. Lecturers and DPAD evidently feared women were over-zealous and emotional in their handling of nylons, which had very limited production capacity at the time. The body and corporeality played a vital role in the success of nylon; it was ultimately women’s embodied experience of nylon that was to decide whether or not it was truly a viable alternative to silk for stockings and therefore a commercial success in this realm.

In addition to not being able to predict nylon’s multi-faceted and timely appeal it is likely DPAD were initially unable to immediately supply sample stockings for handling, or nylon samples for visitors to take with them, because when DuPont was introducing and unveiling nylons at the New York Fair they only had a limited number available – they were still working out production logistics and were displaying sample batch runs of stockings. A lecturer noted:

‘Of course questions about “nylon” continue to outdraw all others. I believe there is more interest in “nylon” than in any other product before being placed on the market. The present demand ought to require many months of plant operation before satisfied.’⁹⁹

It is likely that the heightened interest in nylon at the 1939 fairs encouraged DuPont to concentrate more efforts into nylon’s R&D and production methods. As the 1939 exhibits continued, nylon’s production finally went from small-scale lab sample batch production to larger capacity commercial production in 1940.

When DuPont first unveiled nylon stockings to the public at the 1939 fairs, the yarn from these demonstration stockings came from experimental lab production. DuPont’s exhibit changed and grew just as nylon’s R&D was unfolding live. Eventually, nylon was presented from its ‘birth in the laboratory to its appearance in the form of dainty hosiery’.¹⁰⁰ By April 1940, ‘machinery showing the steps in the manufacture of nylon stockings [was soon to be] assembled, actually knitting the hose on the exhibit floor.’¹⁰¹ On 15 May 1940, nylon was first available to the general public on ‘N-Day’, when hosiery manufacturers

⁹⁸ Ibid.

⁹⁹ Ibid.

¹⁰⁰ ‘DPAD April 24 1940 - New York World’s Fair folder’, DPA, 1410, Public Affairs Department History Files, Box 44.

¹⁰¹ Ibid.

offered 4,000,000 pairs for simultaneous sale throughout the country. The supply of the most popular sizes was exhausted within four days.¹⁰²

Nylon's popularity in stores reveals that the first fully synthetic material had come a long way from some of the earlier concerns voiced by women and recorded by lecturers on the potential dangers: nylon was a commercial success. In early September 1940, a lecturer noted, 'in contrast to past weeks, most of the remarks and questions about nylon this week have been based on actual experience with the stockings. It appears that most women have been able to secure and try out at least one pair of nylon hose.'¹⁰³ Questions now related to experience such as 'how should they be washed?' and concerns that nylon would be rationed: 'is the government going to take over the production of nylon?'¹⁰⁴ There were also complaints including how hard it was to get them, 'they run very fast once started', 'colours fade in time, usually after a month or two', sizing issues, 'they bag on thin ankles', 'are too short', 'heel too low' and 'they are hard to repair'.¹⁰⁵ Female consumers attempting to repair this new material are likely to have been disappointed that what the press presented as utopian science could not stop runs and snags from forming.

Positive comments included 'they last longer than silk stockings', 'they hold their shape and go back when washed', 'they wash easily and dry quickly', 'they look more sheer' and 'many women like the way they feel.' Waller noted a recent phenomenon that had emerged in the previous few weeks, women wore nylons every day for periods of time ranging from two to three months to 'test' them. 'The only complaints received from these women were that either the colour had faded, or that they were "sick" of looking at them.'¹⁰⁶

Once nylon stockings were finally sold to the US public, Mitton's performance had become increasingly spectacular: in late June 1939 DuPont changed her presentation into a multi-sensory, musical spectacle.¹⁰⁷ As W. H. Uffelman, assistant manager of DuPont

¹⁰² '84.259 DP Textile Fibers Product Information Collection', Box 27, Folder: Feb 1964: 25th anniversary of Nylon, 1939 NYWF exhibit.

¹⁰³ 'FINAL NYWF reports', DPA, Acc. 641, Advertising Department, World's fair exhibit - weekly reports 1940, Leonard Waller report 9-7-40, Records of E.I. DuPont de Nemours & co., Series II, Part 2.

¹⁰⁴ Ibid.

¹⁰⁵ Ibid.

¹⁰⁶ 'Leonard Waller report 9-7-40, New York World Fair Exhibit reports', DPA, Acc. 641, Advertising Department, World's Fair exhibit - weekly reports 1940, Records of E.I. DuPont de Nemours & co., Series II, Part 2, Box 35.

¹⁰⁷ November 16th 1939, 'Summary of exhibit operations: DuPont "Wonder World of Chemistry" Exhibit New York World's Fair 1939', WH Uffelman - assistant manager, PDA, New York World's Fair Weekly Reports 1939, Advertising Department, Exhibit Section, NYWF Exhibit 1939, Final Report, 1939, Series II, Part 2, Box 35.

Wonder World of Chemistry exhibit operations, reflected, 'Some changes were made in the show which were a decided improvement, the most important of which was the addition of the dais, or "Lady of Chemistry" demonstration at the end of the Manufacturing Section'.¹⁰⁸ Soon after her initial week of experimentation, Mitton's role, no longer that of the 'girl next door', was promoted to the dais and formally named 'the Lady of Chemistry'.¹⁰⁹ Journalists, DPAD staff, DuPont Style News Service staff and lecturers also referred to her interchangeably as 'Miss Chemistry', referencing the 'Miss' beauty pageants (e.g. Miss America, Miss Corn, Miss Cotton, etc), and 'Princess Plastics', a young heiress to a future of plastic possibilities.¹¹⁰ In her featured role, raised on a special platform, the Lady of Chemistry was no longer an individual but faultless chemistry embodied, and was eventually celebrated as the 'grand finale'. In this binary space, Mitton served as gendered mediator between the lab and visitors, connecting the male gendered world of performed polymer science to the female gendered realm of fashion and domesticity.

DuPont's exhibit staff and advertising department vigilantly continued to monitor Mitton's impact on the public, consistently making improvements as they saw fit.¹¹¹ According to the archives, DPAD made a short promotional film of their fair exhibits, no version of which can be traced.¹¹² Only the following description from a promotional booklet and these figures (7,8) remain:

'the painted test tube (luminescent) which forms part of the backdrop, with the lower edge at the top of the centre demonstration counter, opens a hinge and reveals Miss Chemistry in the spotlight. She steps out and as the stage lights go up, parades on top of the demonstration counters, engaging in repartee with the chemist to bring out the chemical origin of her nylon hose, rayon frock, "Lucite" jewellery and so on through her costume. In conclusion, she and the chemist take a bow, and the curtain comes down as recorded music signals the end of the show.'¹¹³

¹⁰⁸ Ibid.

¹⁰⁹ Ibid.

¹¹⁰ For Princess Plastics see 'Test Tube Fashions', *DP Style News Service* June 15 1940, DPA, Acc. 1410 Folder 'NY World's Fair 1939-1940', Public Affairs Department History Files, Box 44. For 'Miss Chemistry' see 'The Chemical Girl of 1940', *DuPont Magazine*, June 1940, DPA.

¹¹¹ Simpich, 1939.

¹¹² 'Outline for Extension of 'Wonder World of Chemistry' usefulness by means of traveling exhibit' (1939), DPA, 77.242.4-5, H/R 207601-609.

¹¹³ Ibid.

In her final incarnation (received with mixed reviews), Miss Chemistry emerged from a lit-up test tube with a dramatic puff of smoke, clad entirely in the latest synthetic materials. Although she still looked like an ordinary woman, thanks to DuPont she now had an added touch of test-tube glamour, showing the improvements their chemicals could offer women, bodies and the everyday. Here visitors were presented with a sleek celebratory vision of how these materials were produced. Unpleasant chemical smells were removed from lab shows.¹¹⁴ The messy sensorial complexities of lab life were neatly edited out and DuPont's R&D was presented as a near-instant clean and fetishised process: Miss Chemistry stepped out of a test tube with a dramatic puff of smoke and flourish of the male chemist's hand. Actors performed as chemists, presenting a glossy version of labour and production, abstracting 'Fiber 66' from its lab context, alienating it from its complex labour processes and thereby embodying and promoting commodity fetishism.



Figure 7: Miss Chemistry Steps Out From the Test Tube, 1939

¹¹⁴ 'The disagreeable odors caused by the reduction of the black solution in the iodine reaction have been done away with' 'Supervisor's Report – B. S. Nicholson for the attention of Mr. Paul Sampson's office', June 11 1939, DPA, New York World's Fair Weekly Reports 1939, Weekly reports, June 1939, DPA, Advertising department, Exhibit Section, New York World's Fair Exhibit (1939), Series II, Part 2, Box 35, 1.



Figure 8: Miss Chemistry and Nylon Stockings, 1939

Lip-synching her words to a pre-recorded lecture, Mitton, performing as Miss Chemistry, no longer had a voice and was unable to step down to engage with the public. Her vocal repartee, no longer with the female members of the audience, is instead a scripted performance on stage with a male 'chemist'. The revised costume designs for the new chemical show were so many and elaborate that a new changing room had to be built.¹¹⁵ In his writing on Miss Chemistry, Meikle argues that towards the end of the New York fair it is likely that many female members of the audience already owned nylons, and

¹¹⁵ Letter dated September 8 1940 in W. Uffelman, 'Report of the week September 1 - September 7 1940', Addressed to W.A. HART advertising department Wilmington, Delaware, Final NYWF reports, DPA, Acc. 641, Advertising department, NYWF weekly reports 1940, Records of E.I. DuPont de Nemours & co., Series II, Part 2.

that perhaps this is why they no longer felt the need to ask her questions. However, it should also be considered that it was becoming increasingly difficult to approach her, as she was part of a rehearsed, scripted and lip-synced show.

As Figure 9 shows, Miss Chemistry of the Future became an ethereal deified figure, a 'genie' spirit released from a man's test tube and looming larger than life. The accompanying text reads:

'A hint of nylon's versatility in the textile field came during the summer of 1940 at the New York World's Fair, when DuPont introduced to the public a 'Miss Chemistry of the Future' dressed from head to toe in chemically-produced materials, many of which were articles made with nylon yarn. Her shoes were covered with nylon satin and, of course, she wore nylon stockings. Her gown was of light blue nylon lace, rivalling in beauty the once justly famed handiwork of Valenciennes lacemakers. Her underthings and foundation garments all were made with the new yarn, and even her 'Lucite' plastic beads were strung on nylon cord. Nothing was said about 'her operation' but she could well have completed the picture with an incision sewn up with nylon surgical suture.'¹¹⁶

Miss Chemistry was no longer just dressed in nylons the audience could see; her underwear and foundationwear were also made of nylon. Moreover, speculation was made on hidden incisions to her body, stitched with nylon sutures. Indeed, Miss Chemistry was increasingly becoming a figure whose entire body was shaped by advancements in plastics, science, technology and medicine. The reference is opaque and it is not clear what her operation is: is it strictly medical or of the cosmetic variety? Perhaps its vagueness indicates the latter. Here Miss Chemistry's body was increasingly becoming a site of transformation, no longer on the skin's surface but also within it.

¹¹⁶ 'Nylon: Versatile Product of DuPont Chemistry' (1941), p. 8,

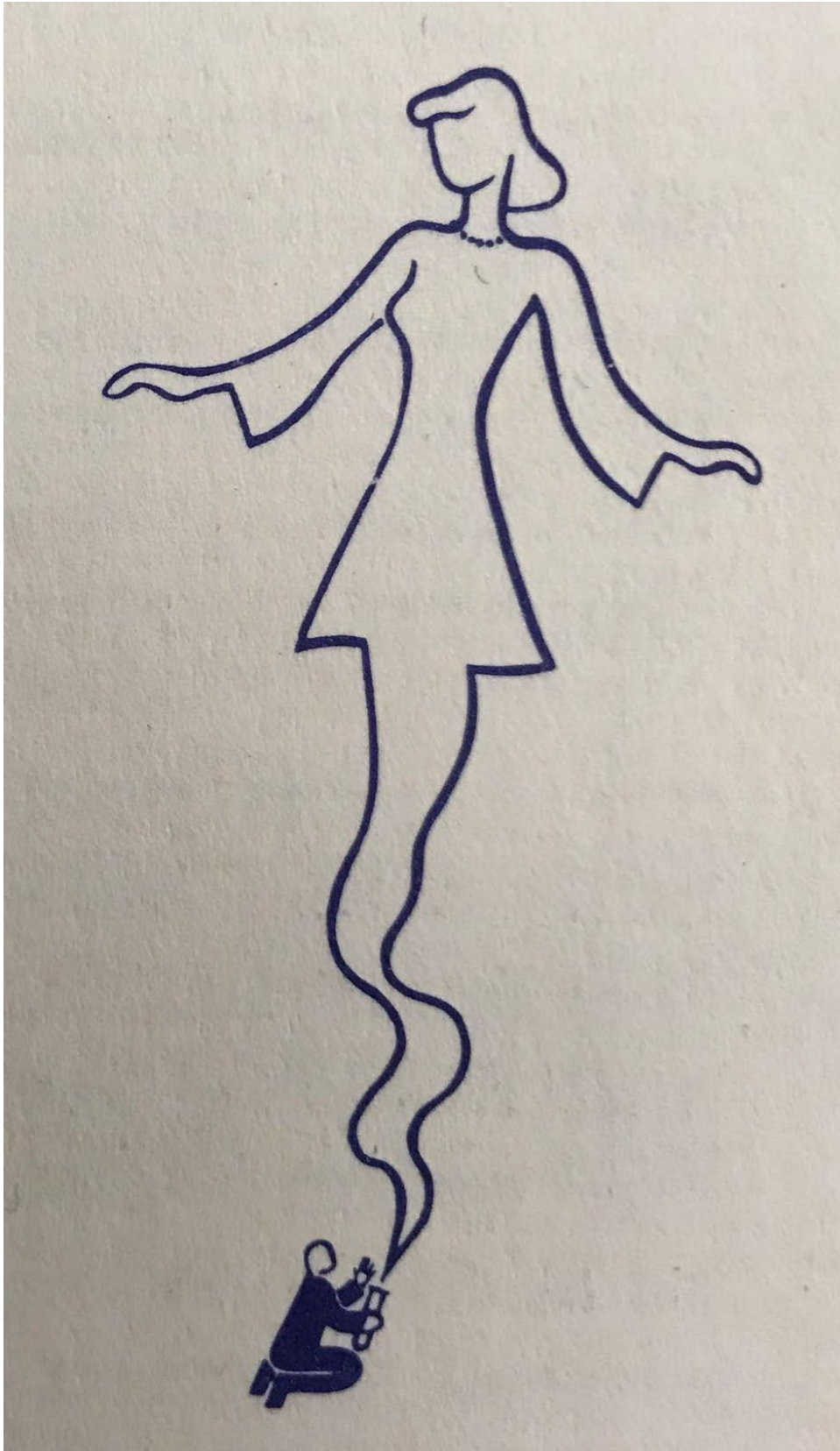


Figure 9: 'Nylon: Versatile Product of DuPont Chemistry', DuPont, 1941

Similarly, returning now to the chapter's opening quote, Fredrick Simpich, reporting on DuPont's New York fair display marvelled:

'at a fashion show, we saw a girl clad from head to foot in artificial materials. Everything she wore was made from synthetic stuffs created by chemists.' He continued, 'only the girl herself was natural – natural flesh and bone wrapped in her own waterproof skin. There she stood, a startling symbol of this new artificial world risen so fast since the World War.'¹¹⁷

It is likely this 'girl' is Mitton, herself transformed into variations of 'Miss Chemistry', embodying a contemporary vision in which future females step out of the test tube, moulded and shaped by artificial materials and male science, or 'Better Things for Better Living... Through Chemistry'.

The vision of a female model dressed from head to toe in plastics and stepping out from a plastic test tube proved to remain a popular trope for DuPont. The company featured 'The Chemical Girl' on the cover of its 1940 magazine (see Figure 10). On 15 June 1940, almost a year after Miss Mitton experimented on stage in the 'lab' and descended into excited crowds, the DuPont Style News Service sent out a press release titled 'Test-Tube Fashions' to 568 newspapers.¹¹⁸ The image depicts a white woman in a glass tube, about to step out into the future in her sparkly new outfit, armed with a smile, she is accompanied by the text 'just about every item in every woman's wardrobe of today, owes something of its origin or better looks or better wearability to the chemist and his work.' According to this rhetoric, women and their appearances can be improved upon, just as Mother Nature can, thanks to the [male] chemist. However, this went beyond representation to corporeality.

¹¹⁷ Simpich, 1939, p. 601.

¹¹⁸ 'Test Tube Fashions', DPA, *DP Style News Service* June 15 1940, Folder 'New York World's Fair 1939-1940', Acc. 1410, Public Affairs Department History Files, Box 44.



Figure 10: 'The Chemical Girl of 1940', *The DuPont Magazine*, June 1940

In the final renditions of Miss Chemistry, in October 1940, items worn on the surface of her skin and Miss Chemistry herself became interchangeable. A DuPont script to accompany her exit from the test tube reads: 'is there a new beauty distilled from the vessels and test tubes of chemistry?' implying that a novel female (body complete with clothing and accessories) can be distilled from scientific apparatus.¹¹⁹ A press release dated a little over a month before the end of the New York fair, on 19 September 1940, clarifies the intention of DuPont's spectacular leanings, 'Where else but the DuPont exhibit could you see a live girl apparently 'created' inside a giant transparent test tube?', adding 'by the way there's a new version of that show, just opened, in which "Miss Chemistry of 1940" is

¹¹⁹ Scripts for Display: 'Lectures for J. L. Hudson, "Wonder World" Show', 27/12/1940, DPA, Acc. 1410, Box 58.

followed by “Miss Chemistry of the Future” clad from head to toe in nylon’.¹²⁰ DPAD are also likely to have promoted Miss Chemistry as a crowd-pleaser to convince local visitors in the New York area to return and revisit DuPont’s new and improved Wonder World of Chemistry display. The vision of Miss Chemistry as ‘distilled beauty’ from the test tube fits into wider contemporary discourse on building, designing and creating female bodies. However, this has also not been discussed in the established scholarship.

Miss Chemistry and Eugenics

Miss Chemistry and the female body as manipulatable surface or material is echoed by ‘Fashions of the Future’, a feature created by male industrial designers commissioned by American *Vogue* for its February 1939 issue celebrating the New York World’s Fair. Of the nine leading American industrial designers, four went beyond designing costumes to comment on and construct future female bodies. This section therefore deals with representation as a site of analysis for how these designers’ interests in material advancements led to a changing understanding of the female body as a site of design in the flesh. It addresses the tension between designing apparel for the female body and seeing the female body itself as an extended site of design.

For his contribution, influential industrial designer Donald Deskey fantasised over a future female race whose bodies would be ‘scientifically beautified’ and no longer required shaping support from foundationwear.¹²¹ Freed from restrictive clothing and underwear, Deskey’s white models appear active, as if in the throes of a eurhythmic dance, as originated by Austrian philosopher and social reformer Rudolf Steiner in the early twentieth century, referencing body fitness, beauty, health and gender. Deskey (see Figure 11) accompanied his design of a semi-transparent flowing gown with the proclamation:

‘Medical science will have made her body perfect. She’ll never know obesity, emaciation, colds in the head, superfluous hair, or a bad complexion – thanks to a controlled diet, controlled basal metabolism. Her height will be increased, her eyelashes lengthened – with some X-hormone.’¹²²

¹²⁰ ‘Press release 9-19-40’ p.7, DPA, NYWF folder, Acc. 1410, Public Affairs Department History Files, Box 44.

¹²¹ ‘Fashions of the Future’, *Vogue*, February 1939.

¹²² *Ibid.*, p. 137.

Deskey saw the future female's 'beautiful body' as a product that she 'owned'. Her body permanently shaped to perfection, 'she'll consider (as I do) corsets and brassieres as unattractive as surgical appliances, and underwear coy. For a woman should never have on anything in which she couldn't appear anywhere - she should never be "undressed"'.¹²³ This implies the future woman must be ready to appear for male consumption anywhere: she is never undressed, as her body is semi-robed to begin with. In Deskey's future fantasy, women no longer relied upon unsightly undergarments: their bodies have been sculpted to perfection, 'emancipated' as they lounge in transparent dresses. Perhaps Deskey thought that being freed of restrictive foundationwear items would appeal to *Vogue's* female readership; however, this freeing of potentially uncomfortable items appears more for the benefit of the male beholder's ability to survey and access the future woman's body than for her own comfort. In this vision, the female form could be permanently displayed, like a living sculpture to be held by the male gaze.

¹²³ Ibid.



Figure 11: 'Donald Deskey Foresees a Great Emancipation', *Vogue*, February 1939



Figure 12: 'Walter Dorwin Teague Forecasts Near-Nudity', *Vogue*, February 1939

Walter Dorwin Teague similarly 'forecasts near-nudity' (see Figure 12). His design comprises a highly revealing robe draped to varying degrees of transparency, the white model's lucite-heeled feet, and legs, thighs, buttocks, breasts exposed to the viewer. Teague reasoned that 'better bodies' and air conditioning will result in 'clothes reduced to a minimum'.¹²⁴ There would be no need to sheath the perfect body in material.

'Most women will have beautiful bodies, and the present trend toward nudity will continue at an accelerated pace. Women's gowns will be designed to reveal the beauty of their bodies and will afford only the minimum of covering that will accentuate their attractiveness. Materials will be draped to reveal their own

¹²⁴ Ibid., 72.

maximum beauty. These materials will be of chemical origin, and many will be either transparent or translucent with an individual life of their own.¹²⁵

In Teague's vision, R&D into transparent plastic materials came of age to coincide with 'better' bodies, each accentuating and complimenting each other. Contemporary fashions for semi-transparent clothing would persist, in turn shaping the body and changes in materials available, and vice versa. Improved flesh required a minimum of coverage, and yet the coverage should also accentuate the beauty and agency of the 'autonomous' materials. In this hierarchy, plastics R&D and women's bodies were given the same importance and value, interchangeably displaying each other's perfections.

Like his white male designer colleagues, George Sakier, engineer and artist, visualised a white woman for his designs. 'The woman of the future will be tall and slim and lovely; she will be bred to it - for the delectation of the community and her own happiness.'¹²⁶ In Sakier's vision of the future, women are 'bred' according to specific racialised corporeal ideals to aesthetically serve the community and in order to realise her 'own happiness'.

As these examples suggest, designers were incorporating eugenics as part of the future in their visions. Raymond Loewy was more direct in his referencing of eugenics, commenting: 'eugenic selection may bring generations so aesthetically correct that such [transparent and revealing] clothes will be in order'.¹²⁷ In 1934, Loewy, an advocate of Streamline design, created a chart of Female Dress and Figure, mapping changes in popular female costume *and* the fashionable female figure (see Figure 13). This stands out from his other evolutionary charts showing product design development, such as that of the desk telephone, or railcar, in that it includes the human body.¹²⁸ Loewy's comparative presentation of the female figure alongside designed artefacts implies that the female body can be designed and sculpted in accordance with the fashionable ideal. It denotes that efficiency and improvement in design can be streamlined to an ever-reduced, svelte body; the female figure is increasingly minimised and, unlike his designs for future telephones or carriages, all that remains for the female figure of the future is a slither-thin question mark

¹²⁵ Ibid.

¹²⁶ Ibid., 144.

¹²⁷ Ibid., 141.

¹²⁸ See Christina Cogdell, *Eugenic Design: Streamlining America in the 1930s* (Philadelphia, PA: University of Pennsylvania Press, 2004), p.50.

suspended in mid-air.¹²⁹ Loewy used female skin as a metaphor for streamlined design, famously referencing Betty Grable's body in his autobiography, reflecting that '[her] liver and kidneys are no doubt adorable, though I would rather have her with skin than without'.¹³⁰ Design historian Ellen Lupton has argued that by masking the internal operations of the machine Loewy domesticated and humanised it, demonstrating that '[he] was certainly aware of the bodily, anthropomorphic quality of his design' and was prone to making comparisons with the [female] corporeal.¹³¹

¹²⁹ For a range of comparisons made by industrial designers between women's figures and the streamlining ideal see Donald Deskey, 'Radically New Dress System for Future Women Prophesies Donald Deskey', *Vogue* (1 Feb 1939), or Raymond Loewy, *Never Leave Well Enough Alone* (Baltimore, MD: The John Hopkins Press, 2002), p. 220, or similarly, Walter Dorwin Teague also refers to 'the body's revealed structure as [...] the mechanism of bone [...] beneath its surface' in Walter Dorwin Teague, *Design This Day* (London: The Studio Limited, 1940), p. 59.

¹³⁰ Loewy, 2002, p.220.

¹³¹ Ellen Lupton, *The Bathroom, the Kitchen and the Aesthetics of Waste* (Cambridge, Massachusetts: MIT List Visual Arts Center, 1992), p. 66. Lupton shows decisively how Loewy and his streamline contemporaries presented female bodies as materials to be shaped and transformed into design. Similarly, Adrienne Berney's article 'Streamlining Breasts: the Exaltation of Form and Disguise of Function in 1930s' Ideals' does an excellent job of presenting how 1930s streamline philosophy impacted on female bodies. Berney focuses on breasts and their potential for nutritive function, arguing that the fashion for 'pointed roundness' was influenced by streamlined technology, as evidenced in lactation breast pumps and conical brassieres. See Adrienne Berney 'Streamlining Breasts: The Exaltation of Form and Disguise of Function in 1930s' Ideals', *Journal of Design History*, 14.4, Technology and the Body (2001), 327-342.

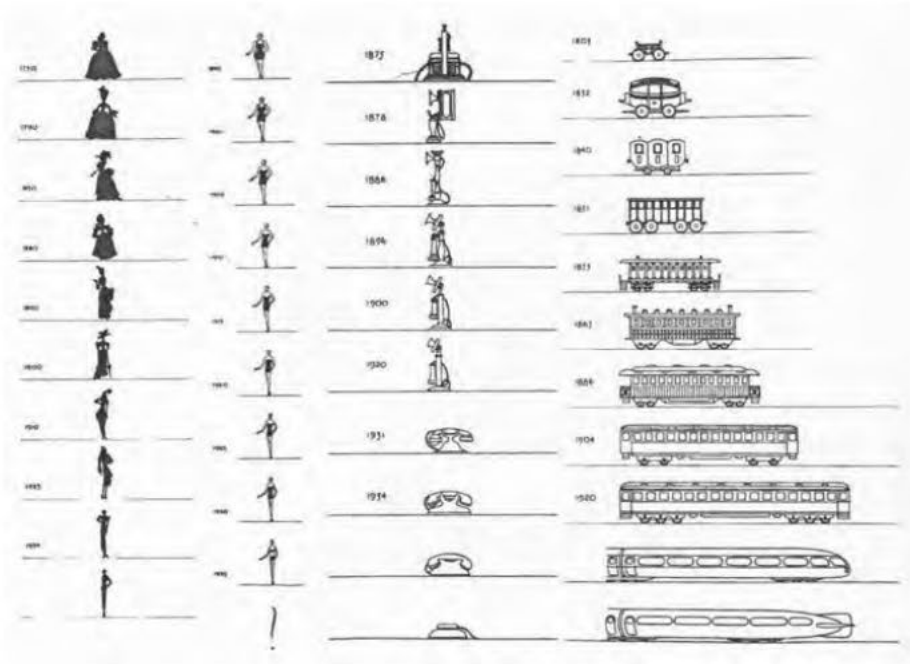


Figure 13: Raymond Loewy, 'Evolution Chart of Female Dress and the Female Figure'; 'Evolution Chart of the Desk Telephone'; 'Evolution Chart of the Railcar' (1934)

American historian Christina Cogdell has most extensively explored the links between streamline design and eugenics.¹³² Her study considers the extent to which eugenic ideology infiltrated middle-class culture in 1930s America and became embodied within streamline design's aesthetics. Cogdell argues that 'streamline designers approached products the same way eugenicists approached bodies'.¹³³ Considering themselves to be 'agents of reform', they both tackled 'mass (re)production, eliminating 'defectiveness' and 'parasite drag' that were thought to be slowing evolutionary progress'.¹³⁴ Working from Cogdell's proposition allows us to see even more clearly how, when *Vogue* invited Loewy, Sakier, Teague and Deskey to design an outfit for the woman of the future, these industrial designers simply extended their approach to designing products and environments to the streamlining of her flesh. In keeping with Cogdell's observation, they treated woman's bodies as any other product that

¹³² Cogdell, 2004. Cogdell builds on Cecelia Tichi's foundational work on technology's impact on the arts in the US from the 1890s to the 1920s, in *Shifting Gears: Technology, Literature and Culture in Modernist America* (Chapel Hill, NC: University of North Carolina Press, 1987).

¹³³ Cogdell, 2004, p. 4.

¹³⁴ *Ibid.*

needed improved efficiency, reflecting eugenicist ideology, similar to the rhetoric I have explored that surrounded Miss Chemistry.

This interchangeable approach to products and bodies is further echoed in February 1939 *Vogue's* nationalist vision of 'To-morrow's Daughter' (Figure 14), a text accompanied by an image not entirely dissimilar from that in Figure 2 (DuPont mural). Edward Steichen's image of 'someone strong and luminous' depicts a white brunette woman draped in a white robe. Referencing Modernist neo-classical sculpture, she stands tall and statuesque, crowned with stars, light radiating from behind her, the New York fair's Tylon and Perisphere towering.¹³⁵ It is worth noting here that she is brunette, rather than blonde. Henthorn writes that the femme fatale, or vamp, was another popular female trope, used in advertising plastics in the US from 1939 to 1959, who signified a 'far more dark and primal seductiveness', less easily tamed.¹³⁶ I would argue that the brunette and the racialised undertones of her appearance 'bordering on the sinister and thus the improper, the unrespectable' was only acceptable as long as her face and body conformed to the athletic Anglo-Saxon hegemonic 'American' white ideal.¹³⁷ In keeping with the industrial designer's streamline dictate, 'The American Woman of To-morrow[']s [...]body will be a perfectly working machine, unencumbered with pain [...] her mind will work clearly, unfogged; with cold logic and warm sympathy.'¹³⁸ This 'profound beauty of body and spirit' is achieved thanks to 'genetics and sciences still uncovered'.¹³⁹ If form follows function, this vision of 'to-morrow's daughter' shaped by eugenicist ideology of her day, reveals that when it comes to designing women, 'spirit' or personality follows beauty.

¹³⁵ 'To-morrow's Daughter', *Vogue* (February 1939), 60 – 61.

¹³⁶ Henthorn, 2006, p. 90. For more on the femme fatale see Helen Hanson and Catherine O'Rawe (eds) *The Femme Fatale: Images, Histories, Contexts* (London: Palgrave Macmillan, 2010).

¹³⁷ Henthorn, 2006, 90. For a history of the creation of 'whiteness', particularly in the US context see Nell Irvin Painter, *The History of White People* (New York: W.W. Norton and Company, 2011).

¹³⁸ 'To-morrow's Daughter'.

¹³⁹ *Ibid.*, 61.



Figure 14: Edward Steichen 'To-morrow's Daughter' *Vogue*, Feb. 1939, p. 60

Lupton considers streamline design in relation to gender and sexuality. She reflects: 'streamlining's evocation of movement, agency, and progress, and its propensity for tapered, conical, and cylindrical forms, makes it a susceptible carrier for masculine sexual connotations.'¹⁴⁰ Designs often featured phallic shapes; however, Lupton argues there is another bodily process involved; the process of elimination [of imperfection]. 'Streamlining presents a surreal conflation of the man-made and the natural; it yields industrial objects whose complex curvature conforms to notions of the organic rather than the mechanical.'¹⁴¹ Lupton demonstrates that designers such as Loewy and Teague drew on natural organic curved shapes, applying rounded aesthetics to hard industrial lines and by doing so creating

¹⁴⁰ Lupton, 1992, p. 68.

¹⁴¹ *Ibid.*

a paradox: in order to create the streamline, organic curves became paradoxically hard and industrial, their transformation creating material waste and sustaining the act of consumption. The 1939 World's Fair issue of *Vogue* shows us that streamline designers applied this approach of obsolescence and reduction to the design of the female body itself; her body is reduced in size, flesh is minimised and bodies that are not white and Anglo-Saxon or Northern European in appearance are entirely left out.

As illustrated, the Test Tube Lady and the streamlined body was a racialised 'white' 'American' body, her ethnicity effaced. The introduction to this thesis has summarised cosmetic surgery historians Elizabeth Haiken's and Sander Gilman's discussions of cosmetic surgery as a tool for Italian Americans and Jewish Americans and immigrants to assimilate to American ideals, to 'efface their ethnicity' and alter their appearance and social presentation: this included Anglicized names, facial surgery, skin lightening and hair straightening, removal or bleaching, in accordance with the representation of then dominant American Anglo-Saxon or Northern European ideals. In *The History of White People*, Nell Painter discusses 'a keen awareness of the difference between *American* standards of beauty and the bodies of women increasingly being called "ethnic"'.¹⁴² Painter writes that in the 1930s, and increasingly throughout the 1940s, 'ethnic' became a label to describe groups of ethnicities that did not match the tall, slender, athletic look celebrated in film, magazines and advertising: these excluded groups included Italian Americans and Jewish groups, particularly Sephardim. In addition to being Anglo-Saxon, desirable bodies also needed to appear middle- rather than working-class.¹⁴³ Scholars such as Richard Dyer and Painter show how individual ethnicity was increasingly effaced in the US in the interwar, WWII and postwar periods in favour of an Anglo-Saxon hegemonic 'American' whiteness.¹⁴⁴

People of colour were largely excluded from the 1939 New York fair, with only a handful of African Americans employed in menial jobs, which led to protests outside the World's Fair Committee Office. African-American attendance was also low at the fair, partly due to economic considerations: the cost of spending a day at the fair was out of reach to many Great Depression-era social groups and families. African-American representation at

¹⁴² Painter, 2011, p. 364.

¹⁴³ *ibid.*

¹⁴⁴ See Richard Dyer, *White* (London: Sage, 1997); Painter, 2011. Painter refers to this period as the 'the third enlargement of American whiteness', tracing how ideas of whiteness are constructed in the US throughout its history.

the fair was limited to entertainment with musicians and performers cast in racist stereotypical roles, reflecting the ideology of the time. Black bodies at the fair weren't streamlined but were othered and presented as overtly sexual and 'savage'.¹⁴⁵ In this troubling dualism, coherent with Haraway's (1991) observations, the body of the undesirable, uncivilised past is black and unruly and the body of the desirable, civilised future is white and controlled.

As we have seen, at DuPont's 1939 displays white women's bodies were placed within the context of the lab and represented in the same discourse as raw materials to be transformed for 'the better' by the scientific superiority of the white man in a white lab coat. Only whiteness is represented and therefore it is implied that only these bodies could be altered to become more desirable and streamlined. *Vogue's* 1939 special issue extolled racist visions of a superior white upper-class American race. An article in this issue, titled 'Good Form', comments on complying with social mores and the shaping of female bodies. It praises '[white] American women' for their meticulous efforts towards streamlined figures and thanks 'controlling garments' for their contribution to giving shape to 'good form'.

'It's not just an accident of nature and heredity that American women, as a group have the most admirable figures in the world. Giving their due to our long-legged frameworks, our athletic lives, and our conscientious efforts towards sleekness, much credit still belongs to those little persuaders, corsets (that includes *all* controlling foundations: girdles, all-in-ones, brassieres).'¹⁴⁶

New stretchy materials employed in foundationwear could help discipline the body into the fashionable streamlined shape. The pliable materiality and mouldability of plastics' materiality became inextricably associated with modelling the fashioned body into a racialised ideal. 'Controlling garments' could help achieve the svelte athletic (Anglo-Saxon white) 'American' middle-class look. In this fight against the female body in its natural unconditioned state, left to the 'mercy of genetics' and 'Mother Nature', *Vogue* argued that foundationwear, which utilised the latest synthetic developments, including nylon, as soon

¹⁴⁵ For more on the representation of people of colour, particularly African Americans, at the NYWF see Robert W. Rydell, *World of Fairs: the Century of Progress Expositions* (Chicago: Chicago University Press, 1993).

¹⁴⁶ 'Good Form in America', *Vogue* (February 1939), p.114.

as they became commercially available, provided a useful cosmetic aid with which to combat 'the pattern of heredity' and shape your body as *you* wanted.¹⁴⁷

'When the Nylons Bloom Again': Wartime Use of Nylon

Following the entry of the US into WWII in 1942, between February 1942 and August 1945 DuPont's entire nylon output was allocated by the War Production Board for vital needs. Here nylon's primary application site shifted from women's bodies to the US Armed Forces. Military and naval applications included tyres for bombers, tow-ropes for gliders, parachutes, Arctic tents, and jungle equipment.¹⁴⁸ DuPont saw this as a marketing opportunity, enthusing: '[nylon is] an all-American peacetime development – and a most timely one – now playing a vital role in winning a global war.'¹⁴⁹ Nylon was presented as far from the home front, deployed in combat, just as male troops were absent.

In the wartime US, nylon became a symbol of hope and aspiration for a synthetic utopian future, free from war and rationing. In 1943, jazz musician, composer and entertainer Fats Waller and screenwriter George Marion, Jr. memorialised wistful dreams of nylon in 'When the Nylons Bloom Again', a song in the comedy musical *Early to Bed*. Their lyrics placed hope in a future of synthetic abundance, a harvest of desirable plastic that would never run dry.

'Gone are the days when I'd answer the bell
Find a salesman with stockings to sell
Gleam in his eye and measuring tape in his hand
I get the urge to go splurging on hose
Nylons a dozen of those
Now poor or rich we're enduring instead
Woolens which itch
Rayons that spread
I'll be happy when the nylons bloom again
Cotton is monotonous to men
Only way to keep affection fresh
Get some mesh for your flesh

¹⁴⁷ 'Fashion: La Belle Poitrine', *Vogue* (September 1 1944), p.167.

¹⁴⁸ 'This is Nylon' 29-minute film mentioned in 1949 folder, DPA, Acc 84.259, DuPont Company, Textile Fiber, Product Information Collection, Box 1.

¹⁴⁹ DuPont Press release 11/20/42, 'Papers on Nylon', DPA File. Acc 1410, Box 10 - nylon papers and patents.

keep on smiling 'til the nylons bloom again
and the WACS come back to join their men
In a world that Mr. [Henry A.] Wallace planned
strolling hand in hand'¹⁵⁰

In these lyrics, nylons are not 'ersatz' replacement materials. Non-polymeric and natural materials are instead seen as a subpar nuisance, that both poor and rich social groups are forced to 'endure' in times of war's hardship. 'When the Nylons Bloom Again' articulates a desire to return to sheathing flesh in synthetic mesh, as natural materials (rayon/cotton) simply will not do any more. Nylons are sexy and silky to touch, and it is implied their seductive and alluring, lightweight, transparent materiality and its novelty can keep love interests 'fresh'. Again, this sensuous intimacy is very far from the fears expressed by some visitors, as collected in the 1939-1940 exhibits reports. Dreams of nylons offered a welcome nostalgic escape from war.

In the early 1940s, purchasing nylons was now only a reality for those who could afford it and were prepared to shop on the black market, where they sold for over \$10 a pair – around \$160 USD in today's currency.¹⁵¹ Some women who could not afford stockings took to a trompe-l'oeil approach – painting seams on their legs to create the illusion of wearing stockings. Nylon stockings became valuable tender when remaining pairs from peacetime production were sold in bond rallies. Movie stars like Betty Grable (famed for her legs) auctioned worn stockings to bids as high as \$40,000.¹⁵² Meanwhile nylon-stockinged pin-ups boosted morale amongst US troops.¹⁵³

Meanwhile on the home front, promises of new resistant materials aimed to boost morale amongst female consumers. A DuPont booklet from 1942 focused on the soft but indestructible nature of nylon's artificial materiality, providing an antidote to the destruction of war, as well as ravages of nature, and promising this is within reach.

¹⁵⁰ Fatts Waller and George Marion, Jr. 'When the Nylons Bloom Again' (New York: Advanced Music Corp., 1943).

¹⁵¹ Handley, 1999, p.48; and 'Inflation', *Dollar Times*
<https://www.dollartimes.com/inflation/inflation.php?amount=10&year=1942>.

¹⁵² See 'Betty Grable in Nylons' DPA, Box 72, 1984.259.

¹⁵³ For more on the pin-up as 'secret weapon' see Despina Kakoudaki 'Pin-Up: The American Secret Weapon in WWII' in Linda Williams (ed) *Porn Studies* (Durham, NC: Duke University Press, 2004), pp. 335-369.

‘Post-war nylon: this spun nylon sweater: soft and warm as fine wool, has the advantage of not shrinking when laundered. Short lengths of the synthetic fiber are spun into soft fuzzy threads to produce a woolly effect. Introduced on a small scale before the war, sweaters, socks, undergarments, fleece coats and other woven and knitted wool-like garments will return after Victory. Nylon is resistant to attack by moths in that moth larvae do not feed on nylon itself.’¹⁵⁴

In this wartime rhetoric, nylon’s novel synthetic materiality could endure all forms of attack and stay preserved in its newness, unaffected by the relentless passing of time in conflict but also stay soft.

Foundationwear companies also promoted the promise of tomorrow’s innovative high-tech materials, which had to be temporarily sacrificed in the war effort.¹⁵⁵ Tomorrow’s peacetime promise of a perfect female body wrapped in an abundance of chemically conjured synthetics was often stressed for its transformative and restorative properties. An all-purpose advert reassured women on the home front: ‘miraculous fabrics [are] doing a wartime job today, but earmarked to glamorise you when the war is won. Then as always, you’ll be a vision of loveliness in your foundations by American Lady.’¹⁵⁶ Stretchy synthetic fibres were promoted as having the advantage of stopping the clock or restoring ‘youth’ to heterosexual female consumers eagerly awaiting the homecoming of the male troops. Such promises of a return to ‘normalcy’ and domestic bliss were frequent and provocative images of war, and soldiers in action were often juxtaposed with images of the domestic to great effect (see for example Figure 15).¹⁵⁷ Textron promised women a synthetic corporeal utopia of auto-design and control, ‘Soon you may wear the Textron gossamer that rides the skies in parachutes today ... soon you may mould your slimness in the delicate-strong fibers that are twisted into tow ropes for gliders!’¹⁵⁸ Here women’s bodies are shaped in new materials that previously served to secure the US’s wartime victory. Although a representation, the proximity of military technologies to the unclothed white female body and role in its shaping

¹⁵⁴ DuPont Company Product Information photograph, *Man-made fibers, Nylon* booklet (1942), DPA, Acc. 1972.34, Box 5.

¹⁵⁵ For more on the politics of US WWII sacrifice see Mark Leff, ‘The Politics of Sacrifice on the American Home Front in World War II’, *Journal of American History*, 77.4 (March 1991), 1296–1318, and Henthorn, 2006.

¹⁵⁶ Advert for American Lady Foundations, *Vogue* (November 1 1943), p.28.

¹⁵⁷ For more advertising images that juxtaposed the war front with the home front to promote wartime use of materials and encourage brand associations with patriotism, see Henthorn’s in-depth discussion of this in *From Submarines to Suburbs*, 2006.

¹⁵⁸ Textron ‘Things to Come, Streamlines Now’ advertisement, 1943, *Vogue* (1 November, 1943) pp.8-9.

is striking. Materials such as Textron's were promoted as protecting ideal femininity, with the power to transform today's stresses of war to tomorrow's promise of peace. They could be transformed from the domestic to the military and back again.¹⁵⁹



Figure 15: Textron 'Things to Come, Streamlines Now', advertisement, *Vogue*, 1943

After WWII, nylons, which had used gendered appeal to promote wartime sacrifice, quickly became a symbol of peacetime prosperity. In August 1945, just one week after WWII ended, DuPont announced its production was to change again, this time to hosiery yarns. DuPont forecast there would be 'enough nylon manufactured to knit 360,000,000 pairs of nylon stockings per year, the equivalent of 11 pairs for every American woman'.¹⁶⁰ It is important to note that DuPont's factories refiguring to produce stockings rather than

¹⁵⁹ These interchangeably gendered materials ultimately had the power to transform a sagging, pendulous bust or a small, under-developed bosom to the conical standardised streamlined ideal. For more on female bodies streamlined by girdles see also Lupton, 1992.

¹⁶⁰ 'Nylon Development', 'Angels Had Help with Nylon 'Miracle'', DuPont press release October 1945 p. 4, DPA, Acc. 1410, Box 57.

parachutes was a production feat more easily achieved than, for example, re-gearing factories to produce white goods. The wartime promise of a future filled with nylons could now finally be delivered.

Riots were reported when the first post-war nylons appeared in shops in early 1946.¹⁶¹ Nylon became equated with the materialisation of peacetime. A Chicago newspaper declared: '[P]eace, it's here! Nylons on sale'¹⁶² The *New York Times* claimed '30,000 women join in rush for nylons', and in Pittsburgh the story was summed up with these words: 'nylon mob, 40,000 strong, shrieks and sways for mile.'¹⁶³ By the end of 1946, nylon production stabilised and journalists reported nylon queues shrinking, even disappearing in some cities.¹⁶⁴ The 'miracle' called nylon was becoming commonplace, and made way for brand new 'miracles' such as 'Orlon' acrylic, 'Dacron' polyester and 'Lycra' spandex fibre, which were being mixed in DuPont's test tubes.'¹⁶⁵ This chapter has argued that it was nylon's glamorous display on the female body and its much anticipated successful reception, however, that paved the way for the acceptance of synthetic materials in such close proximity to the female body.

This chapter has explored the role of the female body in the launching of nylon, the first fully synthetic fibre and the corporeal significance of Miss Chemistry, also known as the Test Tube Lady. Katherine Mitton's transformation into 'chemistry embodied' shows us a willingness to present and understand the female body as a wondrous product or site of design that could be magically concocted from the test tube. This chapter has contextualised the Test Tube Lady within contemporary discourse around eugenics and incorporated critical thinking on the body, gender and race and ethnicity to argue that she represented new ways of thinking about the gendered body as a manufactured site in relation to materials R&D. It has used original archival materials to complicate the established story of Miss Chemistry's appearance at DuPont's 1939 exhibitions, giving a name and a voice to Katherine Mitton, as well as agency to other female actors, such as exhibition visitors, in decisions such as the one to present nylon on a live female body. The chapter argues that women weren't simply 'passive visitors' to the display, they were asking questions and making demands. Although

¹⁶¹ Handley, 1999; Meikle, 1995.

¹⁶² 'Nylon Development', 'Angels Had Help with Nylon 'Miracle', 1963.

¹⁶³ *New York Times*, January 30 1946, *Pittsburgh Press*, June 13, 1946.

¹⁶⁴ 'Nylon Development', 'Angels Had Help with Nylon 'Miracle', 1963.

¹⁶⁵ *Ibid.*

some lecturers' notes reflect misogynist commentary in keeping with social norms and dominant ideology of the time, DPAD were listening to the most common requests made by women, and acted accordingly. Live female embodied experience of nylon became central to its display and success, with the live female body replacing mannequins of earlier renditions.

The chapter has also demonstrated that nylon, although a timely success, was an unexpected one, as blueprints and lecturers' reports reveal it originally had not been incorporated in the exhibition design. It argues that it is likely that nylon's successful and popular presentation at the exhibition was also a result of its presentation on the live female body.¹⁶⁶ Nylon, presented in a utopian fashion, took on a political meaning of autarky, fighting for independence from the importation of silk from Japan, as well as one of hope for building a future moulded by glamorous plastic 'democratic' abundance. Commentary on Miss Chemistry's appearance reveals that her body became increasingly identified as a site of external *and* internal corporeal transformation, her altered appearance stitched together with nylon sutures.¹⁶⁷ By the end of DuPont's exhibit run in 1940, new materials produced by an explosives company once smeared with the slur 'merchants of death' were now generally accepted and less feared, as evidenced by the success of N-Day sales and Miss Chemistry's popularity. The female body played an essential part in softening, domesticating and glamorizing these new synthetic materials. Women's bodies were anthropomorphised into new plastic technologies. Subsequent chapters will develop this point further, building on Chapter One's analysis of representations such as Miss Chemistry to argue that this established a paradigm around women's bodies shaped by military-industrial plastics R&D that was to mould women's bodies inside *and* out throughout the postwar period.

¹⁶⁶ 'Most popular and well attended', as measured by 'Psychological Corporation Studies of Reaction to DuPont's Exhibit 1939-1940,' DPA, Advertising Dept, Exhibit Section, New York World's Fair Exhibit 1939.

¹⁶⁷ Simpich, 1939; 'Nylon: Versatile Product of DP Chemistry' (1941) p. 8.

Chapter Two: Fleshing Out Foam: a History of Polyurethane Foam Development 1937 – 1969

In the postwar US, polyurethane foam (also known as urethane foam) became the plastic foam material of choice for padding. It was used in transportation (cars, aeroplanes, public transport), furniture, upholstery and as insulation in architecture. In addition to clothing, sportswear, accessories and shoes, polyurethane foam was used more intimately in women's foundationwear to pad the body into the curvaceous 'bombshell' ideal. Moreover, cosmetic surgeons such as Robert Alan Franklyn selected polyurethane foam for corporeal feminisation surgery: the permanent padding of the female body under the skin.¹

This chapter discusses polyurethane foam's history, tracing its material inception in Germany in the industrial chemist Otto Bayer's lab and its post-VE day discovery by US plastics experts working for the US Government, accompanying its transfer to the US and examining its commercial application in the designed environment of the postwar US. Particular attention is given to the role of the materiality of polyurethane foam in its corporeal interactions, promotion and commercial success. To highlight its materiality, chemists performed demonstrations in gendered industrial spectacles of science and chemistry's conquest of nature. In its postwar domestic applications, particularly in furniture and other design applications, polyurethane foam was promoted as having gendered corporeal qualities. Chemical companies such as Mobay compared the soft materiality of foam to female anatomy and flesh. It was presented to designers and female homemakers as an ideal material with which to furnish the white middle-class American postwar suburban home.

Unlike the historiographic approach to nylon, there is an absence of archive-driven historical research on foam, both plastic and polyurethane. Indeed, as we shall see in this chapter, polyurethane foam's historiography is sparse by comparison. This chapter on polyurethane foam therefore endeavours to bridge this gap and provide an interdisciplinary history of the material. In addition to bridging a gap in plastics scholarship, polyurethane foam's history is also important in enhancing the following chapter's exploration of its application in the shaping of women's bodies.

¹ Throughout this thesis I use the term 'feminisation surgery' for corporeal (non-facial) cosmetic surgery for both cis and trans women: this includes breast augmentation, as well as surgeries to enhance the buttocks and hips.

This chapter uses a material feminist approach, as proposed by Hekman and Alaimo (2008), to argue that a greater knowledge and understanding of polyurethane's military-industrial provenance and materiality is essential to exploring the cultural and historical significance of its application to the female body in objects worn externally and implanted internally. It explores the changing meanings and applications of polyurethane foam's materiality and its impact on design. By employing a material feminist approach and the interdisciplinary methods this demands, this chapter considers industrial, scientific, military, corporeal and domestic environments to investigate and present the inception and transfer of polyurethane foam to the US, and its gendered domestication in the US postwar consumer market, in more detail. Placing materiality and corporeality at its centre, it illustrates how polyurethane foam, a political, industrial and military material, impacted on the postwar designed environment of the US, which included bodies, particularly women's bodies.

Types of archival material referenced relate directly to the chapter's contributions. First, this chapter draws on a range of interdisciplinary original archival material to produce an in-depth study of plastic foam's development and application, with a focus on polyurethane foam, engaging with technical primary sources.² US Quartermaster Corps intelligence reports and papers of US Military and Government-employed plastics experts are also examined in this chapter to offer a closely observed history of polyurethane foam technology's transfer from Germany to the US. Second, it engages with papers from DuPont's Plastics Products Department, trade and grey literature on plastic foams and interior designer Freda Diamond's papers to explore how polyurethane foam's materiality and soft appeal to the body moved from the lab to domestic space. Third, this chapter employs a materials-centred approach to consider the corporeal materiality of, and bodily engagement with, polyurethane foam, arguing that its appeal and success were due to its visceral, haptic, inviting properties that responded to touch. Fourth, it contextualises foam's military and postwar US history within relevant wider established Science and Technology Studies (STS) and design history scholarship. This includes STS writing on postwar US plastics

² Kurt Frisch and James Saunders *Plastic Foams in Two Parts: Part I* (New York: Marcel Dekker, 1972); R. Crawford *Plastics and Rubber: Engineering Design and Applications* (London: Mechanical Engineering Publications Ltd, 1985); 'Urethane Plastics – Polymers of Tomorrow' *Industrial and Engineering Chemistry* 48 (September 1956) 1383-91.

R&D, the complexities of the military-industrial complex and Project Paperclip.³ STS histories and methods are combined with design history methods and scholarship on US displays of soft power in the Cold War to argue that polyurethane foam was part of a technological and ideological 'Plastics Race'. Overall, these four interdisciplinary areas are combined and engaged with to write a history of polyurethane foam that focuses on its material properties and the changing meaning attached to these properties, with particular attention to the body. This will be essential for a better understanding of its application to the shaping of women's bodies.

Plastic Foam Scholarship

The chapter attempts to contribute directly to the history of plastic foams as a material. Whilst the history of nylon and its relation to the military-industrial complex has been clearly charted by previous scholars, the history of polyurethane foam specifically, and plastic foams in general, is less easily defined. Compared with nylon and silicone, plastic foam is a wider category. Unlike nylon, it does not bear the name of a singular highly successful, specific patent for a synthetic material licensed by one particular chemical company (DuPont), and this makes it more challenging to chart, in terms of historiography as well as archival sources.⁴ In addition to Jeffrey Meikle's *American Plastics: a Cultural History* (1995), histories of plastic foam also emerge briefly in Western design history studies of specific objects, for example the space suit (de Monchaux), surfboards (Neushul and Westwick), bras (Farrell-Beck and Gau) and the Womb Chair (Friedman), as well as the work of architects and furniture designers, including Gaetano Pesce (Pavitt).⁵ In addition,

³ Peter Neushul and Peter Westwick "Blowing Foam and Blowing Minds" in *Groovy Science: Knowledge, Innovation and American Counterculture*, ed. David Kaiser and W. Patrick McCray (Chicago, IL: Chicago University Press, 2016), pp. 51-69; 'Urethane Plastics – Polymers of Tomorrow', 1956; Frisch and Saunders, 1972; Crawford, 1985.

Military-industrial complex: Matthew Wisnioski, *Engineers for Change: Competing Visions of Technology in 1960s America* (Cambridge, MA: MIT Press, 2012); Stuart W. Leslie, *The Cold War and American Science* (New York: Columbia University Press, 1997).

Project Paperclip: Brian Crim, *Our Germans: Project Paperclip and the National Security State* (Baltimore, MD: Johns Hopkins University Press, 2018); Michael J. Neufeld (2012) 'The Nazi Aerospace Exodus: Towards a Global, Transnational History' *History and Technology: An International Journal*, 28.1, 49-67; Douglas M. O'Reagan, *Taking Nazi Technology: Allied Exploitation of German Science After the Second World War* (Baltimore, MD: Johns Hopkins University Press, 2019).

⁴ Examples of specific branded compositions of plastic foams do not feature in fashion history scholarship, but do emerge in medical history scholarship – Ivalon and Surgifoam, for instance. See, for example, Nora Jacobson, *Cleavage: Technology, Controversy, and the Ironies of the Man-made Breast* (New Brunswick, NJ: Rutgers University Press, 2000).

⁵ Jeffrey Meikle, *American Plastics: a Cultural History* (New Brunswick: Rutgers UP, 1995); Neushul and Westwick, 2016, 51-69; Jane Farrell-Beck and Colleen Gau, *Uplift: The Bra in America* (Philadelphia, PA: University of Pennsylvania Press, 2002); Mildred Friedman, 'From Futurama to Motorama', in Brooke Kamin Rapaport and Kevin L. Stayton (eds.) *Vital Forms: American Art and Design in the Atomic Age 1940 -1960* (New York: Brooklyn Museum of Art, 2002); Wendy Kaplan (ed.) *California Design, 1930-1965: Living in a Modern Way* (Cambridge, MA: MIT Press, 2011); Jane Pavitt, 'The Future is Possibly Past: The Anxious Spaces of Gaetano Pesce' in Robin Schuldenfrei (ed.) *Atomic Dwelling: Anxiety, Domesticity, and Postwar Architecture* (London: Routledge, 2012).

this chapter references brief histories of plastic and polyurethane foams discussed in corporate histories, including those of Goodyear, Mobay and Monsanto.⁶

This chapter's efforts to chart the development of foam have been aided by the growth of academic interest in the history of Germany's chemical industry, addressing its wider political context.⁷ In contrast to some of the established work on nylon, some of these studies revisit this history to explicitly ask critical questions around politics, materialism and petrocapiatalism. In her 2005 study *Synthetic Worlds: Nature, Art and the Chemical Industry*, Esther Leslie asks: 'is it possible to tell history from the standpoint of matter?'.⁸ This chapter's exploration of polyurethane foam responds to Leslie's question by beginning with the material itself and engaging with its materiality throughout, arguing that this is essential to 'unmaking' polyurethane foam and gaining new critical perspectives on its gendered applications.⁹

Similarly, historian Andrea Westermann's work on plastics in Germany offers an insightful case study of vinyl as a model for thinking about how material properties impact on politics.¹⁰ Westermann argues that materials and their properties should be understood as artefacts, deserving and demanding academic investigation. This chapter further argues that polyurethane foam's active agentic materiality is closely related to haptics and corporeal engagement, thus proposing the body and corporeality as an essential element of understanding polyurethane foam's materiality.

By engaging with Westermann's and Leslie's approaches and making materials and materiality, as well as the body, central in this chapter, we are also able to better explore the actors and networks, as well as the discourses involved, in polyurethane foam's

⁶ Dan J. Forrester, *Faith, Hope & \$5,000: The Story of Monsanto: The Trials and Triumphs of the First 75 Years* (New York: Simon and Schuster, 1977); Richard Korman, *The Goodyear Story: an Inventor's Obsession and the Struggle for a Rubber Monopoly* (San Francisco, CA: Encounter Books, 2002).

⁷ See, for example, Esther Leslie, *Synthetic Worlds: Nature, Art and the Chemical Industry* (London: Reaktion Books, 2005); Andrea Westermann, 'The Material Politics of Vinyl: how the State, Industry and Citizens Created and Transformed West Germany's Consumer Democracy', in Jennifer Gabrys, Gay Hawkins and Mike Michael (eds.) *Accumulation: the Material Politics of Plastic* (London: Routledge, 2013) pp. 68 – 86; Kathryn Steen, *The American Synthetic Organic Chemicals Industry: War and Politics, 1910 – 1930* (Oakland, CA: University of North California Press, 2014).

⁸ Esther Leslie, 2005, p. 24.

⁹ Esther Leslie's call is one of many from theorists and reflects the 'material turn' in critical thinking. See also for example Jane Bennett, *Vibrant: a Political Ecology of Things* (Durham, NC: Duke University Press, 2009); Daniel Miller, 'Materiality: an Introduction' in *Materiality* (Durham, NC: Duke University Press, 2005) pp. 1 – 50; Bruno Latour, 'Can we Get our Materialism Back, Please?' *Isis*, 98.1 (2007), 138-142; Karan Barad, 'Getting Real: Technoscientific Practices and the Materialisation of Reality', *differences: a journal of feminist cultural studies* 10.2, (1998), 87 – 128. I have chosen to cite and engage with Leslie's work as she conceptually explores the dark poetics of synthetics and their political nature, which is particularly pertinent to my thesis.

¹⁰ Westermann, 2013; Westermann *Plastik und Politische Kultur in Westdeutschland* (Zurich: Chronos Verlag, 2007).

creation, production, application and distribution. This in turn enables us to ask important questions around materials and their materiality: where does polyurethane foam, later implanted in feminisation surgery, originate from? What actors and networks are involved in polyurethane foam's production and promotion? What was polyurethane foam originally *intended* for? How did polyurethane's materiality impact on decisions relating to its US transfer and postwar applications in the designed environment there? What was polyurethane foam used for? How did polyurethane foam's materiality impact on and shape its applications?

In order to help answer these questions, this chapter combines Westermann's and Leslie's critical thinking with that of material feminisms. Material feminisms' inclusive, critically driven material-centred approach and concern with the body is further combined with design history analysis to interrogate primary sources on plastic foams and open new perspectives on materiality. This chapter's interdisciplinary materials, from military intelligence reports to promotional booklets, document corporeal interactions with polyurethane foam and its tactile appeal. These archival sources reveal how polyurethane foam's unique materiality was a central impetus for its applications, in turn impacting on the designed environment and the body.

What is Polyurethane Foam?

Polyurethane foam is a type of plastic foam. Plastic foams can include foam rubber, initially made from whipped natural rubber or latex and later gradually replaced by synthetic alternatives from petroleum by-products.¹¹ Plastic foams are also known as cellular, expanded or sponge plastics. They usually consist of two phases – a gaseous phase (known as the blowing agent) and a solid phase (plastic).¹² During its various production processes, plastic foam essentially traps air and embeds it in its materiality. In its viscous state of production, its chemical reaction ratio can embalm air in myriad labyrinths of tiny pockets, or squeeze it out as it folds into itself like lava. The proportion of blowing agent to solid

¹¹ As I will be discussing throughout this chapter, synthetic alternatives to whipped rubber and latex foams became increasingly common in the postwar US, and cheaper to produce throughout the postwar period. Germany was in the lead when it came to synthetic rubber replacements during WWII: Buna S was the major replacement for rubber, a material born of war and autarky. Westermann's (2007, 2013) extensive and thought-provoking writing on vinyl charts how 'ersatz' became innovation. Nazi propaganda presented plastics research and development scientists as pioneers of a new and exciting field. Plastic came to be seen as something positive, not negative. This was no longer about finding replacements, but instead about bettering the traditional materials nature had to offer in terms of independence and indestructibility. 'Neustoffe' (meaning new materials) was suggested to replace 'ersatz'.

¹² Frisch and Saunders, 1972, p. 3.

plastic matrix determines its density, and this in turn affects the physical properties of the foam. Plastic foams, including polyurethane foams are thus highly versatile: they may be either rigid or flexible, from the hardest, toughest material, almost as dense as solid polymer, to one that is light and fluffy, springy to the touch. Technical descriptions of polyurethane foams often draw on anatomical, biological language. Foams fall into two categories: 'closed cell (unicellular), in which the cells are completely surrounded by a membrane of the solid polymer', and 'open cell, in which the individual cells are interconnected'.¹³ As we shall see, some plastic foams, such as polyurethane, take on corporeal qualities, a complex fleshiness.

Polyurethane foams were used to seal submarines, tanks and planes, encase electricity surging through cables, or to cushion stuntmen plummeting from the perils of their calling. They can be made through 'continuous slab stock production', injection moulding, or baked, foamed in place or sprayed into action, making them ideal for monotonous assembly line production, as well as the spectacular and the performative (more on this later).¹⁴ Shape shifters, they can come pre-packaged in literally any form or size. Examples include boards, blocks, sheets, slabs, tubing, and an infinite variety of moulded shapes. Foam rubber, another type of plastic foam, was also used to make falsies and padded inserts in shapewear.

Scholarship on American foundationwear in the twentieth century touches on 'foam rubber'; however, it does not distinguish between synthetic foams, and there is little mention of polyurethane foam.¹⁵ This seems unusual, as primary sources reveal that over time the market for flexible and rigid plastic foams was eventually dominated by polyurethane foams.¹⁶ In 1956, the US Society of the Plastics Industry, probably wanting to clear up the confusion, announced its adaption of 'the name "urethane foam" for what used to be known as isocyanate, polyurethane, or polyester foam'.¹⁷ A 1959 Mobay booklet

¹³ *ibid.*, p. 2.

¹⁴ *Ibid.*

¹⁵ It appears the terms 'foam rubber' and (poly)urethane foam are used interchangeably within this area of scholarship. See for example Jane Farrell-Beck and Colleen Gau *Uplift: The Bra in America* (Philadelphia: University of Pennsylvania Press, 2002) which does not explicitly mention polyurethane foam, but briefly refers to padding made from 'foam rubber', and 'polyester fibrefill'.

¹⁶ See 'Urethane Plastics – Polymers of Tomorrow', 1956; Frisch and Saunders, 1972; Crawford, 1985. Foam rubbers made from 'synthetic stand-ins', are sometimes called 'poly foams', short for polyurethane or polyester foams.

¹⁷ See 'Urethane Plastics – Polymers of Tomorrow', p. 1383. I have consciously decided to use the term polyurethane as this is the term most commonly used within recent history of design and technology scholarship (Pavitt, Neushul and Westwick) and more closely reflects the material's polymeric qualities.

advised furniture sales staff to explain [poly]urethane foam as ‘a synthetic cellular foam, composed of a mass of tiny air bubbles. Its basic ingredients of manufacture are created by man through chemistry rather than obtained from natural sources such as the rubber tree, or other vegetable or animal sources.’¹⁸

Polyurethane foams offered a new man-made foam material, different to the foam rubber made of rubber tree sap (latex) that preceded it.¹⁹ During WWII, rubber, including foam rubber, became a material with a political context, and Western countries (wanting to cut down on natural rubber imports) were keen on investing resources into researching synthetic rubber and latex production and how to enable this to produce foam.

Tracing Polyurethane Foam’s Provenance and its Archival Legacy

A new type of synthetic rubber foam technology – that of polyurethane – was first developed by Otto Bayer in 1937 at the IG Farben Laboratories, a subdivision of the Bayer Corporation, in Leverkusen, Germany, and can be traced back to nineteenth-century German isocyanate chemistry. Bayer (no relation to the company’s founder), is considered the originator of the polyurethanes industry. He later reflected that his research and developments in polyurethanes stemmed from IG Farben’s ‘urgent problem of creating something similar or better, independent of [Carothers’ nylon] DuPont patents’.²⁰ Plastic foam advancements were created as a reaction to, and an attempt to seek out an ‘ersatz’ version of, the US-developed first fully synthetic fibre, nylon. Bayer developed Perlon, a type of synthetic fibre, for parachute fabrics. Whilst experimenting with the synthesis of novel materials not covered by DuPont’s nylon patents, he realised that new materials with unique properties could be created.²¹ Bayer simultaneously discovered that certain polyols, for example esters and ureas, could be used to produce foamed urethane polymers.²² The

¹⁸ Mobay, *Put the “Soft Sell” of Urethane Foam into your Furniture Sales Story...*, ca. 1959, NMAH Archive Center, #616 Freda Diamond Collection.

¹⁹The Dunlop Rubber Company of Britain first patented a commercial production method for foam rubber in 1929. Foam rubbers could be whipped into a froth or baked into shape. Raider Winget, ‘Foam Rubber Business Has Hit Bonanza’ *Sunday Times Cumberland M.D.*, 19 March 1950.

²⁰ Otto Bayer, ‘Polyurethanes’, *Modern Plastics* (June 1947) (Report first presented 1941 in Frankfurt)

²¹ Otto Bayer created these innovative materials by applying the principle of polyaddition to liquid diisocyanates and existing polyester and polyether diols. This technique is referred to as the ‘basic diisocyanate polyaddition process’ and entails the reaction of two alcohol groups, isocyanates and polyols, to create urethane. ‘Urethane Plastics – Polymers of Tomorrow’, 1956; Frisch and Saunders, 1972; Crawford, 1985.

²² Neushul and Westwick, 2016, p. 58.

presence and type of additional ingredients in the polymerisation formula determine whether solid or foamed polymers result, varying from liquid elastomers to rigid solids.²³

Bayer chemists discovered that rigid urethane foams offered comparatively 'high strength and a wide range of elasticity'.²⁴ DuPont was issued with a series of basic patents in the US from 1937 to 1939 based on Bayer's work, detailing the reaction processes between the key ingredients, demonstrating the international exchange of knowledge and patents that took place in plastic foam R&D before WWII.²⁵ After 1939, all trading between the US and Germany ended, and all research exchange on plastic foam developments consequently ceased. During WWII, German aircraft, tanks and submarines used both rigid and soft urethane foams: rigid for adhesives and fillers and soft 'porophor' foam variations for upholstery and packaging material for transport.

Although DuPont had purchased a series of basic patents just before the outbreak of WWII, the Anglophone historiography of foam notes that the polyurethane group of polymers only piqued the interest of plastics and chemicals groups in the US after WWII, once further developments had continued in Germany and were finally unveiled to the US via military intelligence.²⁶ These scholars posit that it was only in 1945, after the Allies entered Germany, that scientific teams from the US could carry out military intelligence reports on German wartime scientific and technological developments, including foam advancements and application.²⁷ In the historiography, references to these reports, compiled by 'teams of plastics experts', are, however, vague and do not include citations or authors' names.²⁸ I wanted to find out who these 'plastics experts' were and to locate their US military intelligence reports on foam to better understand the provenance of these materials. Eventually, through my research into postwar plastics networks and actors on the US East Coast, I was able to identify and locate the papers of actors within the East Coast plastics military-industrial network (Walter Gloor, Georges Doriot and Gordon Kline), containing notes as well as the original classified Quartermaster Report on German Plastics, including original photographic prints and correspondence. These papers document in detail

²³ 'Urethane Plastics – Polymers of Tomorrow', 1956.

²⁴ *Ibid.*, p. 1383.

²⁵ *Ibid.*

²⁶ See Bernard Dombow, *Polyurethanes* (New York: Reinhold Publishing Ltd, 1957), p. 4; Frisch and Saunders, 1972; 'Urethane Plastics – Polymers of Tomorrow', 1956, p. 1384; Crawford, 1985; Neushul and Westwick, 2016, p. 58.

²⁷ 'Urethane Plastics – Polymers of Tomorrow', p. 1384.

²⁸ Neushul and Westwick, 2016, p. 58; 'Urethane Plastics – Polymers of Tomorrow'; Crawford, 1985.

the initial visceral interactions that members of the US plastics experts team had with these new, previously unseen foams and their materiality. They are also invaluable in evidencing how plastic foam technology was transferred from Germany to the US via military intelligence reports in the postwar period. This narrative illustrates the complex network of military-industrial actors involved in the R&D of postwar plastic foams and their transfer to the US domestic context. Within this narrative, plastic foams were political materials and were understood by US government agents as valuable scientific developments for the furthering of US industry, and thereby ultimately US postwar capitalist ideology. Plastic foams' haptic materiality arguably played a central role in their desirability, successful promotion and corporeal interactions, and consequent impact on the postwar US domestic environment, particularly in relation to women.

German Plastics Industry Quartermaster Report

The political aspect becomes clear in the German Plastics Industry Quartermaster Report, produced under the direction of Brigadier General Georges F. Doriot. Under the auspices of the Quartermaster Corps, a team of plastics experts were sent to Germany immediately after VE day in 1945 to collect data on plastics. Their initial mission was to 'investigate any technical developments in the field of plastics which might have immediate application to the plastics research program of the QM Corps in connection with the war in the Pacific.'²⁹ John M. DeBell (DeBell and Richardson, Springfield, MA) led the team, joined by W. C Goggin (Dow Chemical Company, Midland, MI) and Walter Gloor (Hercules Powder Company, Parlin, NJ). Over three months they visited and reported on the operations of 40 individual plants in all four occupied zones in Germany (British, French, American, Soviet). Headquarters were set up in Frankfurt, from where the group travelled 10,000 miles in tanks, returning 'in one or two weeks [...] loaded with samples and bedraggled personnel'.³⁰ Their journeys took them from the Austrian border to France and from the North Sea to Switzerland.

In August 1945, their observations, recorded for the Quartermaster Intelligence Branch, Procurement Division, were first presented as a technical intelligence report directly to Doriot. The German plastics industry in WWII, the report notes, was largely influenced by

²⁹ Georges Doriot, 'Foreword to the Quartermaster Edition, November 1945' in John M. DeBell, William C. Goggin and Walter E. Gloor, *German Plastics Practice: a Record, Rewritten and Amplified from the Quartermaster Reports* (Cambridge, MA: Murray Printing Press, 1945), p. iii.

³⁰ DeBell, Goggin and Gloor, *German Plastics Practice*, 1945, p.4

two determining factors: 'the enormous wartime demand for substitute articles derivable from the limited raw material available; and the predominant position of the well-organised and well-staffed research divisions of the IG Farbenindustrie A.G.'³¹ The former, driven by autarky, required derivatives of acetylene, heavy chemicals and coal. The latter pushed for the development of the chemical rather than mechanical phases of the plastics industry, favouring reactions over complex equipment, as this would be easier to facilitate with limited access to the materials needed to build equipment.

The experts noted that it was challenging to compare the separate progress of German and American plastics industries in wartime; however, they felt there were some clear and immediate differences, as well as developments identified for military consideration and transfer to the US. They observed: '[Germany has] new chemical types which we consider to be most interesting for the future'.³² One of these areas was plastic foams: '[German] chemical research has been impressive, and has produced fast polymerisation of synthetic rubber, new tough, high-melting or high-curing polymers related to our polyamides (the isocyanates)'.³³ Polyurethane polymers (a type of isocyanate) were an entirely new development, and were not yet available on the US market.³⁴

Isocyanate and polyurethane developments were predominantly located at Bayer's laboratory, the IG Farben Leverkusen plant, within the British occupied zone. DeBell, Goggin and Gloor recognised the great value isocyanates promised for the US for military, industrial and commercial applications. They recommended:

'that after proper negotiation with the British, a commission headed by a very competent chemical development organiser and executive, familiar with plastics and rubber, be installed at Leverkusen until further notice to:

- 1) Extract the enormous information available for the interest of the United States and Great Britain

³¹ John M. DeBell, William C. Goggin and Walter E. Gloor, 'HQ Theater Service Forces, European Theater, Office of the Chief Quartermaster, Quartermaster Report: Technical Intelligence Reports: The German Plastics Industry' p1, Walter E Gloor Papers, Folder 9: De Bell, J.M., W.C. Goggin, W.E. Gloor, 'The German Plastics Industry', Technical Intelligence Reports, Office of the Chief Quartermaster, Technical Intelligence Branch, Procurement Division–August 1945 [APO 757], SHI.

³² Ibid.

³³ Ibid., Appendix 8, p. 1.

³⁴ Gordon Kline, 'Plastics in Germany, 1939 – 1945' *Modern Plastics* (October 1945 152F).

- 2) Put the laboratories to work on applications and improvement problems affecting essential civilian economy and certain military, non-weapon needs for the Pacific war.³⁵

The extraction of plastic foam technology and expertise from Professor Bayer's lab and its transfer first to the US and second to the UK was a top priority for the team of US plastics experts. They recognised the wealth of information that US civilian and military applications could benefit from. Under the direction of an Allied commission, Otto Bayer and his innovative team could be put to immediate work on solution-oriented polyurethane R&D to benefit US (and UK) interests.

Gloor's papers reveal that the consultants had already begun the extraction process in their initial scoping tour, identifying a range of plastic developments to be transferred to the US and UK via reports.³⁶ Intelligence that could be used for the Pacific War was to be prioritised. It was very early in this process, however, that this need shifted, with the end of the Pacific War on 2 September 1945. Priorities were reshuffled somewhat, but rebuilding Germany's factories and reinstating industrial infrastructure was still key. In addition, R&D would also seek to support US military and industrial interests in general, as well as working towards repaying reparation costs. Finally, they recommended 'wide industrial dissemination in the United States of information on the work of [Otto Bayer's I.G. Leverkusen] laboratories'.³⁷ It was hoped that by sharing information widely in the US they would increase competence and production in this new area.

At this time, Otto Bayer's isocyanate discoveries had not yet reached full plant-scale production. However, his pilot-stage production showed great promise, earmarked by the US plastics experts as 'profoundly significant, since this new chemical family has likelihood of wide application in synthetic fibers, high temperature thermoplastics, protective coats, leathers, foams and adhesives.'³⁸ Otto Bayer, they observed, had a large laboratory and staff and, though no work was going on when the experts visited him on 12 and 13 June, repairs were already underway. The report noted: '[Dr. Bayer] should shortly be in position to take

³⁵ DeBell, Goggin and Gloor, 'HQ Theater Service Forces, European Theater, Office of the Chief Quartermaster, Quartermaster Report: Technical Intelligence Reports: The German Plastics Industry' (1945), Gloor Papers, Appendix 8, p. 1, SHI.

³⁶ Walter E. Gloor Papers, SHI.

³⁷ DeBell, Goggin and Gloor, 'HQ Theater Service Forces, European Theater, Office of the Chief Quartermaster, Quartermaster Report: Technical Intelligence Reports: The German Plastics Industry' (1945), Gloor Papers, Appendix 8, p. 1, SHI.

³⁸ *Ibid.*, Appendix 8, p. 2.

on investigations in American interests particularly in utilising isocyanates, or [...] special foams.³⁹ It concluded: 'the splendid laboratory of Dr. Bayer could well be put to work on assigned problems in the interest of the United States.'⁴⁰ Bayer's advances were to be utilised for US applications.

The soft type of polyester-based polyurethane foam Bayer had developed was called Moltopren, described by Gloor, Goggin and DeBell as 'a new light and foamy plastic, which is used as a construction element and insulating material.'⁴¹ Moltopren was 'under investigation for airplane structures and unsinkable airplanes'.⁴² Moltopren was delivered to aircraft manufacturers in block form, approximately 700 x 700 x 100mm and used as a core material, combined with metal and plywood, for aviation wings and stabilisers. It was also used on submarines for sound insulation and on tanks for heat insulation.⁴³ Bosch had also studied Moltopren's insulation properties as a potential solution to auto engines freezing up in Russia, where Germans had had to abandon a vast amount of transportation.⁴⁴ Flexible porophor foam was used for floatation, marine storage compartments and assault boats; meanwhile, 'for peace uses, auto cushions, insulation and bathroom mats are indicated.'⁴⁵

An aspect of the new material that emerges as important in 'The German Plastics Industry', Quartermaster Report's military intelligence, is the foam's materiality and its responsiveness to touch. The report offers a truly unique and perhaps unlikely record of the importance of polyurethane foam's fresh materiality and haptic qualities that made it so inviting to touch and engage with physically. 'The German Plastics Industry Quartermaster Report' is accompanied by 346 photographs. The majority of these document equipment, plants, and heavily bombed industrial sites. The images of foams, however, really stand out. In these photographs we see US investigators and German chemists interacting with each other and the materials. Cigarette cartons are used throughout the report to indicate scale: it is only with the foam images, however, that we see human touch being recorded to indicate materiality. This is evident in a number of images from the report.

³⁹ Ibid., Appendix 8, p. 5.

⁴⁰ Ibid., Appendix 8a, p. 8.

⁴¹ Ibid., Appendix 8a, p. 22.

⁴² Ibid., Appendix 8a, p. 7.

⁴³ Kline, October 1945.

⁴⁴ John DeBell, William Goggin, Walter E. Gloor *German Plastics Practice: a Record, Rewritten and Amplified from the Quartermaster Reports* (Springfield, MA: Murray Printing, 1946) 465.

⁴⁵ DeBell, Goggin and Gloor, 'HQ Theater Service Forces, European Theater, Office of the Chief Quartermaster, Quartermaster Report: Technical Intelligence Reports: The German Plastics Industry' (1945), Gloor Papers, Appendix 8a, p. 7, SHI.

In Figure 1a, a white man's hand reaches in, gripping a white circular object laid out on a dark surface, possibly wooden floorboards; he confidently squeezes the item between his thumb and fingers. His thumb pushes down, almost sinking and vanishing in to one of the seven circular holes, their fleshy white marshmallow-like material inviting touch. Plastic foam is portrayed as easily malleable but also offering resistance; it can be compressed yet has the agency to pop up again into its original moulded shape, a theme that was picked up in later US promotion of plastic foam materials.



PCU porophor foamed submarine galley stowage rack (Report 20c)



Variety of porophor-foamed PCU samples (Report 24d)

Figure 1a (top): 'PCU Porophor foamed submarine galley stowage rack' ca. June, 1945
'Quartermaster Report: Technical Intelligence Reports: The German Plastics Industry'

Figure 1b (bottom): 'Variety of porophor-foamed PCU samples' ca. June 1945 in
'Quartermaster Report: Technical Intelligence Reports: The German Plastics Industry'

Figure 1b shows a group of five white men holding up an assortment of PCU samples. The eye is instantly drawn to John DeBell (second from left), excitedly smiling at the camera. He stands slightly behind two other men, leaning into the space between them somewhat, his right hand lightly holding a small grey ring made of plastic foam, his little finger lifted: this object appears so light that he does not need all fingers or both hands to grip it. In his left hand he raises a larger white circle, the stowage rack from Figure 1a. The other men convey a range of facial expressions: they seem less confident, standing somewhat awkwardly behind their assortment of foam items as if to protect themselves from the camera's gaze. They are wearing suits rather than uniform, and one is dressed in a white lab coat; it is likely that these are local German chemists and engineers working at Continental Gummi Werke AG, Hannover. DeBell's enthusiasm in holding up these objects to the camera (presumably the photographer is either Goggin or Gloor) is almost contagious to the viewer: he appears eager to share his findings at the plant – a new type of material not seen before in the US, so light one barely has to lift a finger to raise it up, and so satisfying to touch and squeeze.

Bayer is shown in Figure 2, his name clearly labelled below. He is the only German chemist to be featured in a named photograph in the entire report. Bayer proudly looks directly into the camera, smiling as he holds up two foam items. The item in his left hand is loosely lifted by a finger, again emphasising its lightness. There are some items on the table behind Bayer; however, these foam items and Bayer himself have been selected as the focus of this photograph. Before WWII, Otto Bayer had participated in international exchange on plastic.⁴⁶ Perhaps Bayer was happy to finally share his developments with American plastics experts and recommence his engagement with international plastics research, interacting with the camera and photographer with confidence.

⁴⁶ Otto Bayer later published his findings in US plastics industry journal *Modern Plastics*. See Bayer, 1947.

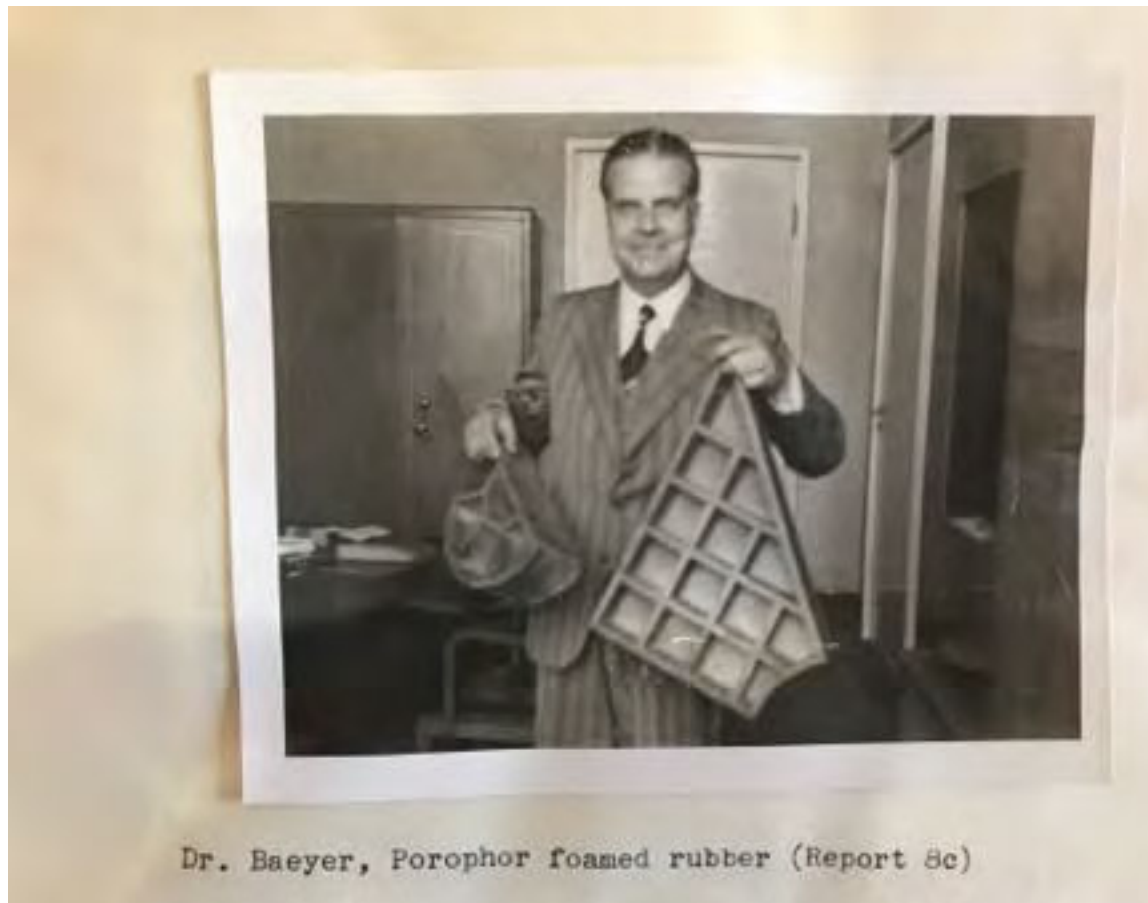


Figure 2: 'Dr. Baeyer, Porophor foamed rubber' ca. June 1945 in 'Quartermaster Report: Technical Intelligence Reports: The German Plastics Industry'

In Figure 3, Bayer's 'physical testing lab' appears with foams in the foreground. A white man dressed in a suit and tie stands behind a funnel-like shape, his right hand resting on the side of it; he smiles at the camera. Unlike many of the images of other (non-foam) plastics locations in the report, the lab looks bright, tidy and clean. In contrast to the photo of Continental Gummi Werke AG, Hannover (see Figure 1b), Bayer's staff seem cooperative and happy to share their research with the investigators, something that was noted in the report, as well as the well-functioning condition of the labs.



Leverkusen, Physical testing lab, foams in the foreground (Report 8k)

Figure 3: 'Leverkusen, (Dr. Baeyer's) Physical Testing Lab, foams in the foreground' ca. June 1945 in 'Quartermaster Report: Technical Intelligence Reports: The German Plastics Industry'

The military intelligence Gloor and his colleagues returned with encompassed written reports, photographs and also material samples. Gloor was particularly keen on sharing samples so that American chemists and industrialists could handle and touch the materials.⁴⁷ Correspondence between Gloor and his colleagues reveals the complex internal working of their operation as plastics consultants to the Quartermaster. The sheer scale of the Quartermaster Reports project was vast, and the military bureaucracy this entailed was, as Gloor notes, incredibly challenging to navigate.⁴⁸ Thus the Quartermaster Report on the German Plastics Industry was clearly of great interest, but its significant length and range of

⁴⁷ John DeBell, letter to General Georges Doriot, dated October 23, 1945, Box 1, Folder 1, Correspondence, Walter Gloor Papers, SHI.

⁴⁸ See for example WC Goggin of Dow Chemical Company, letter to Major Hobson, Office of the QM General, January 29 1946, Box 1, Folder 1, Correspondence, Walter Gloor Papers, SHI.

sites visited far exceeded those in other studies, making it logistically even more challenging to compile and manage.⁴⁹

When considering the German plastics report, it is important to consider that chemical industry competition with Europe, especially Germany, had long been a concern for the US. Kathryn Steen has written extensively on the 1917 Trading with the Enemies Act and how this triggered a concentrated effort among firms, the federal government and universities to make the US independent of foreign chemicals.⁵⁰ Europe's technological advances remained a preoccupation and a concern for decades to come. Leslie and Westermann also explore in great detail Germany's position as a global leader in the production and R&D of synthetics in the years preceding, during and following WWII.⁵¹ The US military-industrial complex was keen to overtake Europe (and particularly Germany's) advancements in synthetics and to secure a position for the US as world leader in scientific and technical achievements: this, of course, included plastics.

In the aftermath of WWII, the US government and its various military branches were anxious to keep up to date with technology since their military equipment, particularly in the American Air Corps, was insufficiently equipped to enter battle at the outbreak of war in Europe in 1939: political concern and unease developed from this acknowledgement of weak military power. In 1939 the US Air Corps had 26,000 personnel, compared with the British Royal Air Force's 100,000 and the German Luftwaffe's 500,000.⁵² President Roosevelt called for the immediate strengthening of the air force, which continued over the next six years, and by the end of WWII US aircraft production facilities were capable of producing over 110,000 aircraft a year.⁵³

In 1941 Roosevelt approved the creation of the Office of Scientific Research and Development (OSRD), a new organisation designed to support the crucial role research and development were going to play in the war effort. The OSRD was to be a civilian organisation, powered by an army of engineers and scientists and set up to coordinate all research activity in all the various disciplines that the government, specifically the military, was funding. WWII was the first war in which US scientists and engineers were almost

⁴⁹ See US Department of Commerce Office of the Publication Board, *Bibliography of Scientific and Industrial Reports*, 2.1, (July 5 1946).

⁵⁰ Steen, 2014.

⁵¹ Esther Leslie, 2005; Westermann, 2007; 2013.

⁵² Ruth Schwartz Cowan, *A Social History of American Technology*, (New York: Oxford University Press, 1997), p. 257.

⁵³ Ibid.

entirely mobilised for the war effort and were part of what social historian of technology Ruth Schwartz Cowan has described as ‘a large-scale, nationwide search effort mounted to solve a series of very particular and very practical problems’.⁵⁴ This vast range of activity and funding was staffed in a huge joint effort by industry and academics; however, it was the government who managed the research, and, since they were sponsoring it, was responsible for awarding grants. The anxiety around technical preparedness on an international scale ultimately gave traction to greater R&D in materials, equipment and munitions in the postwar period.

In 1944, Roosevelt commissioned a report from Vannevar Bush, then head of the Office for Scientific Research and Development (OSRD). It explored ways in which the government might promote scientific and technological progress after the war to improve national health, create new businesses and jobs and raise the standard of living.⁵⁵ The report, which Bush titled *Science, The Endless Frontier* (July 1945) also highlighted a fourth area, ‘the nation’s offensive and defensive capability, to which scientific and technical research, could, and should, contribute’.⁵⁶ In the ensuing years and decades, and as the Cold War increased in intensity and technological complexity, Bush’s assertions rang true with a growing number of supporters and federal funds were increasingly invested in R&D. The US as ‘world leader’ is a sentiment voiced in DuPont’s promotional film *A New World Through Chemistry* (1939) (see Chapter 1). This reflects how various component members of what Eisenhower later famously referred to as the US military-industrial complex, including military-related agencies and organisations such as the OSRD (1941) and RAND Corporation (1948), were keen to secure the US’s position as the world leader in scientific and technical achievements, which included plastics. Doriot was keen on access to extracted information / military intelligence being available to all: ‘on the matter of giving away information we should make very sure that all companies, large, small, medium, individually, anyone who might want it can have it.’⁵⁷ An important concern at this point was the fair, but also rapid, distribution of the German plastics reports.⁵⁸

⁵⁴ Ibid.

⁵⁵ Ibid., p. 260.

⁵⁶ Ibid.

⁵⁷ ‘Colonel Romer and General Doriot, August 14 1945’, conversation transcript, War Dept. Files Correspondence: German scientists and experts, Georges Doriot Papers, Box 8, Library of Congress, Washington, DC, US.

⁵⁸ See correspondence in Gloor and Doriot’s papers. Both Gloor and Doriot were anxious to come up with an efficient and seemingly unbiased system for distributing plastics intelligence. Gloor and Doriot hoped the Department of Commerce, a federal agency, could act as neutral intermediary in the distribution of intelligence amongst industry to avoid accusations of

German plastics intelligence collected by American investigators just after VE day, between May 20 and September 1 1945, was also rapidly disseminated via plastics trade and industry publications. In October 1945, just a month after technical intelligence extraction had been completed, *Modern Plastics* published the first of two review articles reporting on developments in plastics in Germany during WWII.⁵⁹ These articles were authored by its Technical Editor, Gordon Kline, Chief of Plastics, National Bureau of Standards, a physical sciences laboratory and agency of the US Department of Commerce. In addition to technical representatives from the QM Corps and National Bureau of Standards, the team included members of the Ordnance Department, Chemical Warfare Service, Technical Intelligence Industrial Committee and other groups, such as the Field Information Agency, Technical. Kline's report further celebrated polyurethanes as an exceptionally dynamic group of materials previously unknown to the US, providing an overview of technical information, applications and economics.

In 1946, DeBell, Goggin and Gloor's *German Plastics Practice: a Record, Rewritten and Amplified, from the Quartermaster Reports* soon followed Kline's article. *German Plastics Practice* provided far greater technical detail than Kline's introductory articles on the findings. This 554-page indexed publication sold for \$4 (roughly \$57 today) and included all the images from the original Quartermaster Reports.⁶⁰ Legal disclaimers preceded US-based publication of German industry intelligence, distancing the US Government from potential copyright infringements.⁶¹ These were, however, followed by conflicting statements of interest, such as 'it is expected that the various plastics companies will keep the

military favouritism. See John DeBell, Letter to General Georges Doriot, October 23, 1945 and Goggin, letter to Major Hobson, Office of the Quartermaster General, January 29 1946', Correspondence, Walter E. Gloor Papers, Box 1, Folder 1, SHI; 'Colonel Romer and General Doriot conversation, August 14 1945', Georges Doriot Papers, War Dept. Box 8, Files Correspondence: German scientists and experts, Library of Congress, Washington, DC, US. Papers show that companies who had development contracts with the Quartermaster Corps may have been granted priority access, however this is beyond the scope of the thesis' research.

⁵⁹ Kline, October 1945 pp. 152A – 152P; Gordon Kline 'Plastics in Germany, 1939-1945 Part II' *Modern Plastics* December 1945 (page numbers not included), Gordon Kline Papers 1930-1980, Hagley Museum and Library, Wilmington, Delaware, US.

⁶⁰ Reports on German and Japanese industry, including FIAT (Field Information Agency, Technical) reports, were also distributed in the UK by HM Stationery Office and could be viewed by appointment at The Technical Information and Document Unit. *Classified List No. 19: Reports on German and Japanese Industry published during the period April 1 to August 31, 1948* (London: HMSO, 1948), Gloor Papers, Correspondence, Box 1, Folder 1, SHI. <https://www.in2013dollars.com/us/inflation/1945?amount=4> (accessed 15 Feb. 2020)

⁶¹ For example, Kline's (1945) articles stressed that the US Department of Commerce was 'merely distributing technical information' from Germany and that it 'should be made available to all United States citizens interested in it' but that caution should be exercised around patent laws.

Quartermaster Corps informed of any interesting products or processes that result from information contained in this report.⁶²

American Context for German Plastics Industry Intelligence and Foam Reception

It is important to consider these disclaimers within the context of Germany's long rivalry with the US in the chemical, and more recently the plastics, industry.⁶³ Government agencies such as the US Department of Commerce (USDC) were keen on getting intelligence on German technological advancement to the burgeoning US plastics industry as quickly as possible in order to minimise competition from Germany. The USDC repeatedly warned about patent infringement, but how would this really have been enforced? Disseminating industrial information extracted from Germany could bring the US up to date with any technological developments that had occurred there during the war. The USDC's role in the technological extraction and transfer of intelligence about Otto Bayer's polymeric polyurethane foam inventions reveals how plastics were part of the postwar political push by the US to secure its position as scientific and industrial world leader. This also shows the complexity and scale of the plastics intelligence transfer project. Distributing information to plastics R&D labs across the country also ensured the stimulation of activity in an area the Quartermaster Corps were actively interested in, thus essentially outsourcing R&D to commercial companies and asking that they alert them to any promising new materials that could be useful to the US Armed Forces, thereby reducing costs associated with materials experimentation.⁶⁴

The technological and ideological postwar battle of the Cold War Arms and Space Race has been well covered in scholarship.⁶⁵ In addition, scholars such as Elaine May, Cynthia Henthorn, Walter Hixson, Beatriz Colomina and Greg Castillo have argued that there was a third race, one of 'living standards'.⁶⁶ These unstudied Quartermaster Reports,

⁶² Doriot, 1946, p. iii.

⁶³ As discussed in Chapter 1 on nylon and the 'Test Tube Lady'. For more on this see for example Steen, 2014.

⁶⁴ For more on postwar outsourcing of R&D see Eric Hintz, 'The Post-Heroic Generation: American Independent Inventors, 1900–1950' *Enterprise & Society* 12. 4 (2011), 732-48.

⁶⁵ See for example Naomi Oreskes and John Krige (eds.), *Science and Technology in the Global Cold War* (Cambridge, MA: MIT Press, 2014); Crim, 2018; Michael J. Neufeld 'The Nazi Aerospace Exodus: Towards a Global, Transnational History' *History and Technology: An International Journal* 28.1, (2012), 49-67; Douglas M. O'Reagan, *Taking Nazi Technology: Allied Exploitation of German Science After the Second World War* (Baltimore, MD: Johns Hopkins University, 2019); Stuart W. Leslie, 1993; Katherine C. Epstein, *Torpedo: Inventing the Military-Industrial Complex in the United States and Great Britain* (Cambridge, MA: Harvard University Press, 2014); Charles J. Hitch and Roland N. McKean, *The Economics of Defence in the Nuclear Age* (Cambridge, MA.: Harvard University Press, 1960).

⁶⁶ Elaine Tyler May, *Homeward Bound; American Families in the Cold Era* (New York: Basic Books, 1988); Cynthia Lee Henthorn, 'The Emblematic Kitchen: Labor-Saving Technology as National Propaganda, the United States, 1939 – 1959', *Knowledge and Society*, 12 (2000), 153 – 87; Cynthia Lee Henthorn, 'Commercial Fallout : The Image of Progress and the

however, now demonstrate there was a 'Plastics Race'. This is an essential aspect of polyurethane foam's origin story, demonstrating how the material was embroiled in an ideological Cold War 'East vs. West' scramble for technological domination. It is particularly significant in our later discussion of its application to the shaping of women's bodies in the US and its relation to national and international ideological displays, particularly in relation to consumption and gender. Correspondence from the Gloor Papers shows that there was a frustration and a worry that Russia was not sharing their technological findings in relation to plastics.⁶⁷ As we have seen, plastics were seen as a viable currency for reparations. The reports reasoned that some German plastics labs and factories, such as Bayer's, could soon be up and running and that they could also work in the US interest.

In a letter to Gloor, fellow US military chemical consultant and engineer Gaston DuBois, former vice president of Monsanto until his retirement in 1945, who was employed to look into reparations, reasoned that 'what we need is responsible men in Germany who can work out proper policies [on plastics], have them accepted by Washington and London, and then carry them out.'⁶⁸ DuBois had recently given a paper to the Foreign Trade Bureau of the St. Louis Chamber of Commerce, where he argued:

'information obtained as reparations is quite different from equipment taken for reparations. If we take equipment out of a German plant, the plant is unable to produce, but if we take information only, the Germans are not deprived of the use of this information. In this way we obtain reparations without greatly impoverishing Germany's economy.'⁶⁹

Feminine Consumer from World War II to the Atomic Age, 1942-1962, in Alison Scott and Christopher Geist (eds) *The Writing on the Cloud: American Clutter Confronts the Atomic Bomb* (Lanham, MD: University Press America, 1997), 24 - 44; Cynthia Lee Henthorn, *From Submarines to Suburbs: Selling a Better America, 1939 - 1959* (Athens, OH: Ohio University Press, 2006); Walter L. Hixson, *Parting the Curtain, Propaganda, Culture and the Cold War, 1945 - 1961* (Basingstoke: Palgrave Macmillan, 1997); Greg Castillo, *Cold War on the Home Front: the Soft Power of Midcentury Design* (Minneapolis, MN: University of Minnesota Press, 2010); Beatriz Colomina, *Domesticity at War* (Barcelona: Actar, 2006); Beatriz Colomina, Annmarie Brennan, and Jeannie Kim (eds) *Cold War Hothouses: Inventing Postwar Culture from Cockpit to Playboy* (New York, NY: Princeton Architectural Press, 2004); Ruth Oldenziel and Karin Zachmann (eds) *Cold War Kitchen: Americanisation, Technology and European Users* (Cambridge, MA: MIT Press, 2009); Paul B. Preciado, *Pornotopia: an Essay on Playboy's Architecture and Biopolitics* (New York: Zone Books, 2014)).

⁶⁷ See for example Gaston DuBois letter to Gloor, July 8 1947, Walter E. Gloor Papers, Box 1, Folder 1, Correspondence, SHI.

⁶⁸ Ibid. N.B. DuBois frequently travelled to Germany pre-World War II for research trips and was familiar with the main chemical companies.

⁶⁹ 'Industrial Germany Today', p.7, attachment in Gaston DuBois letter to Gloor, July 8 1947, Walter E. Gloor Papers, Correspondence, Box 1, Folder 1, SHI.

Plastics, just like other technological and material developments, could be used as currency for reparations and help stabilise Germany's economy. Urethane foam was particularly well suited to this type of intelligence extraction approach to reparations. As mentioned earlier in this chapter, during WWII there was a strategic focus in Germany on the development of chemical processes rather than mechanical developments in order to circumnavigate the limited wartime access to materials. As a result, plastic developments such as polyurethane foam, that were created via a chemical process, were particularly well suited to such an approach to extraction rather than bulky mechanical equipment. In a paper entitled 'Notes on the Stimulation of Plastics Technology by German Disclosures', given at the American Society of Chemists on September 18 1947, DeBell and Richardson echoed DuBois' sentiment, arguing that established production capacity in Germany could be used to help short American supply and work towards mitigating foreign relief costs to American taxpayers.⁷⁰ Sharing Germany's technological advancements with the US plastics industry can also be seen as a material example of the country's postwar aspiration to become the world's leading military and industrial capitalist power.

Major air, space and weaponry technologies within the military-industrial complex, particularly Wernher von Braun's research on space exploration, were essentially Nazi technologies transferred to the US from Germany via Project Paperclip, adapted for US use and a shared ideological contempt for Soviets.⁷¹ In *Science and Technology in the Global Cold War*, the key argument in Naomi Oreskes' and John Kriges' edited volume of essays is that military-industrial complexes are far more internationally interconnected than has been considered previously in much of the established scholarship.⁷² Oreskes argues that 'the arms race, most obviously, would not have occurred without the East-West political conflict that is often taken to define the Cold War, but it also *could* not have occurred without the work of scientists and engineers.'⁷³ The extraction of German technological expertise through information, equipment, scientists and engineers also contributed to the successful emergence of the US military-industrial complex and R&D culture that was to shape postwar US technology. US intelligence that had formerly been classified and was deemed less

⁷⁰ John M. DeBell and Henry N. Richardson 'Notes on the Stimulation of Plastics Technology by German Disclosures' (paper given at the American Society of Chemists, September 18 1947) (p. 9), Walter E. Gloor Papers, Box 1, Folder 5, SHI. See also DeBell, Goggin, Gloor *German Plastics Practice*, 1946, p.12.

⁷¹ See Douglas M. O'Reagan, 2019; Crim, 2018; Neufeld, 2012.

⁷² Oreskes and Krige, 2014.

⁷³ *Ibid.*, p. 1.

sensitive, such as that collected by Gloor, Goggin and DeBell, and later published in *German Plastics Practice* (1946), was theoretically accessible to 'all'. As DuBois has pointed out, the US Department of Commerce's publishing of this data meant it was 'available not only to the US but to the whole world, and certainly the Russians are taking full advantage of it'.⁷⁴ Urethane foams and other German plastics advancements documented in the German Plastics Quartermaster Reports were no longer secret, and were now available internationally.

These reports on German advancements in the field of urethane foams and their military applications, as disseminated in classified and later publicly accessible articles and reports, spurred the interest of both the US Air Force and US industry in studying and producing these foams. Defence research and development contracts, primarily interested in the application of rigid foams for aviation, tanks and submarines, were placed with several organisations including DuPont, Monsanto, Princeton University, Goodyear Aircraft and Lockheed Aircraft.⁷⁵

The US press and plastics companies frequently made production comparisons with Europe, adopting a nationalist and patriotic rhetoric extolling the superiority of US products. For example, in 1950 a journalist noted: 'it wasn't until after [WWII] that Americans jumped into the production battle and started beating out foam [rubber] in typical US mass production style'.⁷⁶ Combative language is employed to imply that the US would overtake Europe in this area. In 1956, *Industrial and Engineering Chemistry* wrote: 'the scores of products presently being manufactured from urethane foams in [the US] represent only a fraction of European applications'; however, projected outputs indicated that the US would soon 'surpass Europe'.⁷⁷

⁷⁴ 'Industrial Germany Today' (p.7) attachment in Gaston DuBois, letter to Gloor, July 8 1947, Correspondence, Walter E. Gloor Papers, SHI, Box 1, Folder 1.

⁷⁵ Neushul and Westwick, 2016; 'Urethane Plastics – Polymers of Tomorrow', 1956; Frisch and Saunders 1972; Crawford, 1985. This list is significant in that it relates to the military-industrial complex and scholarship on this subject. In *Engineers for Change: Competing Visions of Technology in 1960s America* (2012), Wisnioski writes that Princeton was amongst the small number of elite schools, including John Hopkins and Stanford, as well as MIT, to be 'empowered in the military-industrial-academic nexus' (p. 24). Similarly, Lockheed was amongst the top defence contractors to secure vast shares of military research and development funds see, Stuart W. Leslie, 1997. Furthermore, in *Nylon and Bombs: DuPont and the March of Modern America* (Baltimore: John Hopkins University Press, 2006) Pap A. Ndiaye points out that in comparison to DuPont, General Electric, McDonnell Douglas and Lockheed all had far closer collaborative ties with the US government. This will be returned to in Chapter 4 on silicone.

⁷⁶ Raider Winget, 'Foam Rubber Business Has Hit Bonanza', *Sunday Times Cumberland, MD*, March 19, 1950.

⁷⁷ 'Urethane Plastics – Polymers of Tomorrow', 1956, p. 1387.

The first of these products to be commercially available on the US market were rigid polyurethane foams. Lockheed's chemical engineers developed and patented a foamed-in-place rigid polyurethane technique.⁷⁸ In 1950 they licensed further development and production to American Latex Products Co. An article titled 'Foam Rubber Has Hit Bonanza' (1950) enthused: 'foam rubber is obsoleting all except the very cheapest cushioning materials'.⁷⁹ Demand was so high that '[manufacturers] just can't make enough latex foam to fill the insistent demand for automobile seats, furniture cushions, mattresses, pillows, powder puffs and falsies'.⁸⁰ Flexible foams were increasingly being applied to a wide range of everyday items, from transport to domestic and foundationwear items.

In 1951, owing to its continued research and development in Germany, Bayer offered the first *commercially* available urethane protective coatings, followed by polyester-based flexible urethane foams in 1952.⁸¹ DuPont and Monsanto had been producing pilot plant amounts of diisocyanates by 1950 in the US, and other companies, including National Aniline & Chemical Company and B.F. Goodrich, were quick to follow, consequently initiating and expanding their R&D programmes.⁸² One company, however, was to take the lead in polyurethane foam technology supply and licensing in the US. In 1954, after lengthy negotiations, Farbenfabriken Bayer and Monsanto Chemical Co. tapped into the surge of interest in German polyurethane technology in the US by establishing a joint transnational company, Mobay Chemical Co., which would facilitate the introduction of these German technologies to the US.⁸³ Foams were a lucrative area of investment and offered a burgeoning market in postwar interiors (see Figure 4 and 5). House furnishings were the largest market for flexible foams, with 60m lb. consumed in 1960; this was projected to reach 840m lb. by 1975.⁸⁴ Second was the automobile industry, followed by 'marine and flotation, textiles and coverings (including footwear, luggage, wall and window coverings etc.), and floorings' (see Figure 4 and 5).⁸⁵ In addition to home furnishings, urethane foam was particularly appealing to the aviation industry. By 1956, cored, flexible foams were being successfully applied to US aeroplane seat cushioning. At the time the material was

⁷⁸ Ibid., p. 1384.

⁷⁹ Winget, 1950.

⁸⁰ Ibid.

⁸¹ Frisch and Saunders, 1972; 'Urethane Plastics – Polymers of Tomorrow', 1956.

⁸² 'Urethane Plastics – Polymers of Tomorrow'.

⁸³ Frisch and Saunders, 1972.

⁸⁴ Ibid., p. 13.

⁸⁵ Ibid.

understood as boasting both longevity and lightness, providing ideal ventilation and seating properties. The weight saving alone was said to cut the cost of a New York to Los Angeles flight by \$100.⁸⁶

Plastic Foams by Type and Market (in million lb) (42)d

Type	1960	1965	1967	1970	1975
Flexible urethanes	84	235	365	582	900
Rigid urethanes	10	80	134	226	430
Styrenes	44	139	200	333	600
Vinyls	22	85	145	275	570
Olefins	1	12	19	35	65
Other	3	17	22	40	68
Total Plastic Foams	164	568	885	1491	2633
Market					
flexible foams					
housing furnishings	60	166	253	446	840
vehicles	28	82	150	254	364
other	18	72	107	157	266
Total Flexible Foams	106	320	510	857	1470
rigid foams					
low temperature	25	84	103	135	187
buildings	5	30	56	123	294
packaging including cups	7	54	107	208	397
other	21	80	109	168	285
Total Rigid Foams	58	248	375	634	1163
Total Plastic Foams	164	568	885	1491	2633

Figure 4: 'Plastic Foams by Type and Market in Million lb'

⁸⁶ 'Urethane Plastics – Polymers of Tomorrow', p.1388.

Urethane Foam Markets (in million lb) (43)d

Market	1965	1970	1975	1980
Packaging				
flexible	5	15	30	50
rigid	3	10	20	30
Total	8	25	50	80
Furniture				
flexible	90	125	180	240
rigid	0	40	100	200
Total	90	165	280	440
Bedding (flexible)	50	90	130	150
Transportation				
flexible	51	155	235	330
rigid	22	37	55	95
Total	73	192	290	425
Flooring (flexible)	5	20	50	100
Appliances (rigid)	20	70	120	100
Textile and covering (flexible)	15	60	80	110
Construction (rigid)	40	100	200	300
Flotation				
flexible	1	3	7	10
rigid	5	10	17	25
Total	6	13	24	35
Miscellaneous				
flexible	30	60	80	120
rigid	10	30	60	90
Total	40	90	140	210
Total flexible	247	528	792	1110
Total rigid	110	297	572	890
Total urethane	347	825	1314	2000

Figure 5: 'Urethane Foam Markets in million lb'

Spectacle and Material

There is something truly spectacular and performative about the active materiality of polyurethane foam that lent itself to displays. Chemists at Mobay and Bayer's companies utilised this in promotional activities, both at the factory/lab and as part of public exhibitions. A Mobay employee recalls the early days of experimenting at the pilot plant in St. Louis. They would open the converted garage to curious locals, who would see for the first time the production process: 'a nozzle squirting a liquid down on a moving belt; [...] the liquid turn milky as carbon dioxide was formed within it; [...] the liquid mass rather suddenly begins to foam up, increasing in volume many times'.⁸⁷ Wide-eyed visitors would enthuse about the expanding bubbling mass: 'it's like Bromo Seltzer!'.⁸⁸

This was the age of the Las Vegas Atomic Viewing Party, where Nevada's nuclear bomb testing spawned a spectator culture of 'Dawn Bomb Parties', 'Atomic Cocktails' and the 'Miss Atomic Bomb' beauty pageant featuring women dressed as mushroom clouds (see Figure 6, Lee Merlin).⁸⁹ Far smaller in scale, Mobay's displays of polyurethane foam production also enabled the viewer to participate in a spectacle of industrial testing and transformation, its active materiality coming to life through chemical reactions, performed for the consumer's viewing pleasure. Spectacles such as these served to soften, normalise and domesticate the scientific by making lab discoveries accessible and fun.

⁸⁷ Dan J. Forrestal, *Faith, Hope & \$5,000: The Story of Monsanto* (New York: Simon and Schuster, 1977), p. 160.

⁸⁸ Ibid.

⁸⁹ On December 18, 1950 President Harry Truman approved the Nevada Test Site, located in the Nevada Desert 65 miles outside of Las Vegas. The site was aimed at supporting secret government nuclear testing. These blasts became a vehicle for promoting Las Vegas and its hotels. The Las Vegas Chamber of Commerce mapped the best viewing locations for tests and provided this, along with schedules of blasts to tourists. Hotels tapped into this and offered 'all night parties with predawn viewings of a test blast that usually ended with a dubbing of a chorus girl as Miss Atomic Blast... "atomic cocktail" made of equal parts of vodka, brandy, and champagne with a dash of sherry' (Titus Constandina, *Bombs in the Backyard: Atomic Testing and American Politics* (Reno & Las Vegas, NV: University of Nevada Press, 1986), p. 9). For more on Las Vegas atomic viewing parties see also Don Knepp, *Las Vegas: The Entertainment Capital* (Menlo Park, CA: Sunset Books, Lane Publishing Co., 1987); Sally Denton and Roger Morris, *The Money and the Power: The Making of Las Vegas and its Hold on America, 1947-2000* (New York: Alfred A. Knopf, 2001), pp.139-140. Furthermore 'Miss Anatomic Bomb' is discussed by Paul Boyer in 'The United States, 1941-1963: a historical overview' in Rapaport and Stayton, 2002, pp. 38 - 77. Similarly, 'Miss Bomarc', a contestant in a 1958 hair styling competition (named after the US missile) is discussed by Christopher Bright in *Continental Defense in the Eisenhower Era: Nuclear Antiaircraft and the Cold War* (New York: Palgrave Macmillan, 2010). For more on 'atomic age culture' in the US see Paul Boyer *By the Bomb's Early Light: American Thought and Culture at the Dawn of the Atomic Age*, (Chapel Hill, NC: The University of North Carolina Press, 1994); Allan M. Winkler, *Life under a Cloud: American Anxiety about the Atom*, (Oxford: Oxford University Press, 1993); Scott C. Zeman, and Michael A. Amundson (eds.) *Atomic Culture: How We Learned to Stop Worrying and Love the Bomb* (Boulder, CO: University Press of Colorado, 2004).



Figure 6: Don English, *Lee Merlin: 'Miss Atomic Bomb'* (1957), Las Vegas News Bureau

White men in white lab coats or smart suits could perform such displays of scientific superiority in the postwar period on varying scales. Figure 7 captures two chemical

engineers at Bayer, Leverkusen, Germany, demonstrating polyurethane foam. Similarly, in Figure 8, we see Otto Bayer smiling enthusiastically as he stands behind a table decked with beakers, the largest of which has foam material swelling over, angling towards him. Unlike the previous 'chemists' in DuPont's 1939 displays, these are actual working Bayer chemists performing to an industry or university audience.⁹⁰ In both images, the mass bubbles over the confines of the container, mushrooming into a chemical cloud, not entirely dissimilar to carefully monitored US imagery of mushroom clouds looming over Bikini Atoll, Hiroshima, or Nagasaki.⁹¹



Figure 7: Bayer chemists Walter Simmler (right) and unknown (left) perform a polyurethane foam demonstration, circa 1956-1960.

⁹⁰ The photograph in Figure 8 of Otto Bayer, labelled as being taken in Göttingen, Germany, is likely to have been taken at a foam demonstration to students in this famous university city. It is unknown exactly where the photograph in Figure 7 was taken; however, it is likely to have been at a university or industry demonstration, most likely in Germany, possibly in the US.

⁹¹ For more on the carefully monitored use of images of the atomic bombings see Kyo MacLear *Beclouded Visions: Hiroshima-Nagasaki and the Art of Witness* (New York: State University of New York Press, 1998); Boyer, 1994.



Figure 8: 'Otto Bayer performing a foam experiment with polyurethane during a lecture in Goettingen' (1952)

Foam was promoted as a magical material of infinite possibilities. Unlike the previous Bayer images, Figure 9 (1950-59) was shot in a studio and staged. It depicts a white man dressed in a white lab coat. He stands behind a table, an assortment of immaculate glass chemistry accessories at his disposal. These are pristine and untouched: he works confidently and knows exactly what to do. Surrounded by abstract shapes suspended in mid-air, his brow is creased and his eyes focused in utmost concentration. His left arm reaches upwards to pour the fluid contents of a metal bucket into a transparent conical shape, secured by a stand and steadied with his right hand. The caption reads:

‘The chemical being poured and the foams surrounding the scientist in the Elastomers Laboratory at Chestnut Run are made from DuPont's new organic isocyanates. Customers combine the isocyanates with other chemicals to produce urethane foams, which can be soft or rigid, heavy or light and have potential uses in many industries.’⁹²

‘Uses of Organic Isocyanates’ was employed as a DuPont company product information photograph. Its purpose was to promote the infinite transformations that ‘men of science and industry’ had at their fingertips thanks to this new and highly innovative material. An instant conjuring of shapes, concealing its complex technological processes of production, with the test tubes, pipette and beaker unsullied and finished shapes appearing as if by magic, suspended in time and floating in space, this image promotes polyurethane foam as malleable, controllable, low cost and instant.

⁹² DuPont, ‘Uses of Organic Isocyanates’ (1950-1959) DPA, DuPont Company Product Information photographs, Acc. 1972.341



Figure 9: DuPont, 'Uses of Organic Isocyanates' (1950-1959)

As Roland Barthes observed in his essay on plastic, 'so more than a substance, plastic is the very idea of its infinite transformation'.⁹³ This photograph connotes that foam could be shaped into any form. We see an individual white man in a lab coat, responsible for creating

⁹³ Roland Barthes 'Plastic', in *Mythologies* (London: Vintage, 2009 [1957, first translated into English 1972]), 117 – 120 (p. 117).

a new 'miracle' material, no longer reliant on natural imports from foreign and colonised countries: Mother Nature, too, has been made redundant. In keeping with capitalist models, labour processes are disguised and are no longer messy or complex: chemistry utensils are left untouched, finished objects appear as if by magic, the product of a sole superior male creator. This image celebrates the illusory alchemy of petrocapitalism. Barthes reflected: 'plastic is less a thing than the trace of a movement, and as the movement here is infinite, transforming the original crystals into a multitude of more and more startling objects, plastic is, all told, a spectacle to be deciphered: the very spectacle of its end-products'.⁹⁴ In the US postwar period, polyurethane signified absolute abundance: magically conjured from air, it could be moulded to any shape, size or density that was required.

The ideological battle of the Cold War was, as many scholars have argued, also one of soft power.⁹⁵ Popular social commentator David Reisman's fictional account 'The Nylon War' (1951) describes an imaginary US Cold War tactic ('Operation Abundance') that involved bombing the USSR with American consumer goods, including '200,000 pairs of nylons'. Reisman explained that the reasoning behind this operation was simple:

'that if allowed to sample the riches of America, the Russian people would not long tolerate masters who gave them tanks and spies instead of vacuum cleaners and beauty parlors. The Russian rulers would thereupon be forced to turn out consumers' goods or face discontent on an increasing scale.'⁹⁶

In Reisman's satire, labour-saving devices and glamour for women prove a winning combination in the fight against Communism. Incidentally, the export of the American feminine ideal as shaped by the latest synthetics was in fact supported by US Government action. Ida Rosenthal, founder of Maidenform, was the only woman and underwear manufacturer invited to join the US - USSR exchange programme that ran as part of the 1962-63 US - USSR Exchange Agreement.⁹⁷ Journalists enthusiastically covered Rosenthal's

⁹⁴ Ibid.

⁹⁵ Colomina, Brennan, Kim, 2004; Colomina, 2006; Castillo, 2010; Preciado, 2014. See also footnote 66 for more.

⁹⁶ David Reisman 'The Nylon War', in *Abundance for What* (New York: Transaction Publishers, 1964), pp. 67-75 (p.67).

⁹⁷ See 'First Woman on Trade Trip to Russia Leaves Tomorrow', *The New York Times*, July 4; Alice Hughes, 'U.S. Clothiers Plan Tour of Russian Apparel Plants' *Poughkeepsie N.Y. Journal*, June 27 1963; Harry Golden, 'Only in America: Uplift Mission', *New York Post*, Monday, November 18, 1963; Letter from Dept. of State to Ida Rosenthal, Washington, December 31, 1963; Hinda R. Kohn 'Olga and Sonja Have Style But Quality is Still Lacking' *Women's Wear Daily*, Monday, July 29, 1963, all in Maidenform Collection 1922-1997, Acc. 585, Box 66, Folder 7, NMAH Archives Center.

trip, likening her 'bullet' bra designs to a powerful arsenal, able to seduce even the most devout Communists with the allure of capitalism. Upon her return, Rosenthal lamented the inferior quality of synthetics in the USSR: they 'claim to be their own, but who knows'.⁹⁸ Emphasising the US superiority of synthetic advancements, Rosenthal pledged to export Maidenform's superior American products to the USSR. Here we see how nationalist narratives around plastic advancements and a glamorous feminine ideal became politicised.

The Cold War period saw a range of consumer goods strategically paraded by the US in a spectacular stand-off display battle between 'East' and 'West'.⁹⁹ American consumer goods were also deployed in the Americanisation of post-war Europe and Japan. Jane Pavitt, Colomina and Castillo are among the scholars who have argued that modern design and products were used to export and promote American ideology in the Cold War when they were 'assigned an ambassadorial role in Europe' and displayed in exhibitions, including '50 Years of American Art'.¹⁰⁰ The Kitchen Debate of July 1959 is a well-documented example of Cold War ideological combat, thrashed out in words flying over objects in an exhibition.¹⁰¹

The Kitchen Debate demonstrates the importance assigned to the domestic at this time: May posits that 'for [Vice-President] Nixon, American superiority rested on the ideal of the suburban home, complete with modern appliances and distinct gender roles for family members'.¹⁰² The 'model' home was not just the domain of the male breadwinner and female homemaker but also a vast assortment of consumer goods, 'represent[ing] the essence of American freedom'.¹⁰³ Essential to this liberty was what Nixon referred to as the 'housewives' choice'; there were many different manufacturers and many different labour-saving devices to choose from.¹⁰⁴ Freedom became equated with spending power and the variety of goods available for purchase. 'Consumerism was not an end in itself; it was the

⁹⁸ Ida Rosenthal, cited in Kohn, 1963.

⁹⁹ See for example, Henthorn, 1997; Henthorn, 2000; Henthorn; 2006; Castillo, 2010; David Crowley and Jane Pavitt (eds.) *Cold War Modern: Design 1945 – 1970* (London: V&A Publishing, 2008); Colomina, 2004.

¹⁰⁰ 'Fifty Years of American Art' was organised in 1955 by the Museum of Modern Art, New York and sent on tour to Paris, Zurich, Barcelona, Frankfurt, London, The Hague, Vienna and Belgrade. Jane Pavitt, 'Design and the Democratic Ideal' in Crowley and Pavitt, 2008, p. 83. Colomina, 2004; Castillo, 2010; Victoria DeGrazia *Irresistible Empire: America's Advance through 20th-Century Europe* (Cambridge, MA: The Belknap Press of Harvard University Press, 2005).

¹⁰¹ On 24 July 1959, American Vice President Richard M. Nixon and Soviet Premier Nikita S. Khrushchev toured the American national exhibit at the Moscow Fair. They stopped in front of General Electric's radiant yellow kitchen display, a domestic space shut off from the public and debated their respective ideological values. For more on the Cold War Kitchen Debate see Ruth Oldenziel and Karin Zachmann, eds. *Cold War Kitchen: Americanization, Technology and European Users* (Cambridge, MA: MIT Press, 2009).

¹⁰² May, 1988, p. 16.

¹⁰³ *Ibid.*

¹⁰⁴ Richard Nixon, cited in May, 1988, p. 17.

means of achieving individuality, leisure, and upward social mobility'.¹⁰⁵ Newfound postwar affluence and a burgeoning white middle class spread in postwar white American suburbia. The average number of objects in the home increased, afforded by changes in spending power, manufacturing methods, plastic materials and consumer habits.

Having worked on the US home front in the absence of men, women were now encouraged to return to the home. The exhibitionist myth of the ideal American suburban home was stealthily used as what Castillo terms a 'Trojan House' in the Cold War battle of conflicting material ideologies.¹⁰⁶ Here, 'the housewife had become a soldier on the home front; the kitchen, the command post from where she not only controlled the domain of her living space but was purported to defend the nation.'¹⁰⁷ The white cis female heterosexual housewife was presented as a domestic embodiment of American capitalist values.

The bombshell, then, scholars argue, is the antithesis of the housewife.¹⁰⁸ In his interdisciplinary study *Pornotopia: an Essay on Playboy's Architecture and Biopolitics*, Paul B. Preciado argues that in the US post-war period female bodies outside the domestic space were represented as 'disruptive' sexual forces that needed to be disarmed and re-domesticated in the private realm of the home.¹⁰⁹ Preciado, engaging with US postwar histories of domesticity such as May's, writes that US government bodies, such as the American Social Hygiene Association and the Civil Defence Association, perceived 'the increasing presence of women within the public sphere during and right after the war as a civil danger and a sign of sexual disorder, relating paid work and economic independence to promiscuity and prostitution'.¹¹⁰ The independent female body outside the home became politicised, and was increasingly represented as dangerous and capable of mass destruction, a threat to the racial and sexual purity of the American white heteropatriarchal nuclear family. May concludes that the self-supporting woman was unpatriotic and 'in some way un-American'.¹¹¹ The bikini-clad bombshell, along with the sexual and economic emancipation

¹⁰⁵ May, 1988, p. 18.

¹⁰⁶ Castillo, 2010.

¹⁰⁷ Colomina, 2004, p. 14.

¹⁰⁸ May, 1988, p.106; Stephanie Smith, 'Bombshell' in Stephanie Smith, *Household Words* (Minnesota, MN: Minnesota University Press, 2006), pp. 69 – 96; Beth L. Bailey, *From Front Porch to Back Seat: Courtship in Twentieth Century America* (Baltimore, MD: Johns Hopkins University Press, 1989); Preciado, 2014.

¹⁰⁹ Preciado, 2014.

¹¹⁰ Preciado, 2014, p. 71. See also 'Explosive Issues: Sex, Women and the Bomb' in May, 1988, pp. 92 – 113.

¹¹¹ May, 1988, p. 19.

of women, needed to be defused. I would add, however, that the overtly sexual bombshell, as embodied by Marilyn Monroe, was in fact also understood and flaunted as 'American'. In *Cold War Modern*, Pavitt and Crowley argue that Cold War culture witnessed a 'doubling' effect in which that which is 'threat' was also articulated as 'progress', or even desire.¹¹² The bombshell's threatening potential was harnessed and controlled, often through propaganda, Hollywood and also domestication.¹¹³ Political bodies such as the American Social Hygiene Association and the Civil Defence Association were interested in making female bodies disappear back into the home.

Simultaneously, the US postwar home was increasingly filled with alluring new technology and so-called 'labour-saving devices'. Historians of design and technology have discussed the politicised role of gendered consumer goods and technologies in the postwar US home extensively.¹¹⁴ Nixon, in the Kitchen Debate, famously praised postwar advances in domestic technology, such as the washing machine, as emancipating the housewife from domestic chores, thereby stressing their ideological function in capitalist gender roles. Similarly, the most potent weapons in Reisman's imaginary arson were gendered consumer items aimed at women, such as nylons, vacuum cleaners and beauty products. Susan E. Reid reflects that 'a "universal feminine" desire to be a leisured consumer and to beautify herself and her home was presumed to transcend the Cold War ideological divide'.¹¹⁵ Western observers constructed Communist Bloc women as 'deprived, dowdy and work-worn': in short, the antithesis of the white American middle-class housewife.¹¹⁶ Eastern Bloc women were presented as rough, tough, and harsh, while the white American model housewife was, in contrast, polished, soft and glamorous, embodying the consumerist hyper-femininity of the capitalist West.

¹¹² Pavitt and Crowley, 2008.

¹¹³ On the political power of harnessing the sexual potency of the American bombshell in representation see Despina Kakoudaki, 'Pin-Up: The American Secret Weapon in WWII' in Linda Williams (ed.) *Porn Studies* (Durham, NC: Duke University Press, 2004), pp. 335-369.

¹¹⁴ See for example Henthorn, 2000; Henthorn, 1997; Oldenziel and Zachmann, 2009; May, 1988; Ruth Schwartz Cowan, *More Work for Mother: the Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic Books, 1983); Ellen Lupton, *Mechanical Brides: Women and Machines from Home to Office* (New York: Smithsonian, Cooper-Hewitt Museum, 1993); Hixson, 1997; Castillo, 2010; Beatriz Colomina, *Domesticity at War* (Barcelona: Actar, 2006); Colomina, Brennan, and Kim, 2004.

¹¹⁵ Susan E. Reid, "'Our Kitchen is Just as Good": Soviet Responses to the American National Exhibitions in Moscow, 1959' in Crowley and Pavitt, 2008, pp.154 -162, (p.156).

¹¹⁶ *Ibid*, p. 154.

In the Cold War period, American patriotism became increasingly equated with consumerism.¹¹⁷ To purchase goods was to buy into capitalist ideology of postwar America and make ideological opposition to the USSR manifest materially through consumerism. American materialism embodied the 'American Way of Life', and was promoted as a passport to living the American Dream of social mobility and happiness through the pursuit of consumer goods, an abundance of which were now produced using the latest developments in synthetics. Plastics' transformative and spectacular materialities, such as those of polyurethane foam, embodied the transformative ideology of the postwar American Dream.

One of the first companies to capitalise on these apparently limitless possibilities was the Mobay Chemical Company, who celebrated the inviting tactility of foam. Its promotional material emphasised the joy of touching, stretching and squeezing foam.¹¹⁸ Figure 10 shows a page from a 1950s Mobay booklet titled *Put the "Soft Sell" of Urethane Foam into your Furniture Sales Story...*, which illustrated 'why furniture designers and manufacturers choose foam', and was aimed at helping furniture salesmen sell urethane foam to 'Mrs. Homemaker'.¹¹⁹ The booklet is indicative of how polyurethane foam's materiality was gendered and promoted in the postwar US for the domestic environment. It included a summary page with six photographs featuring white male hands engaging with the material; accompanying copy lists urethane foam's benefits: 'TOUGH!', 'STRONG!', 'CHEMICALLY STABLE!', 'LIGHT WEIGHT!', 'SOFT!' and 'VERSATILE!'.¹²⁰ Urethane foam's soft materiality was promoted as 'an entirely new experience. You will have to *feel* urethane foams to understand the growing preference for these materials in cushioning markets'.¹²¹ Corporeal interaction with foam was encouraged and presented as a process of gaining tacit, haptic knowledge.

¹¹⁷ See Henthorn, 2006.

¹¹⁸ See Mobay, promotional material in the Smithsonian's collections; this includes the National Museum of American History Trade Literature Collection and #616 Freda Diamond Collection, NMAH Archive Center.

¹¹⁹ Mobay, *Put the "Soft Sell" of Urethane Foam into your Furniture Sales Story...*, ca. 1959, #616 Freda Diamond Collection, NMAH Archive Center.

¹²⁰ *Ibid.*

¹²¹ *Ibid.*

here's why furniture designers and manufacturers
choose . . . **URETHANE FOAM**



TOUGH! Tear strength up to 8 psi; tensile strength up to 40 psi; may be stretched to 500% of original length without parting.



STRONG! Urethane foams have been flexed at 30 cps at 20-80% deflection for 3,000,000 cycles with minimum property loss.



CHEMICALLY STABLE! Urethane foams are unharmed by dilute acids, alkalis, detergents, water or dry cleaning solvents.



LIGHT WEIGHT! At 2 lbs. pcf, properties of urethane foams are superior to other foams weighing twice as much.



SOFT! An entirely new experience in cushioning effect. You will have to feel urethane foams to understand the growing preference for these materials in cushioning markets.



VERSATILE! Urethane foams may be sliced, sawed, mown, stapled, glued, sprayed or foamed in place, die-cut, flocked, laminated, tufted, contour-cut, with standard fabricating equipment.

Figure 10: Mobay, *Put the Soft Sell of Urethane Foam into Your Furniture Sales Story* (1959)

Urethane foam's presentation as an 'entirely new experience' implies that it is exciting, modern and at the forefront of technology. That said, the copywriters chose to place urethane foam within an established plastics context. They referred to nylon as an example of how recent developments in synthetics improve everyday life:

‘We all know of many examples of how scientific research has improved upon natural materials in our generation. One of the more notable, and perhaps best-known to your homemaker customer, is their replacement of silk (a natural fiber) with nylon (a synthetic) in women’s hosiery.’¹²²

By mentioning nylon, Mobay suggested that the salesman could build on a recent synthetic development to better contextualize another improvement on nature: polyurethane foam. Nylon and its rhetoric were used as a way of contextualising polyurethane foam to the female consumer by example. It was hoped that nylon stockings would invoke trust, sensuality and all the excitement of a new material that would change the everyday life of ‘Mrs. Homemaker’.

Polyurethane foam was presented as an engineered material for a particular application, thereby making it superior to Mother Nature’s flawed offerings. Sales staff were encouraged to promote polyurethane foam as a material designed by chemical engineers with a particular function in mind. Mobay instructed furniture sales staff to stress that natural materials have been applied for specific uses, such as the Hevea tree’s latex sap for natural foamed rubbers; however, this is not the original intention of the material. The male engineer, in contrast, created materials to fit a specific purpose and can therefore provide materials that are superior to Mother Nature’s ‘coincidental’, unreliable and inadequate offerings. In this gendered paradigm, materials offered by the male scientist are carefully calculated and non-coincidental, in contrast to the unpredictability associated with the stereotypical negative traits assigned to women.

Mobay’s promotion of polyurethane foam’s materiality took on a corporeal quality. ‘What are the advantages of urethane foam?’ is listed in a section dedicated to providing answers to questions frequently asked by Mrs. Homemaker. Mobay proposed the following corporeal response: ‘urethane foam does not mat down, stiffen or crumble after prolonged use or ageing’.¹²³ Here, foam is presented as resistant to extended interaction with human bodies – resilient, it keeps bouncing back. Unlike natural bodies it defies decay and ageing. Mobay’s foam ‘is unaffected by dampness, will not rot or deteriorate, and has no food value

¹²² Mobay, 1959.

¹²³ Ibid.

for vermin, bacteria or cold spores.’ It remains unchanged by its environment: again, unlike bodies or natural materials it is inhospitable to naturally occurring bacteria and attracts no other undesirables, such as pests.

Finally, urethane foam becomes flesh-like:

‘Cushions remain plump and lively through an extended period of service life, and even when new, do not have the excessive buoyancy and annoying ‘jiggling’ effect characteristic of other types of foams. Its durable liveliness tends to keep seams and welting snug, straight and neat for better appearance, and it prolongs the ‘new look’ over many years of service.’¹²⁴

Cushions remain as youthful, plump, lively and inviting in their movement as pouty lips or pert, nubile, flesh. Mobay’s foam is superior, however, in that absolute control is exerted over foam’s materiality. Its cushioning is not excessive in its buoyancy: the engineer still has agency and absolute control over the material, disciplining it into just the right softness and without the irritating, uncontained wobbling effect of competing foams. Mobay’s foam materiality is pliable and soft, but its softness is not out of control like that of gendered flabby flesh or hyperactive bouncing foams: it moves and reacts exactly as directed. Foam is presented as a gendered material of science, exuding precision, discipline and control.

Should Mrs. Homemaker enquire about the safety and cleanliness of urethane foam, she would be told:

‘[I]t is one of the cleanest and safest materials ever created by man or Nature. Urethane foam is called “chemically inert”, which means it will not react with other common household chemicals such as cleaning fluids, soaps, spilled foods or liquids, as many natural fibres and foams do. It is sterile, non-allergic and odorless. It is also fire-retardant.’

Urethane foam’s purity is presented as impenetrable to everyday domestic actants such as spillages. It is a unique material in the home, distinguished from previous forms of foams

¹²⁴ Mobay, 1959.

and natural fibres. Mrs. Homemaker was further assured: 'Urethane foam's safety features and purity are among the many reasons it is being selected by automotive and aircraft firms for seating, insulation and safety padding.'¹²⁵ Urethane foam's application in transportation upholstery was flaunted as a promise of security and safety for domestic application. Industrial and peacetime reconversion was understood as a seal of quality: if polyurethane could pass safety tests for aviation and automobiles, then it would surely meet Mrs. Homemaker's strict standards.¹²⁶

A 'furniture designer' explained why polyurethane foam was gaining such popularity:

'The versatility of urethane foam as a cushioning material is readily apparent. Intricate curves, quilted effects and other style features are easy to achieve because urethane foam is tough and strong, may be cut, molded or shaped to any contour, yet retains a smoothness of line and finished appearance that are marks of the quality craftsman.'¹²⁷

Urethane foam could be shaped to any desired form; the seamlessness granted by its foamed-in production was particularly pleasing to the eye and in keeping with streamlined visions of excellent 'craftsmanship'.

Urethane foam's materiality was seamless. Its production methods appeared instant, the pouring or injecting of liquid into a pre-moulded shape in turn supporting designs for fashionable smooth organic shapes. Foam was informing approaches to design and design was impacting on the latest petrochemical company developments in foams.

Once the furniture salesman had closed in on a deal with Mrs. Homemaker, he must be prepared to answer her final question:

'Q: When can you deliver the set? A: With urethane foam your answer should be "almost immediately." Since urethane foam suppliers are located in or near all of the

¹²⁵ Ibid.

¹²⁶ For more on peacetime reconversion, gender and consumption, see Henthorn, 2006, 'Reconversion and the Military Endorsement' and 'Plastic World in the Making', pp. 86 – 100. I will return to this in greater detail in Chapter Four.

¹²⁷ Mobay, 1959.

major furniture manufacturing centres, prompt supply reduces inventory problems and shipment delays.’¹²⁸

Foam’s materiality was touted as immediate: shapes could be produced quickly to meet the demands of designers and prototypes, as well as consumers themselves, making it an ideal material to mushroom in burgeoning white suburban domestic spaces. Plastic foam can be seen as a comforting material of growth, expansion, domesticity, cushioning and cleanliness. Its soft, haptic, agentic materiality encouraged touch and corporeal interaction. Once compressed, it springs back into action, appearing to breathe, or come ‘alive’ as it does so. Spongy soft polyurethane foam appeared instant, created by chemical process rather than mechanically, the fluffy stuff of angel food cake, its hypnotic contraction and expansion when touched appearing endless and reliable. The somatic appeal of plastic foam’s materiality for touch, embrace and many other forms of corporeal interaction is always inviting: as we shall see in the following chapter, this makes it particularly significant for corporeal applications.

This chapter has drawn on a range of interdisciplinary sources to provide a detailed overview of foam’s inception. It has identified and located original archival materials, including previously uncited Quartermaster Reports. Using these reports and correspondence, it shows how, at the close of WWII, foams were transferred from Germany to the US and beyond via the dissemination of intelligence, and describes the role of touch and materiality as an impetus within this. It explores how foam’s materiality appealed to touch and the corporeal. It charts polyurethane foam’s arrival and expansion on the postwar US market and the role of soft power and demonstrations of foam within this. It investigates how foam’s materiality was gendered, becoming corporeal in its association with female anatomy and endowed with fleshy bodily qualities.

As a material, polyurethane foam embodied postwar power structures of technological advancement, ideology and status, which is also apparent in its gendered applications. In summary, this chapter argues it is important to enhance knowledge of the military-industrial origins of polyurethane foam in order to better contextualise its reapplication in the shaping of women’s bodies. Simply put, narrating the history has importance. Greater understanding

¹²⁸ Ibid.

of foam's military-industrial provenance can also provoke new perspectives in critical thinking on foam's gendered applications and the complex patriarchal power structures it embodies, which will be useful in the next chapter's discussion of polyurethane's application in the shaping of women's bodies.

Chapter Three: Outwards, Upwards and Inwards: Implanting Foundationwear in the Postwar US

This chapter follows and contextualises the impact of plastic foam on the shaping of the female body, focusing on the mid-1940s to the mid-1960s. Building on the previous chapter's exploration of urethane foam's military-industrial origins and materiality, the chapter charts the movement of foam across the surface of the female body, through padded designs on the skin's surface, to its implantation within it. The chapter's structure follows a material and thematic trajectory (outwards, upwards, inwards) rather than a chronological one, in order to illustrate examples within these three areas and aspects of application.

Foam moves outwards! Outwards and onwards from its original military-industrial applications, it pushed gendered flesh out from the body and into the fashionable silhouette, from conical missile bras to hips and derrières. This chapter begins with a section on Hollywood, contextualising urethane foam falsies and implants within the 'star system' and US celebrity and consumer culture.

Foam moves upwards! External and internal foam padding promised greater social mobility and acceptance, and was key to passing as the curvaceous 'bombshell' corporeal ideal. This chapter considers urethane foam's role as a gendered material and accessory for passing in society in this way for both cis and trans women.

Foam moves inwards! Foam objects, resembling fashionable falsies and other 'gay deceivers' of the time, were embedded within flesh via cosmetic surgery, permanently pushing the female body outwards and upwards.

This chapter explores how foam was used to shape and sculpt women's bodies externally with padding devices in foundationwear and internally through implants. Ultimately, it will show how the fashionable conical bustline aesthetic was shaped by changes in technology, which simultaneously informed the fashion for this shape. It will argue that women's bodies were pathologised by actors in medicine and cosmetic surgery in keeping with the conical bombshell ideal. What was presented as healthy and aspirational was shaped by changes in technology (materials and medical procedures) and fashion, and vice versa.

The chapter culminates in two case studies (Robert Alan Franklyn MD and Herbert Conway MD) to address the provenance of foam and its impact on the shaping of women's bodies through cosmetic surgery. The first of these investigates the work of Hollywood-based cosmetic surgeon Robert Alan Franklyn, widely publicised in the mainstream press and prominent in shaping public perceptions of cosmetic surgery for women. Franklyn published 10 books in the US on the subject of cosmetic and plastic surgery between 1956 and 1979, and one in Italy (1967).¹ These books, many of which were published in a series of editions, were commercially popular, available to purchase in mainstream bookshops, advertised in newspapers and circulated in public libraries across the US.² Franklyn's publications were predominantly targeted at a female readership: the text addressed a female reader, guiding her through steps to improve her body via beauty, diet and exercise regimes, as well as Franklyn's cosmetic surgery procedures, which also included compelling stories of women's 'before and after' moments, raising hopes for self-actualisation, social mobility, acceptance and fame.³ All of Franklyn's books promoted cosmetic surgery; however, their titles communicate this in different ways and to varying degrees. Public libraries in the US have classified Franklyn's books in the 600s of the Dewey Decimal System, thereby broadly situating them within Technology (Applied Sciences). Titles with less obvious links to cosmetic surgery, such as *The Art of Staying Young* (1964) and *Instant Beauty* (1967), are classified in 646: Sewing, Clothing, Management of Personal and Family Life. Meanwhile, publications with more direct links to surgery are classified as 617 (Surgery and Related Medical Specialties): see, for example, *Beauty Surgeon* (1960) and *The Clinical Atlas of Cosmetic Plastic Surgery: a Teaching Manual* (1976).⁴ Competitively priced at between 50 cents and \$1.45, they were published commercially as self-help guides, and reached a wide audience. A number of these books were published by Frederick Fell, a New

¹ Robert Alan Franklyn, *Basic Principles of Cosmetic Surgery of the Face and Breast* (Hollywood, CA: Plastic Surgery Academy Institute, 1956); *Developing Bosom Beauty* (New York: Frederick Fell, 1959); *Beauty Surgeon* (Long Beach, CA: White Horn, 1960); *Beauty Surgeon* (New York: Pyramid Royal, 1961); *The Art of Staying Young* (New York: Frederick Fell, 1964 – 1968; 5 editions), *The Art of Staying Young* (New York: Triboro Books, 1963), *Instant Beauty* (New York: Frederick Fell, Inc., 1967; second edition, New York: Arco Publishing, 1973), *A Doctor's Quick Way to Achieve Lasting Beauty; How to Play the Beauty Game* (New York: Information, Inc. 1970), *Augmentation Mammoplasty* (Rome: International Academy of Cosmetic Surgery, 1976), *The Clinical Atlas of Cosmetic Plastic Surgery: a Teaching Manual* (Rome: International Academy of Cosmetic Surgery, 1976), *Supercharge Yourself! : Why Wear out? Supercharge Yourself for Youth, Beauty and Long Life* (Robert Alan Franklyn, 1979).

² See, for example *The Art of Staying Young*; full page advert in *The Sedalia Democrat* (Sedalia, MI) August 29, 1965, p.43,

³ See for example Franklyn, *Beauty Surgeon*, 1961 and *Developing Bosom Beauty*, 1959.

⁴ Gender biases are clear in the application of the Dewey system. *Augmentation Mammoplasty* (1976) is classified in 618: 'Gynaecology and other Medical Specialties'. Whereas *The Art of Staying Young* (1964) and other 'self-help' guides on beauty and the body are classified in 646, 'Sewing, Clothing, Personal Living'.

York-based self-help guide publisher: the most popular was *The Art of Staying Young*, which boasted four editions by Fell from 1964 to 1968, as well as further editions by other publishers, indicating that Franklyn's publications were lucrative, warranting repeated investment and new editions from 1956 to 1979.⁵ *Beauty Surgeon* (1960) was published by Pyramid Royal Press, in a 'new series of books designed to bring women everywhere the latest and most authoritative information on vital topics as Love and Marriage, House and Home, Health and Beauty'.⁶

Franklyn also published medical articles; the International Academy of Cosmetic Surgery, based in Rome, attested to his status as 'director of the first licensed teaching institution in California for Plastic Surgery – The Plastic Surgery Academy Institute'.⁷ Franklyn claimed to have completed 2,170 'Breastplasty' operations using plastic foam between 1950 and 1957.⁸ In 1956 he claimed to average ten to 15 surgeries a week, and by 1967 Franklyn's operations had allegedly exceeded 10,000.⁹ It is important to note that the 'medical' publications Franklyn published in, such as *Southern General Practitioner of Medicine* and *General Practice Medical Journal of the West* were of questionable repute, or have since folded: they appear to have been either local US medical publications or international publications; but whichever is the case, it is clear that Franklyn did not publish his medical findings in reputable international journals such as *JAMA*, *PRS* or *BMJ*.¹⁰ The AMA disapproved of his practice, and their archive attests to Franklyn's impact: he is the only cosmetic surgeon they hold files on in their Franchises, Frauds and Rackets Collection (1951-1981). These files contain the press coverage Franklyn received for his operations in popular magazines such as *Confidential* and *Pageant*, and are accompanied by files of correspondence the AMA received in response to these, which question his medical credentials, request his contact details for treatment, and report malpractice.

⁵ Franklyn, *The Art of Staying Young*, 1964 – 1968; *The Art of Staying Young*, 1963, *Instant Beauty*, 1967, 1973.

⁶ Franklyn, *Beauty Surgeon*, 1961. Other titles in the series included cookery books and hairstyling tips, again pointing to Franklyn's role as a contributor to publishers of self-help guide books for women.

⁷ Franklyn *The Clinical Atlas of Cosmetic Plastic Surgery*, 1976.

⁸ See Franklyn, 'Augmentation Mammoplasty' article and accompanying Surgifoam advert in *General Practice: the Medical Journal of the West*, 20.11 (November 1957), 11-12, p. 27 in Franklyn AMA files. This number is repeated throughout his publications but is also impossible to verify.

⁹ Ralph Lee Smith, 'All the Twiggies Want to Be Sophia', *True*, November 1967, pp.81-82

¹⁰ See, for example, *Southern General Practitioner of Medicine* and *General Practice Medical Journal of the West* – held at AMA.

Franklyn spoke openly of his sourcing of foam from a captured WWII German bomber plane, effectively linking his practice to the material remnants of war.¹¹ This chapter will pay attention to this transfer of material and the associations with war that developed in polyurethane foam's application to the body. Of the two case studies I examine it is important to begin with Franklyn, for a number of reasons – he was the more visible of the two, publishing self-help books, communicating with journalists and actively trying to sell his services through Yellow Pages listings and adverts in pseudo-medical journals.¹² He was particularly important in this period, as he posed such a problem for the AMA; however, I also want to start with Franklyn as I demonstrate that not only was he sourcing his foams from industry: this was also being done by well-respected doctors who were working behind closed doors and did not speak publicly about it. One of the 'respectable' doctors engaged in polyurethane foam implant work was Herbert Conway, my second case study. Based on the East Coast, in 1936 Conway established and ran the Division of Plastic and Reconstructive Surgery at New York Hospital-Cornell Medical Center.

These comparative case studies provide in-depth examples of how foam's materiality informed its application in the shaping of the female body. They also provide greater knowledge of the provenance and sourcing of this material, exposing the complex postwar power structures that produced them and how these impacted on women's bodies. I have chosen to first discuss Franklyn's work, as he was a prominent figure in the popular press, promoting foam and his cosmetic surgery procedures as a means of auto-design (self-design of the body / appearance). The chapter will show how he was comparatively transparent about the sourcing of his materials, linking them to German wartime advancements in plastics, particularly polyurethane foam. Franklyn's Surgifoam origin story is particularly significant to the chapter's discussion of foam's military-industrial provenance and its transfer from Germany to the US before its application in the body; however, this has not attracted in-depth critical scholarship to date.¹³ Conway, on the other hand, was one of a small number of active, journal-publishing AMA-approved plastic surgeons in the US

¹¹ See Franklyn *On Developing Bosom Beauty*, 1959, pp. 73-74; Franklyn, *Beauty Surgeon*, 1961.

¹² Franklyn's active pursuit of prospective patients is another reason why he was blacklisted by the AMA; their doctors are not allowed to advertise their services. The AMA's files on him contain cuttings from Yellow Pages directories across the US which list his services. See also Franklyn, 'Augmentation Mammoplasty', and accompanying Surgifoam advert in *General Practice: the Medical Journal of the West* November 1957 Vol. 20. No. 11, pp. 11-12, 27 in Franklyn AMA files.

¹³ In *Reducing Bodies: Mass Culture and the Female Figure in Postwar America* (London: Routledge, 2017), p. 44, Elizabeth Matelski recounts Franklyn's plastic foam origin story in a brief section that summarises his career but does not contextualise or explore this.

working on cosmetic breast augmentation in this period. He published in medical journals but did not divulge the industrial origins of his foams. His archival papers reveal, however, that he was sourcing his plastic foams for implantation in women's bodies via car and furniture suppliers, revealing a complex network of national and international networks of plastics and their cosmetic implantation in women's bodies.

In summary, this chapter argues that foam shaped the female body first externally (temporarily) and then internally (in some cases permanently), marking a shift in practices of shaping gendered and sexualised bodies. Changes in plastics technology and medical practice relating to the sterilisation of materials, anaesthesia and after-care with antibiotics meant the women aspiring to the bombshell figure might now have external shaping items permanently embedded in the body for prolonged periods of time. Foreign body reactions and the expulsion of these new plastic materials were not as immediate as those experienced historically, involving materials such as ivory or silk. However, as this chapter will document, the body had agency, reacting to and intercepting these materials that transformed foam into living 'flesh'. The chapter demonstrates how in some cases it took longer for the body to react and that this coincided with evolving scientific/medical understandings of toxicity in this period. As I show, changes in material, scientific and medical technologies, fashion, consumer culture and attitudes to women were manifest in the shaping of the bombshell figure. It was now possible to implant items in the body that closely resembled external objects; in addition, due to changes in available materials that could be sterilised, changes in surgical technology and practice and post-operative after-care, the body would not always immediately reject these items.

This chapter combines histories of fashion, design, consumer culture and film, with those of medicine, cosmetic surgery, and science and technology: areas of scholarship that are traditionally dissociated but inextricably linked. Objects and papers held at NMAH's Maidenform Collection are referenced, as well as foundationwear in curator Kristina Haugland's private collection. Other original primary sources consulted include Frederick's of Hollywood catalogues.¹⁴ The research also draws on original archival materials sourced from the papers of cosmetic surgeons and AMA members Conway, Jerome Pierce Webster,

¹⁴ These are from my own collection, as well as ones the Hagley Museum and Library kindly purchased on my behalf and added to their collections.

Milton Edgerton and Joseph E Murray.¹⁵ In addition to this, it analyses primary sources relating to Franklyn, particularly the AMA's Franchises, Frauds and Rackets division files on his practice. Ocularist Walter Spohn's papers are also consulted, as they provide valuable information on prosthetics production at the time.

Hollywood and Falsies

The history of the bombshell and the design of her body, particularly her conical bustline, are enmeshed with that of Hollywood, glamour and celebrity culture.¹⁶ Foundationwear brands such as Hollywood Maxwell or Frederick's of Hollywood used the allure of silver screen sirens to market their products, referencing the American entertainment industry's capital in their names.¹⁷ Some scholars have been quick to identify the conical 'whirlpool' stitched bra with the postwar era, when it became known as the 'bullet' or 'missile' bra; however, it actually made its initial appearance in the 1930s.¹⁸ In 1934, a year after the release of *Blonde Bombshell* (1933) and prior to its later use of foam padding, Hollywood Maxwell launched their signature whirlpool stitched bra for a conical bustline. Advertising emphasised its links to Hollywood studios.¹⁹ Similarly, Maidenform's best-selling design, the 'Chansonette', patented in 1937 and launched in 1938, was promoted as 'delightfully young in line' and promised to '[give] bosoms the new pointed roundness'.²⁰ It arrived a year after Lana Turner starred as the innocent girl next door in *They Won't Forget* (1937), gaining the nickname 'The Sweater Girl' for her tight-fitting top and pointed bustline.

¹⁵ These archives and papers are predominantly located on the East Coast and in Chicago in the Midwest. Franklyn, who was mainly based on the West Coast in Hollywood and travelled to New York to perform procedures, does not have an archive. The majority of medical archives that hold papers on plastic and cosmetic surgeons are based on the East Coast. It is also interesting to note that the majority of plastics archives and polyurethane companies are also based here (see Figure 15). The geographical concentration of archives in New England, the Mid-Atlantic and Midwest is around densely populated areas, with major established medical universities and an established industrial infrastructure of petrochemical plastic factories.

¹⁶ Marilyn Yalom, *A History of the Breast* (London: Pandora, 1988); Marianne Thesander, *The Feminine Ideal* (London: Reaktion, 1997); Jill Fields, *An Intimate Affair: Women, Lingerie, and Sexuality* (Berkeley, CA: University of California Press, 2007).

¹⁷ For more on the 'Golden Age of Hollywood' and consumption of celebrity culture see: Richard Dyer, *Stars* (London: BFI Publishing, 1998); Richard Dyer, *Heavenly Bodies: films, stars and society* (London: Routledge, 2004); Christine Gledhill (ed), *Stardom: Industry of Desire* (London: Routledge, 1991); Jackie Stacey 'Feminine Fascinations: forms of identification in star-audience relations' pp.141-163 and Charles Eckert 'The Carole Lombard in Macy's Window' pp. 30 - 39 in Christine Gledhill (ed) *Stardom: Industry of Desire* (London: Routledge, 1991); Stephen Gundle, *Glamour: a History*, particularly 'The Hollywood Star System', pp. 172-199 (Oxford: Oxford University Press, 2008); Carol Dyhouse, *Glamour: Women, History, Feminism* (London: Zed Books, 2011).

¹⁸ See, for example, Yalom, 1988, who inaccurately attributes the launch of the Maidenform 'bullet bra' 'Chansonette' to 1949.

¹⁹ For more on Hollywood Maxwell see Jane Farrell-Beck and Colleen Gau, *Uplift: The Bra in America* (Philadelphia, PA: University of Pennsylvania Press, 2002).

²⁰ Patent number 112,238 issued November 15 1938 Selection of ad mat designs for the Maidenform 'Chansonette' brassiere, in a Maidenform foundation sales kit, 1937 - 38, Maidenform Collection 1922-1997, 585, Box 67, Folder 1, NMAH Archives Center.

In the 1930s, the fashion for a conical bustline began to emerge, but this was halted by rationing: the synthetic materials with which lingerie designers were experimenting to explore such a silhouette were soon needed for military applications, thus preventing further experimentation and production. In the postwar US, once materials were free from rationing or made commercially available after military applications, foundationwear brands such as Maidenform were able to offer a range of conical designs for achieving a fuller, uplifted bustline. The popularity of Maidenform's Chansonette design continued until the late 1950s and its 'I dreamed...' advertising campaign ran until 1969.²¹ Indeed, as objects, images and other primary sources discussed in this chapter demonstrate, the sweater girl conical bustline remained a fashionable silhouette well into the 1960s. White celebrity culture as presented by Hollywood encouraged female spectators to experiment with the different looks, roles and identities their silver screen counterparts conveyed, from Turner's sweet 'sweater-girl-next-door' conical silhouette to Jane Russell's femme fatale image in *The Outlaw* (1943) or actress Rita Hayworth in *Gilda* (1946), to buxom blondes Marilyn Monroe in *Gentlemen Prefer Blondes* (1953) and Jayne Mansfield in *The Girl Can't Help It* (1956).²²

In 1939 Gerald Wendt, Director of the Department of Science at the New York World's Fair wrote in *Science for the World of Tomorrow* about the inseparable link that had been forged between chemical factories and fashion in the US. Wendt observed that the burgeoning industrial development of synthetic materials such as rayon, nylon and cellophane depended on 'the large and varied style wardrobe with special style requirements for clothes to be worn at home, in the office and factory, for different special occasions and for sports'.²³ Indeed, the foundationwear that fashion magazines advocated for women underneath these 'large and varied style wardrobes' were equally opulent:

²¹ See Farrell-Beck and Gau, 2002.

²² For more on the 'female gaze' (which complicates Laura Mulvey's writing on the 'male gaze'), female spectatorship, cinema, consumption and celebrity culture, see Jackie Stacey, *Star Gazing: Hollywood Cinema and Female Spectatorship* (London: Routledge, 1994). Mulvey's work has been further complicated by Jack Halberstam's writing on 'the transgender look' see *In a Queer Time and Place: Transgender Bodies, Subcultural Lives* (New York: NYU Press, 2005). For more on the femme fatale see E. Ann Kaplan (ed.), *Women in Film Noir* (London: British Film Institute, 1999) Hispanic Margarita Carmen Cansino's name was anglicised by Harry Cohn, studio head at Columbia Pictures, to Rita Hayworth. Cohn demanded Hayworth remove an inch of her hairline by electrolysis treatment and ordered her to lose weight and dye her hair red. No longer 'relegated' to playing 'senoritas', Hayworth was consequently cast in leading roles as 'an ethereal all-American girl' and 'love goddess'. For more on the effacement of Hayworth's ethnicity and 'the shift to more ethnically homogeneous white Anglo-Saxon images' of other entertainers in this period see Clara E. Rodriguez, *Heroes, Lovers and Others: the Story of Latinos in Hollywood* (Washington, D.C.: Smithsonian Press, 2004); Adrienne L. McLean 'I'm a Cansino: Transformation, Ethnicity, and Authenticity in the Construction of Rita Hayworth, American Love Goddess' *Journal of Film and Video* Vol. 44, No. 3/4, Latin American Cinema: Gender Perspectives (Fall 1992 and Winter 1993), pp. 8-26.

²³ Gerald Wendt, *Science for the World of Tomorrow* (New York: W W Norton & Company Inc, 1939), p. 263.

'American women have corset wardrobes [...] this includes all-controlling foundations: girdles, all-in-ones, brassieres [...] averaging from two and one-half to six corsets a piece. They suit the foundation to the occasion.'²⁴

Foam's instant fleshy materiality played a key role in the proliferation of foundationwear items employed in the design and construction of the curvaceous bombshell look. These items could be produced quickly and at low cost, further securing their part in giving shape to the bombshell figure. The changes in plastics technology shaped the new silhouettes and the competitively priced shaping devices they required. As Chapter Two discussed, foam pads could be moulded into shape simply by pouring urethane foam into designed moulds, creating identical forms and new options for 'pointed roundness'. Magazines and advertisers claimed that a foundationwear wardrobe was needed to keep up with ever-evolving styles and necklines, and urethane foams and short production times fulfilled this task.²⁵

The materials available to brassiere manufacturers were a major determining factor in the design process, and the fashion for brassieres padded with plastic foams after WWII is certainly linked to findings in the Quartermaster Reports and subsequent increase in the production and availability of foam in America. Primary sources such as the Quartermaster Reports, news reports and press releases reveal that synthetic materials and foams that had briefly been introduced to female consumers before being required for the war effort were now improved upon and increasingly available to the postwar US consumer market. This has not, however, been considered by established scholarship on the bra.²⁶

In 1946, within a year of the end of WWII, Maidenform, making use of materials developed in wartime, launched two new versions of its Masquerade bust pads, that had first been introduced in 1936 (see Figure 1).²⁷ These two types of falsie, originally offered in the 1940 Sears catalogue, were facing increasing competition in the postwar era.²⁸

²⁴ 'Good Form in America', *Vogue*, February 1, 1939, pp. 114 – 115, (p. 114); Farrell-Beck and Gau, 2002, write on the emergence of the 'bra wardrobe', arguing that foundationwear companies managed to stay afloat during the Great Depression, through brassiere manufacturers' relentless advertising of a whole range of styles.

²⁵ For more on the 1930s emergence of 'bra wardrobes' see Farrell-Beck and Gau, 2002, p. 62; see also 'Good Form in America' and 'WACs Prove Good Market', *CUR*, August 1943, 61.

²⁶ Farrell-Beck and Gau, 2002; Jill Fields, *An Intimate Affair: Women, Lingerie and Sexuality* (Berkeley, CA: University of California Press, 2007).

²⁷ 'Maidenform Now Making Two New Types of 'Masquerade' Bust Pads', *Maidenform Mirror*, September 1946, p. 5, Maidenform Collection, NMAH.AC.0585, Series 4, Box 19, NMAH Archives Center.

²⁸ Kirsten E. Gardner provides a brief study of padded falsies in Sears catalogues in 'From Cotton to Silicone: Breast Prosthesis before 1950' in Katherine Ott, David Serlin and Stephen Mihm (eds.), *Artificial Parts, Practical Lives: Modern Histories of Prosthetics* (New York, New York: New York University Press, 2002), pp. 102 – 118.

Maidenform's publicity departments enthused that the 'sponge rubber' used in its falsies before the war 'made an ideal medium for pads designed to compensate for nature's deficiencies'.²⁹ However, it was unable to supply these popular products during the war, when military demands 'cut off the supply of rubber'.³⁰ Maidenform assured its buyers that 'now that rubber has been finding its way back into civilian goods, lighter, airier *foam* rubber bust pads are being introduced [...] in a new shape and [...] sizes. They are hollow cone-shaped pieces of *foam* rubber encased in Rayon Satin "envelopes"'.³¹



Figure 1: Maidenform Masquerade Falsies and Packaging circa. 1948

The second type of falsie offered by Maidenform in 1946 marked a new approach to design; they were described as: 'really sensational, [these] pads of *moulded foam* rubber shaped into exact replicas of natural bosom contours [...] such as one sees frequently in

²⁹ 'Maidenform Now Making Two New Types of 'Masquerade' Bust Pads', September 1946.

³⁰ Ibid.

³¹ Ibid.

idealistic [statues] but not as frequently, alas in actual life!'.³² These new and improved 'Masquerade' forms were 'light, airy, comfortable and, above all, convincing'.³³

NMAH has no examples of this second type of Maidenform falsie, and I have been unable to find them in any other museum collection in the US. However, I would expect them to look like the designs in Figure 2, which also include nipples. Changes in technology during WWII meant that Maidenform was now able to offer 'exact replicas' of 'natural bosom contours', complete with nipples. The copy emphasises that this new type of material and design are more realistic than ever before, supposedly making the undetectable emulation of perfect sculptural bodies a reality. The text references Classical Greek sculpture and its white European body ideals.³⁴



Figure 2: Foam Rubber Falsies, c. 1948

³² Ibid.

³³ Ibid.

³⁴ For more on neoclassical sculpture and its role in the creation of whiteness see Nell Irvin Painter, *The History of White People* (New York: W.W. Norton and Company, 2010) and Richard Dyer, 'White Death' in *White* (London: Routledge, 1997), pp. 207 – 223.

Maidenform was not the only brand to offer such technically innovative products. By 1951, the Sears catalogue offered 22 variations of this bust-transforming product in various designs, from foam rubber cones in a white or pale flesh tone to beige-coloured synthetic moulds complete with erect nipples.³⁵ It appears that women of colour were ignored by these companies.³⁶

A 1948 British Pathé film, *New Look Underwear*, describes 'how to get the New Look even if Mother Nature forgot to give you the right figure for it', enthusing: 'fitted pads make madame look like a destroyer having its armour plating laid, but these are the armaments of beauty'.³⁷ The white model's body is padded out to achieve a pointed silhouette, her re-sculpted figure compared to a weapon of mass destruction. From Christian Dior's Parisian haute couture to Maidenform's American department store lingerie, the 'pointed roundness' look varied greatly, and some shapes are more extreme than others. Frederick's of Hollywood, set up in 1947 by returning G.I. Frederick Mellinger, was clearly influenced by the full-bosomed ideal of the Alberto Vargas pin-ups he would have been surrounded by in the absence of women on the war front.³⁸ The mail order catalogue company was notorious for its overt sexuality, embodied in its aggressively shaped and pointed designs, and copy such as 'bait him' and 'keep him'.³⁹

Frederick's employed the language of Hollywood to sell its body-shaping designs: brassiere names included 'Showbiz', 'Understudy' and 'Rising Star'. Mellinger enthused: 'gone are the days when one bra goes with everything! A bra wardrobe is an invisible but

³⁵ Beth L. Bailey, *From Front Porch to Backseat: Courtship in Twentieth-Century America*, (Baltimore, MD: The John Hopkins University Press, 1988), p. 74

³⁶ I have searched for objects or information on falsies designed for American women of colour but have been unsuccessful to date. I have consulted *Ebony* magazine's digital archive and have corresponded with the Smithsonian's National Museum of African American History and Culture, where I also met with Elaine Nichols, Fashion Curator. The NMAAHC and NMAH do not hold any such items in their collections. Today falsies and foundationwear are available in a range of skin tones – see for example, *Nubian Skin*, available at: <https://www.nubianskin.com/pages/skin-tone>; *GuGu Intimates* <https://www.guguintimates.com/shop-by-shade/>; *Skims*, <https://skims.com/collections/shapewear#?> (all accessed 18 February 2020). London College of Fashion, Textile and Design Department PhD Candidate Kadian Gosler's project works on black women's lingerie experience. Available at: <https://www.arts.ac.uk/research/current-research-and-projects/textiles-and-materials-student-research/kadian-gosler> (accessed 18 February 2020).

³⁷ British Pathé, 'New Look Underwear' 1948, Available at: <https://www.youtube.com/watch?v=baxaHMpL9cQ> (accessed 18 October 2019).

³⁸ For more on the power of the pin-up and idealised visions of women on the US war front see also Kakoudaki, 2004.

³⁹ See Laura Gottwald & Ed Janusz, *Frederick's of Hollywood 1947 - 1973: 26 Years of Mail Order Seduction* (New Jersey: Castle Books, 1973). Sadly, none of its items appear to be held in any of the major costume collections in the US, which may say something about class and museum collections. What would have once been a ubiquitous object amongst some white working-class women of the US is not available in collections; besides collection policies around elite design pieces, this may also have to do with the poor condition of pieces due to wear and tear, as well as foam degradation, or that these items were considered disposable and perhaps not kept by their owners, or later hidden from friends or relatives due to their sexual nature.

invaluable necessity! Here are some behind the seams secrets from Hollywood!⁴⁰

Consumers were urged to sculpt their bodies according to the fashion shaping requirements of their outfits. 'Movie-star cleavage' could be achieved with an assortment of 'in-up' push-ups.⁴¹ Foam gave shape to celebrity aspirations and enabled cis and trans women consumers to test out different looks and identities. In 1959 a newspaper reporting on the 'Big Bust Boom' claimed that the foundationwear industry was using over 12,000,000 pounds of foam rubber.⁴²

Frederick's catalogues promoted the latest in foam developments as key to their 'in-up push-ups'. Foam offered the ideal lift for a pointed cleavage, pushing 'inwards, upwards and outwards'.⁴³ 'Any bust – the small – the natural – the wide – ALL obey the gentle persuasion of the magic in-up angle pads.'⁴⁴ In this formulation, soft female flesh obeys the agency of foam, which disciplines abject sagging or 'jiggling' flesh into the desirable conical shape: taming the 'wild' natural body. Frederick's catalogues employed a scientific rhetoric when extolling the advantages of foam. See for example in Figure 3:

'Learn the instant-magic of Frederick's 'Secret Circle'! Mr. Frederick's alone knows the scientific formula for pads that lift you up as they push you in! Cleavage is created that you must see to believe! "A" and "B" bosoms blossom to new dimensions! Suddenly, "C" and "D" busts are higher, firmer, younger than Spring time! Only Frederick's knows the secret!'⁴⁵

⁴⁰ Frederick's of Hollywood catalogue, 1960, p. 9, f853, Hagley Museum and Library.

⁴¹ Ibid., p. 17

⁴² Hal Boyle, 'Venus was a fat pig: what's behind the bust boom?' *Waterloo Daily Courier Iowa*, Tuesday August 15 1959, p. 8

⁴³ See for example Frederick's of Hollywood catalogue, 1965, p. 23, f853, Hagley Museum and Library.

⁴⁴ Frederick's of Hollywood 'New Bosom Glamour' advert, 1957, (tear sheet) author's personal collection.

⁴⁵ Frederick's of Hollywood catalogue, 1965, p.9, f853, Hagley Museum and Library.

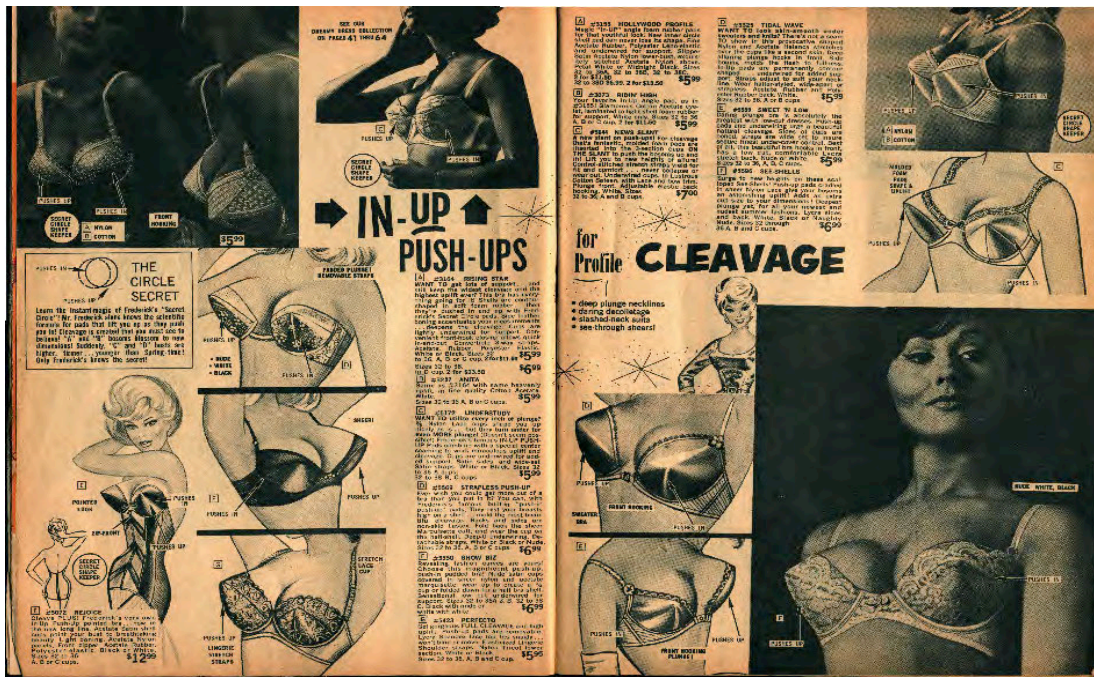


Figure 3: Frederick's of Hollywood catalogue, 1965

Here consumers are offered a bra with an undisclosed scientific formula that unlocks the secret to attaining the desirable hourglass shape; plastic technology is extolled as innovative and transformative. The diagram in Figure 4 exclaims: 'this is YOU', pointing to an uplifted white bosom, to stress the transformative powers of foam. In this gendered rhetoric, male actors such as Frederick Mellinger are the only holders of the secret behind the foam that was specially developed to nudge flesh into a desirable shape. Scientific knowledge (male, intellect, power) is exerted over the body (female, nature, weakness).

I GUARANTEE YOU NEW BOSOM GLAMOUR or your money back!

**Thousands of Women Who Have Already Done It Say
"YOU TOO, CAN HAVE A GORGEOUS BOSOM!"**

DO SOMETHING WITH WHAT YOU'VE GOT

What you may not have realized is that famous stars and models have bosom problems, too. Some are small busts. Others have flat, sagging busts—or wide busts. Yes, Hollywood's most exotic stars are really no different from you—except for just one thing: That one thing is what they do about their problem.

Stars have beautiful bosoms because they make the most of what they've got by wearing the fabulous bra that solves all problems. This is their glamour secret, I know—because I have seen bosoms that nature overlooked become glamorous and exotic—just with the proper bra—and that's all you need to do!

DON'T READ ANY FURTHER unless you are one of the millions of women who have dreamed of heaven-sent cleavage and youthful uplift—but never found it. What I have to tell you is only for those of you who have gazed with envy at stars and models and said, "Oh—but I could never look like that." It is to you that I say, "Yes, you CAN look like that!" You can achieve the most glamorous bosom beauty imaginable just as easily as any movie star or model.

I AM SO SURE THAT MY HOLLYWOOD PROFILE BRA CAN BE YOUR GLAMOUR SECRET THAT IT IS ABSOLUTELY GUARANTEED... Or your every penny will be refunded!

And before you read any further, I want you to know **HOLLYWOOD PROFILE BRA IS GUARANTEED**

- * To give you gorgeous cleavage and décolletage
- * To give you high-rise movie star curves
- * To keep its NEW shape—always.

I personally spent two years designing this bra—the only bra—that can guarantee you so much. Every line—every curve was designed and redesigned until it became the marvelous creation that will give you bosom perfection.

Any bust—the small—the natural—the wide—ALL obey the gentle persuasion of the magic IN-UP angle pads. This magic feature angles in from the sides so that your bosom must fall into the gorgeous natural cleavage that spells alluring womanhood. At the same instant, this pad pushes you in and UP to give your bosom the youthful, pointed uplift that will never let you down. Equally miraculous is the NEW inner circle shell pad—so light it's almost invisible. This is my secret "shape-keeper" that guarantees NEW shapeliness forever—or your money back. This bra won't sag—ever—and neither will you!

You might think that any bra of this description and talent might be a cumbersome, ugly, uncomfortable affair. But I guarantee that the exact reverse is true. This is the most comfortable and glamorously feminine bra you've ever seen! The lower bust section is luxurious Slipper Satin. The upper bust section is exotic peek-a-boo Nylon Sheer with exquisite stitching. The very finest quality Nylon Leno Elastic back and sides guarantee perfect fit. Wear it wide-shoulder or halter style. However you wear it, you will instantly become the glamorous creature you've always dreamed of being. #3155 in Petal White or Chorus Black, sizes 32 to 36 A, B & C cup.

Remember! This is a never-before-sensational at a never-again price! **\$5.00 NOW!**

fredericks 1430 N. CAHUENGA BLVD. Dept. 4427
HOLLYWOOD 28, CALIF.

Please send the following styles:

#3155 @ \$5.00 Size _____ Cup _____ Color _____

#3073 @ \$5.00 Size 36 Cup B Color White

#3074 @ \$15.00 Size _____ Cup _____ Color _____

I enclose payment. Send C.O.D. (No C.O.D. without \$1 dep. on Each item)

Name _____

Address _____

City _____ Zone _____ State _____

READ FOR YOURSELF...







What these movie people and thousands of other women say about Frederick's clothes!

"I want to thank you for your feminine creations and styles, and I wish you also had a store in New York City."
LINDA LOMBARD

"I'm just wild about your clothes and nobody believes me when I tell them how little I paid. They've helped me to succeed—but definitely!"
JUNE SVEDIN

"I'm on my way to starring roles in two big pictures—and I know it was my Frederick's dress that helped me get my first role."
ALISON HAYES

"No matter where I go in Hollywood, my Frederick's dresses make me the center of attention... on the set or off. They're the most wonderful and dramatic creations in the world."
ALLISON HAYES

Lovely **REGINA GLEASON**... popular young TV and Film Star wears Style #3155... for that "Frederick's fit and fashion flair so important to the theatre."

Favorite of Hollywood photographers, marks Frederick's #184 Swim Suit as a "must-go" for every "out-of-doors" assignment.
TOTTI AMES



fredericks OF HOLLYWOOD ©1957
1430 N. CAHUENGA BLVD., HOLLYWOOD 28, CALIF.

FREE Just 3 of the 1630 stunning styles you'll find showcased in Frederick's 8 bi-monthly catalogs FREE to you with every order!

Don't wait! Rush your order today—and if you're not 100% satisfied send it right back—and your every single penny will be refunded.

#3073



#3074



BEFORE ★ AFTER



Figure 4: Frederick's of Hollywood advertisement, 1957

In addition to bust and shoulder pads, foam was also used to pad the buttocks, hips, thighs and calves in shapewear items: see, for example the designs by Frederick's in Figure 5 and 12. Frederick's exclaims: 'where nature leaves off... ADD WITH PADS!'. Mother Nature may have let the customer down, but Frederick's is here to help rectify her errors, with a lending hand from science and the arts:

'Each pad is hand-sculptured by an artist who works from life, following the natural delicious curves of a woman's body. Then the pads are cast... molded in softest, bounce-back poly-foam. They're curved... natural ... delightfully feminine! Very femme fatale!'⁴⁶



Figure 5: Frederick's of Hollywood catalogue, 1965

Here a (presumably) male artist was able to 'sculpt' boosting pads, and the foam became agentic. The female body becomes a plastic sculptable material; foam becomes flesh and flesh becomes foam. The copy concludes: 'the pads slip in wherever they're needed. 'Only you will know they're not all you!'.⁴⁷ Foam is presented as a realistic fleshy substitute, an instant femininity booster. Foam pads could simply be slipped in by the wearer 'wherever they're needed', enabling them to take control of the shaping of their figure. There was, however, another way of more permanently concealing and embedding these boosting objects within the body and making them 'all you' – or, at least, 'more you'.

⁴⁶ Frederick's of Hollywood, 1965, p. 11, f853.

⁴⁷ Ibid.

Implanting Foundationwear

Franklyn wrote, in a number of his publications: 'with all the success the medical world had enjoyed in utilizing plastics all over the body, I could see no reason why the same kind of material couldn't be used to expand under-developed breasts'.⁴⁸ Here Franklyn implies that women's incomplete, flawed bodies can be 'fixed' with plastics.⁴⁹ Changes in medical technology relating to advances made in wartime plastic surgery to repair 'broken soldiers', and to improve surgical procedures and post-operative healing, meant that there was now less risk of infection.⁵⁰ Furthermore, emerging plastic materials, such as polyurethane foam, could be sterilised, making them ideal for implantation in the body as this reduced the risk of infection and foreign body reactions. As will be demonstrated, the similarities between plastic foam falsies and breast implants used in cosmetic surgery are striking in terms of form, design, aesthetics and materials. In 1948, a newspaper reported that the multi-million dollar US falsie business was 'imperilled' by plastic surgery, which 'removed the need for falsies'.⁵¹ Cosmetic surgeons were keen to offer their services as a way of making more permanent the boosting effect that accessories such as bullet bras and falsies could provide only temporarily. Surgeons promised that this under-the-skin procedure made the detection of provisional 'fakery' impossible, and replaced the need for padded bras and falsies altogether.

Books by cosmetic surgeons with titles such as *The Breast Beautiful* (1947) and *Developing Bosom Beauty* (1959) began with histories of the brassiere, encouraging readers to question its efficiency as a tool to achieve a healthy and aesthetic ideal, before promising that reduction and augmentation surgery posed no health risks.⁵² Promotional and news copy frequently referred to male lingerie designers, health instructors and surgeons as sculptors, or artists of the female form. Comparisons to white nudes, Venus, and classic

⁴⁸ Franklyn, *On Developing Bosom Beauty*, 1959, p. 73

⁴⁹ The pathologisation of women's bodies, particularly breasts, and the way this was used by US surgeons and health insurance companies to legitimise the cost of cosmetic surgery has been well covered in the established scholarship. See for example Elizabeth Haiken, *Venus Envy: a History of Cosmetic Surgery* (Baltimore, MD: Johns Hopkins University Press, 1997); Sander L. Gilman, *Making the Body Beautiful: A Cultural History of Aesthetic Surgery* (Princeton, NJ: Princeton University Press, 1999); Nora Jacobson, *Cleavage: Technology, Controversy and the Ironies of the Man-made Breast* (New Brunswick: Rutgers University Press, 2000); and Matelski, 2017.

⁵⁰ David Serlin, *Replaceable You: Engineering the Body in Postwar America* (Chicago: Chicago University Press, 2004); Gilman, 1999; Haiken, 1997; Katherine Ott, 'The Sum of Its Parts: an Introduction to Modern Histories of Prosthetics' in Katherine Ott, David Serlin and Stephen Mihm (eds.), *Artificial Parts, Practical Lives: Modern Histories of Prosthetics* (New York: New York University Press, 2002), pp. 1-43

⁵¹ 'Plastic Surgery to Cut Out Rich "Falsie" Business', *Hollywood*, November 15 1948.

⁵² Else K. La Roe, *The Breast Beautiful*, (New York: Froben Press, 1947), Franklyn, *On Developing Bosom Beauty*, 1959.

European masterpieces of art were recurring themes in foundationwear advertising. An advert for 'Edith Lances Sculptural Bras' (Figure 6) displays a sculpted white torso, with head and arms missing, on a plinth. The image focuses on the bosom, which can be sculpted to perfection thanks to Lances' custom-made bras 'for lovelier bosom contours'. In this advert there is no need to display the actual product it promotes: the message is clear, the brassiere is a tool with which to sculpt the bosom's soft flesh into one's own masterpiece.

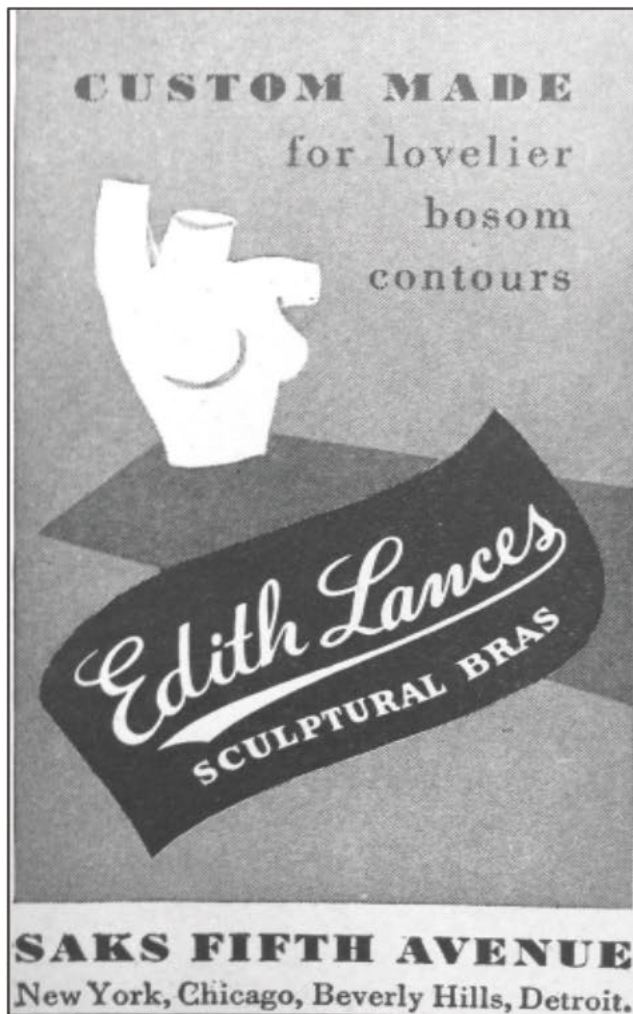


Figure 6: 'Edith Lances, Sculptural Bras', advertisement, *Vogue* (1944)

Within this omnipresent celebration of youth, the body, and in particular the bust – the most obvious visual distinguisher between the sexes – is an idealised malleable surface. Lances' comparison of the female body to sculpture even caught the attention of plastic surgeon Conway, who added the company to his file on prostheses. Conway noted the

‘identical custom-made plastic form for breast’ and the cost, as well as a phone number.⁵³ He also kept a cutting of a classified advert for ‘Nubrest’ – ‘individually sculptured’ post-mastectomy artificial breasts.⁵⁴ These cuttings could indicate that Conway connected the design and manufacture of an external object to its potential for internal implantation for cosmetic surgery in collecting information on external prostheses with sculptural connotations as part of his research into the permanent embedding of these objects.⁵⁵ Conway and the other surgeons whose papers I have consulted do not appear to have worked on mastectomies, and therefore were not focused on providing patients with post-mastectomy prostheses. Their work was instead concerned with cosmetic breast augmentation or reduction. It is likely that information on external breast prostheses for mastectomy patients was being archived by these surgeons as research into potential manufacturers and materials for implantation beneath the skin’s surface, or as form guides.⁵⁶

The aforementioned examples all point to a pattern in viewing and speaking of the female body as sculptural on the surface, and now having the potential for permanent implantation. Other notes Conway filed under ‘prostheses’ include contact details for a former exterminator turned sculptor who claimed to have recently started specialising in prosthetics.⁵⁷ Conway may have collected these details for contacting people to assist him in carving and designing individual implants. The business card with ‘exterminators’ crossed out and ‘prosthetics’ pencilled in is symptomatic of the haphazard approach to the manufacture of prosthetics before the Medical Device Regulation Act of 1976: surgeons were influenced by plastics salesmen with no qualifications in medicine or the body, who in turn were reliant on so-called ‘sculptors’. At the same time, ‘designers’ working on the creation of implantable breast prostheses did not appear to have had formal medical qualifications or experience of how foreign materials might work in the body. In turn, prostheses were shaped by the materials available: these materials were frequently promoted to doctors by plastics salesmen rather than medical researchers or professionals.

⁵³ See ‘Edith Lances’ note, ND, HCP, BOX 7, ‘Prostheses 1946-53’ file

⁵⁴ See ‘Nubrest’ clipping, ND, HCP, BOX 7, ‘Prostheses 1946-53’ file.

⁵⁵ Nubrest advertisements featuring a female sculptural figure ran regularly in American *Vogue* from 1947 to 1954.

⁵⁶ Walter Spohn’s Papers also hold information on mastectomy prostheses.

⁵⁷ See ‘Campbell Company’ card, HCP, BOX 7, ‘Prostheses 1946-53’ file.

This in turn then shaped ideas of what was fashionable at the time, simultaneously publicly pathologised by medical actors in the mass media as safe and ‘healthy’.⁵⁸

In his book *Developing Bosom Beauty* (1959), targeted at a popular female readership, Franklyn presented a sequence of images depicting his ‘ten-minute simple Breastplasty surgery’. Figure 7, the first image, is captioned: ‘author sculpturing model bust in clay to serve as guide to surgery’, implying that a sculpture or representation of the body is used as a guide in a medical procedure to augment the bust.⁵⁹ It shows a white man in a white coat, his face turned away from the camera. Another image of a white man in a white coat: but this time it is a surgeon, not a scientist or chemist, presenting himself in a setting that resembles an art studio. His right hand is raised around the female bust’s headless neck, his thumb and fingers presumably steadying himself as he sculpts. In his left hand Franklyn holds a trimming tool, motioning towards the clay bust as if to carve into its chest, minimizing any excess material to create a smoother line.



Figure 7: ‘Author sculpturing model bust in clay to serve as guide to surgery’, in Franklyn, *Developing Bosom Beauty* (1959)

⁵⁸ In their publications, surgeons pathologised women with breasts that were ‘too small’ or ‘too pendulous’. See, for example, Franklyn, *On Developing Bosom Beauty*, 1959, Herbert Conway and George Dietz, ‘Augmentation Mammoplasty’ *Surgery, Gynaecology & Obstetrics* May 1962, 573 – 579, Milton Edgerton and McClary, ‘Augmentation Mammoplasty: Psychiatric Implications and Surgical Indications’, *PRS* 21. 4 (April 1958). The pathologising of women’s bodies is well rehearsed in cosmetic surgery scholarship; see for example Haiken, 1997; Jacobson ‘The Medical Construction of Need or The “Psychology of the Flat Chested Woman”, in Jacobson, 2000, pp. 106-143; Matelski, 2017.

⁵⁹ Franklyn, *Developing Bosom Beauty*, 1959, p. 76.

The next image in the series is captioned: 'start of ten minute simple surgery. Note flat chest' (Figure 8). In the foreground of the image is a white woman's upper torso, propped up, her face hidden from view, bust exposed and illuminated. Behind her, somewhat in the shadows, we see a male figure wearing scrubs, a surgical mask and cap. The male figure has a voyeuristic and somewhat pornographic quality: his spectacled gaze looks down at her chest, his arms and hands are hidden, his face is obscured behind a mask.⁶⁰ It is important to note that this image appeared in a number of publications and contexts, both medical and popular.⁶¹ It is striking in that it positions the surgeon in the frame, surveying the anonymous female patient's torso, which is exposed. This image, presented in parallel with the image of Franklyn as sculptor, denotes that the female patient is a material to be sculpted by Franklyn. Like her clay counterpart that serves as a guide, her body is a surface to be surveyed and shaped as desired by the 'expert' eye of the surgeon beholder.⁶²

⁶⁰ It is worth noting that a number of Franklyn's publications are missing or stolen from libraries, potentially indicating their popularity as desirable artefacts in the medical and public library domain because of their sexualised nudity (as in these constructed images) that could be used for pornographic purposes. This image appears to relate to the medical imagery shown in 'shockumentary' or 'sexploitation' style of films screened as 'midnight movies'. For more on this genre see J. Hoberman and Jonathan Rosenbaum *Midnight Movies* (Boston, MA: Da Capo, 1991); Kristen Hatch, 'The Sweeter the Kitten, the Sharper the Claws: Russ Meyer's Bad Girls' in Murray Pomerance (ed.) *BAD: Infamy, Darkness, Evil And Slime on Screen* (New York: State University of New York Press, 2004), pp. 143-155. For a discussion of the sexualised and exploitative aspects medical imagery can have, see C. Riley Snorton, *Black on Both Sides: A Racial History of Trans Identity* (Minneapolis, MN: University of Minnesota Press, 2017).

⁶¹ See Franklyn, *On Developing Bosom Beauty*, 1959; 'The Operation that Remolds Flat-Chested Women', *Pageant*, August 1953, CUHSL, JPW, 1888 – 1974, Box 199, Folder 4, also in AMA files on Franklyn, and Franklyn, 'Breastplasty', *The Southern General Practitioner of Medicine and Surgery*, CIV.4 (April 1953).

⁶² For more on the plastic and cosmetic surgeon as artist or god see Virginia L. Blum, *Flesh Wounds: the Culture of Cosmetic Surgery* (Berkeley, CA: University of California Press, 2003) pp. 92 – 109. She discusses an 'eerie surgical sisterhood' in which female patients of a male surgeon closely resemble each other after the operation.



Figure 8: 'Start of ten minute simple surgery. Note flat chest.' in Franklyn, *Developing Bosom Beauty* (1959)

Archival papers show that plastic surgeons such as Edgerton and Conway, as well as the ocularist Walter Spohn, attended and collected information on sculpture courses to improve their work with prosthetics.⁶³ When asked by a journalist for advice on identifying the right doctor to perform cosmetic surgery, Conway recommended consulting the family physician, County Medical Society and AMA for an approved list of competent surgeons. He also, however, stressed the need for the surgeon to have an artistic eye:

'The surgeon also must be a psychologist and an artist. Portrait painting and life modelling and sculpturing are studied by already well trained, experienced cosmetic surgeons; for the [...] reshaping of the [...] breasts calls for an understanding of aesthetics, as well as of conscious and unconscious motives of patients.'⁶⁴

⁶³ See Walter Spohn Papers, NMAH; HCP; Milton Edgerton Papers.

⁶⁴ Gobind Behari Lal, 'Surgery Pledges Beauty' *Los Angeles Examiner*, Friday October 7 1960.

As in Franklyn's image, the female patient's flesh can be moulded, using foam, to fill out the fashionable conical ideal, itself shaped by plastic. In Conway's vision, female flesh assimilated to meet the standards for silhouettes set by external fashion-shaping devices such as the bullet bra, falsies, girdles and hip and buttock padding. Polyurethane foam meant that the female body could now be permanently moulded to mirror an ideal created by predominantly male actors.⁶⁵

Fashions such as the enduring sweater girl look, having been put briefly on hold during WWII due to materials rationing, remained popular throughout the 1950s and into the early 1960s (see Frederick's of Hollywood catalogues), and impacted on the shaping of the pathologised 'healthy' and 'desirable' white American female ideal. Franklyn chose to include pre- and post-surgery photographs of patient 'case studies' in his book: this includes 'before' and 'after' profile shots of white patients sporting the fashionable sweater girl look (Figure 9). It is noteworthy that these images appeared in *Developing Bosom Beauty* (1959) and *Beauty Surgeon* (1960) but are missing from *Augmentation Mammoplasty*, published much later in (1976), probably because the conical ideal embodied by the sweater girl fashion had finally become outdated.



Figure 9: 'Sweater before surgery, sweater after surgery' in Franklyn, *Developing Bosom Beauty* (1959)

⁶⁵ For more on cultural representations of the enduring fantasy trope of man creating an ideal female see Julie Wosk, *My Fair Ladies: Female Robots, Androids and Other Artificial Eves* (New Brunswick, NJ: Rutgers University Press, 2015).

Although Franklyn included a selection of the same 'before' and 'after' images in all three publications, there is some evidence to suggest that the later selection criteria for these changed to reflect the less conical fashionable ideal breast. Whilst the images in *Developing Bosom Beauty* (1959) present exclusively nude side views of white patients, and *Beauty Surgeon* (1960) only presents a sweater-clad 'before and after' image (there is no nudity in this more general publication), *Augmentation Mammoplasty* (1976) presents a selection of views, including ones taken from the front. The image of the most extreme conically shaped breasts (see Figure 10) has been removed, whilst breasts with more of a 'pointed roundness' aesthetic remain. By 1976, the selection of 'after' photos includes a greater variation in breast sizes, including rounder shapes (see for example Figure 11). By 1976, Franklyn replaced his Surgifoam, or 'polyethylene-coated polyester foam', with smooth silicone implants, and the change in shape is evident.⁶⁶ These images demonstrate that breast augmentation surgery, like brassiere design, was affected by changes in materials R&D, thus informing prosthetic design and consequently impacting upon the fashionable and 'healthy' ideal breast, both in representations and in the flesh.

⁶⁶ Franklyn, *Augmentation Mammoplasty*, 1976, pp. 72 - 73

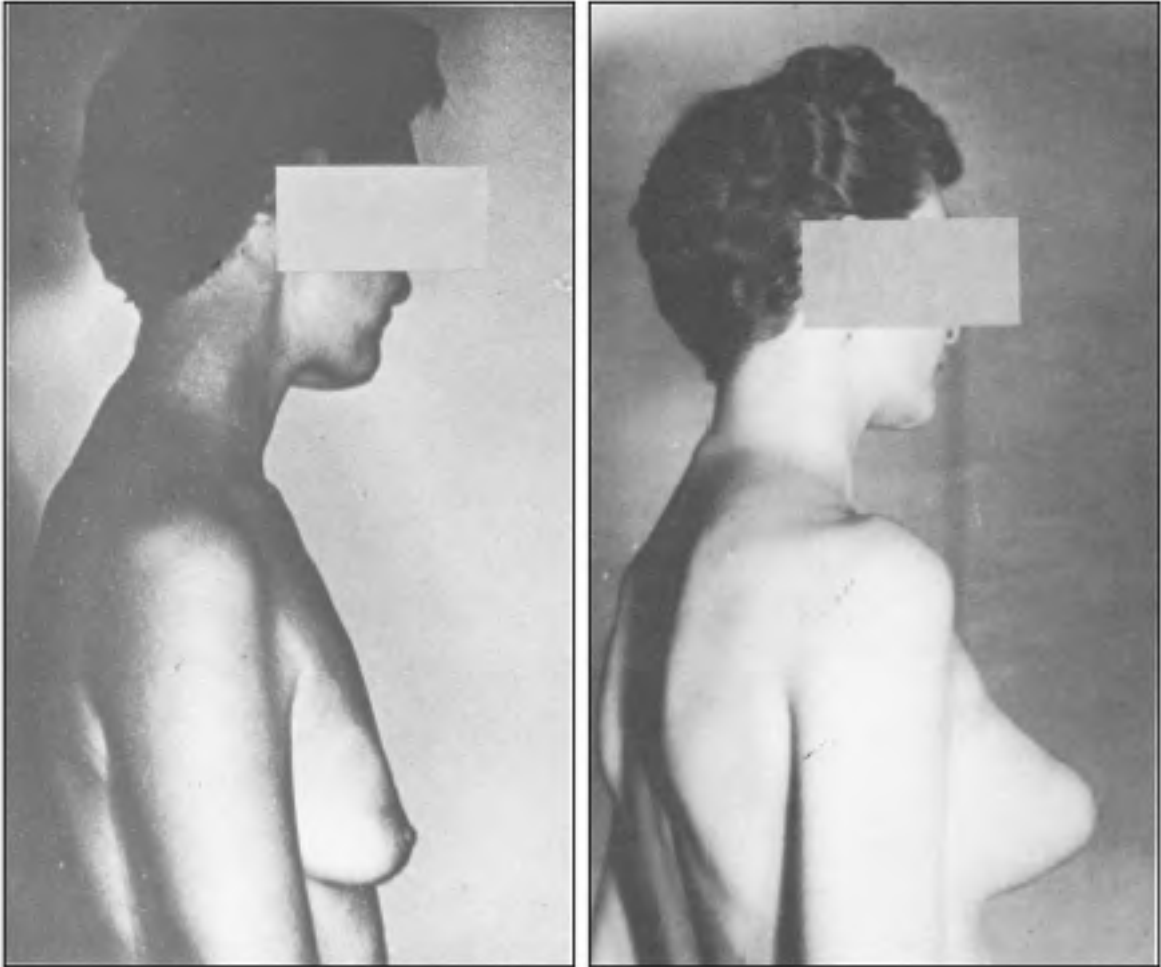


Figure 10: 'Before Surgery, After Surgery', in Franklyn, *Developing Bosom Beauty* (1959)

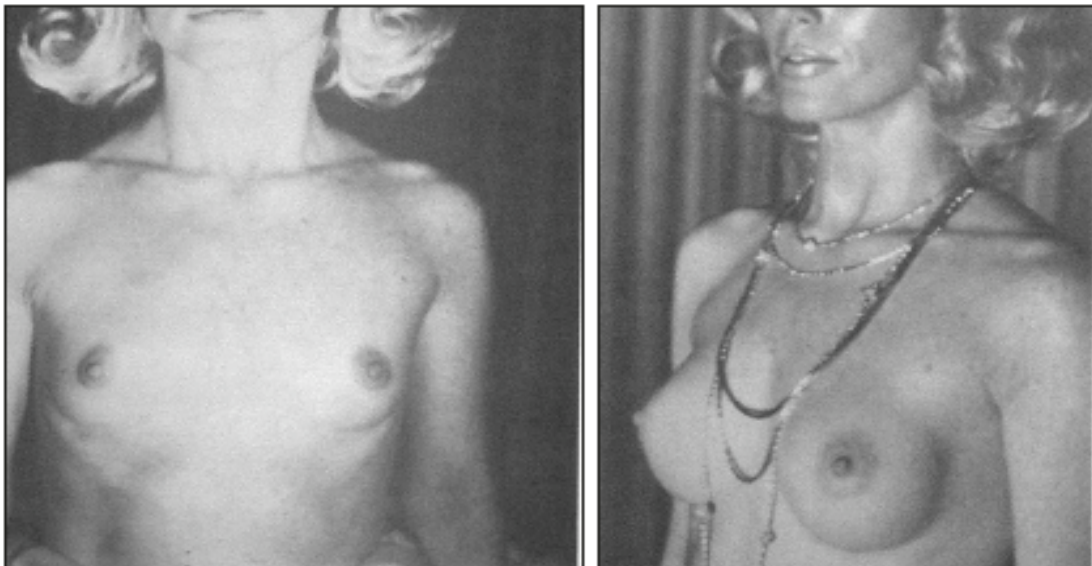


Figure 11: 'Before Surgery, After Surgery', in Franklyn, *Augmentation Mammoplasty* (1976)

Anne Hollander's *Seeing Through Clothes* (1978) examines the relationship between fashion and depictions of cultural corporeal ideals, as represented, for example, in painted and sculptural nudes. She observes:

'although clothes may appear to reduce the grand truth of unclad natural humanity simply by being contingent, specific and intrinsically bound to style, they are recognisably the only thing that gives – has always given – that shapeless and meaningless nakedness its comprehensible form.'⁶⁷

Hollander, whose approach is art historical, argues that the ideal disrobed body is culturally shaped by prevailing fashions in clothing at any given time. Flesh is represented as shaped through exterior garments, even in their absence. I would like to take Hollander's argument a step further, additionally addressing Joanne Entwistle's concept of the 'fashioned body', to argue that the pathologised gendered nude body of cosmetic surgery is also shaped by fashions and technologies of the time. This is particularly evident in Franklyn's work, as well as that of his peers, including Edgerton, Conway, Webster and Elsa K. LaRoe, a New York-based female cosmetic surgeon and author of *The Breast Beautiful* (1947), a guide to achieving the perfect bustline with surgery and/or hormone treatments. Hollander's theory can be applied to the photograph of Franklyn posing as a sculptor next to a female bust discussed above (Figure 7), as well as foundationwear companies' promotion of products as having body-sculpting properties with which to mould female flesh into the fashionable ideal (see, for examples, Figures 3 and 6).

Cosmetic breast surgery, journalists and some surgeons claimed, removed the need for falsies and padded bras. 'Patients for this form of living sculpture raid their dressing table drawers the minute they're out of the hospital – to throw away those slip-and-slide falsies and padded bras, once and for all.'⁶⁸ In the 1950s, prospective female patients who thought that their breasts did not meet the ideal standard wrote to surgeons and the AMA seeking advice.⁶⁹ Many cited their psychological anguish at feeling excluded from a society where, as

⁶⁷ Anne Hollander, *Seeing Through Clothes* (Berkeley, CA: University of California Press, 1978), p. 447
56

⁶⁸ Audrey Minor, 'Operation Hollywood: Custom Tailored Bosoms' *Confidential*, 2.3 (July 1954), pp. 13-15, 64-65 (p. 14) in AMA papers.

⁶⁹ For letters from prospective patients see JPW Papers and AMA papers.

Franklyn put it, 'the girl who can wear a low-cut gown and display a lovely, clean valley running between two full-grown, well-proportioned mounds of flesh [...] is the girl who will qualify as the belle of the ball in every phase of modern American life'.⁷⁰ Foam breast implants were presented to women in a range of publications, newspapers and television programmes. These included mainstream newspapers such as the *San Francisco Chronicle*, high-end women's fashion magazines *Vogue* and *Harper's Bazaar* to Hollywood gossip publication *Confidential* and men's publications such as *Esquire*, where foam implants were presented as a safe, quick and easy solution to achieving a fuller bust and gaining the social mobility this supposedly brought with it.⁷¹ In this gendered rhetoric, success and failure could be attributed to a series of corporeal measurements, which foam could help women achieve. A male journalist enthused that, thanks to 'one swift operation', surgeons can now 'add to a woman's own breast the few inches that measure the difference between a bust and a failure'.⁷² In an *Esquire* article titled 'Beauty and the Bust: build 'em, buy 'em, or ignore 'em – the deficient damsel's dilemma', Victor Warren Quale observed that 'the female bust is with us more opulently and more openly than ever before in our history'; however, 'unlike other revolutionary changes in feminine fashion, it has not cruelly excluded women whose contours do not conform to dictates'.⁷³ Here, Quale equates liberation for women with a wider range of consumption options.⁷⁴ Advancements in technology are thus beneficial to 'deficient' women. He continues, 'the new fashion [for a fuller bosom] made the invention of the falsie possible and inevitable, and gave the flatbreasted an artificial chance for equality'.⁷⁵ Social historian Beth Bailey reflects that 'women insufficiently endowed by nature could resort to technological artifice; they could compete by consuming [falsies]'.⁷⁶ This did not come without its disadvantages, though. If one can compete by consuming, is this then considered cheating, and therefore committing what was known at the time as a 'social error'?

⁷⁰ Franklyn, *Developing Bosom Beauty*, 1959, p. 8.

⁷¹ Minor, 1954; Victor Warren Quale, 'Beauty and the Bust', *Esquire*, June 1954, pp. 85- 109.

⁷² Arman Hartley, 'Surgery's New Miracle – Permanent Curves', *Confidential* magazine, January 1956, pp. 18 – 19.

⁷³ Quale, 1954, p. 85.

⁷⁴ Vice President Nixon famously argued for the housewife's choice as embodying liberatory capitalist ideals during the Kitchen Debate of 1959 (see Chapter Two).

⁷⁵ Quale, 1954, p. 109

⁷⁶ Beth L. Bailey, *From Front Porch to Backseat: Courtship in Twentieth-Century America* (Baltimore, MD: The John Hopkins University Press, 1988), p. 74.

Foam-padded items such as Maidenform's 'Masquerade' falsies and bras could only provide a temporary solution to generate approval and passing in the public sphere. As cosmetic surgeons such as Franklyn were keen to point out, the 'truth' behind these 'little deceivers' would eventually be exposed in more intimate moments. Franklyn's 1960 case study of 'the Counterfeit Bride' capitalised on fear of rejection and exposure.⁷⁷ 'Carol', a white female patient, was afraid of unmasking herself as a falsie-wearing 'fake' on her wedding night and sought Franklyn's services. He accommodated her needs by giving her 'a thirty-eight-inch bosom every bit as big as the brassiere she had worn into the office'.⁷⁸ Now that Carol has had her external shaping device permanently embedded in her flesh, she is no longer phony, or a fake: 'the Counterfeit Bride became a real bride the following week'.⁷⁹ Other women in this period were perhaps less concerned about what others thought. In Russ Meyer's 'shockumentary' on the East Coast 'topless craze', *Mondo Topless* (1966), white go-go dancer Darlene Grey comments: 'people will say ah, she's phony, that's all foam rubber [referring to breasts]. [Giggles]. I go: "honey, believe what you want, I don't care!"'⁸⁰ Meyer's sexploitation genre movie provides taped interviews with women on the 1960s West Coast go-go circuit, providing a rare opportunity to hear these women's lived experiences as sex workers.⁸¹

Agency in women's decision to undertake foam augmentation surgery is complex. A study in the respected US medical journal *Plastic & Reconstructive Surgery*, conducted by Edgerton with 32 breast augmentation patients aged between 22 and 43 at Johns Hopkins between 1952 and 1958, found 'almost all of the women studied were the dominant members of their marriages, with rather astounding passivity noticed in many of the husbands'.⁸² Edgerton implied that these women had agency in their decisions. It should also be noted that women also often sought these operations following separation, divorce or as a financial investment (entertainment and sex industries), and that not all patients were married. Countering the common belief in a Hollywood-led craze in 'bosom mania'

⁷⁷ 'The Case of the Counterfeit Bride' in Franklyn, *Beauty Surgeon*, 1960, pp. 91 - 101

⁷⁸ Ibid.

⁷⁹ Ibid.

⁸⁰ Darlene Gray in Russ Meyer, *Mondo Topless* (1966), 27:18. It is likely most dancers were injected with silicone shots – this is discussed in detail in the following chapter. Interestingly, this is the only mention in the whole film of any foreign materials being inserted into the bust for synthetic augmentation. We do not know whether or not Gray had foam or silicone in her body – but these are the sorts of comments she was subjected to.

⁸¹ For more on Russ Meyer and female stars of his films see Hatch, 2004.

⁸² Edgerton and McClary, 1958, p. 297.

that was widely reported in the US press, Edgerton claimed that more complex personal issues were part of the decision-making process:

‘To understand the origin of the fixation of feelings on the breasts, we were led to a study of cultural factors, such as varying trends in style for women's figures. These did not seem to be the important factors in the women studied, and we concluded that the personal symbolic meanings, constructed from their own life experiences were much more significant.’⁸³

Here Edgerton probes common assumptions perpetuated in the press by pondering the sustainability and gendered fickleness of the ‘bust boom’: for instance, ‘what will happen if Jayne Mansfield goes out of fashion and the flapper comes back?’⁸⁴ Primarily interested in the psychological motivation behind cosmetic surgery, Edgerton argued that the female patients he spoke to were directly influenced less by changes in fashion trends and more by past experiences. By doing so he effectively pathologises breast augmentation by grounding his study in psychiatric implications rather than those of fashion. Furthermore, by publishing in an esteemed medical journal on plastic surgery, his readership and approach are different to those of cosmetic surgeon Franklyn; however, the arguments are effectively the same: breast augmentation surgery is encouraged. I would argue, however, that these ‘life experiences’ were in fact partly shaped by the prevailing ideological heteronormative and patriarchal concepts and expectations of the performance of hyper-feminine gender in the postwar US. This understanding of what constitutes the ‘normal’, ‘healthy’ and ‘desirable’ white female ideal consequently impacted on the design and shaping of women who could increasingly be shaped from the inside out. Deep-seated patriarchal structures and ideas around gender shaped women’s bodies in representation and reality as malleable and curvaceous. Although the popular female silhouette may change with the prevailing fashion, it is the dominant ideological approach to women’s bodies as malleable and the role they serve in a gendered performance that remains unchanged and, in this period, increasingly possible through a culmination of changes in technology. A female patient’s reasons for undergoing surgery might be personal in terms of the trauma she has experienced for not

⁸³ Ibid.

⁸⁴ ‘The Operation that Remolds Flat-Chested Women’, *Pageant*, August 1953.

meeting the social norms dictated by a heteronormative standard; however, who is the cause of this shift to trauma?⁸⁵

Passing for the heavily gendered hyper-feminine curvaceous ideal was not just the reserve of cis women. It included trans women such as Charlotte McLeod, the second major female transgender case to be covered by the US mainstream press. McLeod, who was the second publicised trans white woman to travel from the US to Denmark in 1953 to undergo gender confirmation surgery, followed in the footsteps of Christine Jorgensen, who underwent the first surgery of this kind in 1952.⁸⁶ McLeod is said to have undergone an operation to 'round out her figure into a more womanly shape' and turned to foam as an aid to perform and embody gender.⁸⁷ She is also counted amongst Elsa K. LaRoe's female trans patients to receive her breast implant surgery.⁸⁸ In 1953 *Jet* magazine ran a series of articles on African American trans woman Carlett Brown who was planning on having the same gender confirmation surgery carried out in Europe as Jorgensen, however unlike McLeod's coverage, it does not mention bust, hip or buttock augmentation procedures using foam.⁸⁹ Historian Emily Skidmore highlights the significance of race within media representation of transsexuality and has noted that access to plastic and cosmetic surgery was even more limited for trans women of colour and so too was coverage of their stories in mainstream US publications.⁹⁰ For trans women, utilising cosmetic surgery as a means of passing was

⁸⁵ For scholars who deal with cosmetic surgery and issues around agency, trauma and feminism, see Kathryn Poly Morgan, 'Women and the Knife: Cosmetic Surgery and the Colonisation of Women's Bodies', *Hypatia*, 6. 3. (Fall 1991), 25-53; Cressida J. Heyes and Meredith Jones (eds) *Cosmetic Surgery; a Feminist Primer* (London: Routledge, 2009), particularly Kathy Davis 'Revisiting Feminist Debates on Cosmetic Surgery: Some Reflections on Suffering, Agency and Embodied Difference' (pp. 35 -49) and Suzanne Fraser, 'Agency Made Over? Cosmetic Surgery and Femininity in Women's Magazines and Makeover Television' (pp. 99-116); Blum, 2003; John A. Byrne, *Informed Consent* (New York: McGraw-Hill, 1997); Jacobson, 2000; Susan Zimmermann, *Silicone Survivors: Women's Experience with Breast Implants* (Philadelphia: Temple University Press, 1998).

⁸⁶ Jorgensen and McLeod were frequently compared in the press. Jorgensen was presented in the press in a largely favourable light, whereas McLeod was not. Both had served in WWII; however, McLeod was discharged from the army and perhaps this is one of the reasons why she received less favourable press. See also Emily Skidmore, 'Constructing the "Good Transsexual": Christine Jorgensen, Whiteness, and Heteronormativity in the Mid-Twentieth-Century Press', *Feminist Studies*, 37.2 (2011), 270-300.

⁸⁷ Jean Howard, "'Charlotte" in Second Surgery' *New York Journal – American*, 14 August 1955, p. 9, JPW, Box 199, Folder 4.

⁸⁸ Joanne Meyerowitz 'A "Fierce and Demanding" Drive' in Susan Stryker and Stephen Whittle (eds) *The Transgender Studies Reader* (London: Routledge, 2006) 362 – 386, 372

⁸⁹ Brown told *Jet* she had made arrangements for gender confirmation surgery with a doctor in Bonn, Germany. See 'Male Shake Dancer Plans to Change Sex, Wed GI in Europe' *Jet*, June 18, 1953, pp. 24 -25; 'Male Dancer Becomes Danish' *Jet*, June 25, 1953, 26; 'Jail Male Shake Dancer' *Jet*, July 9, 1953, 20; 'Tax Snag Halts Male Dancer's Trip for Sex Change' *Jet*, October 15, 1953, 19.

⁹⁰ Skidmore, 2011.

particularly important, as it could also help them to avoid physical assault or arrest for cross-dressing, a common occurrence in many states until 1974.⁹¹

The foam implant was an object strikingly similar to the falsies that fashion magazines recommended as a cosmetic tool with which to combat ‘the pattern of heredity’; it was, however, no longer an accessory or item of clothing, but an internal extension of the female form.⁹² As demonstrated, cosmetic surgeons such as Franklyn were keen to offer their services as a way of making permanent the boosting effect props such as bullet bras and falsies could only temporarily provide.

⁹¹ Trans women, particularly trans women of colour, have suffered a history of violence and continue to be targeted. The annual Hate Violence Report by the National Coalition of Anti-Violence Programs states that in 2012, 53% of anti-LGBTQ homicides in the US were against transgender women, and 73% were against people of colour (Laura Erickson-Schroth *Trans Bodies, Trans Selves: a Resource for the Transgender Community* (New York: Oxford University Press, 2014) p. 29). For more on this read C.R. Snorton and J. Haritaworn, ‘Trans Necropolitics: A Transnational Reflection on Violence, Death, and the Trans of Color Afterlife’, in S. Stryker and A. Z. Aizura (eds.), *The Transgender Studies Reader 2* (New York, NY: Routledge (2013), pp. 66–76; T.M. Bettcher, ‘Evil Deceivers and Make-believers: On Transphobic Violence and the Politics of Illusion’, *Hypatia*, 22.3 (2007), 43–65; Kimberlé Crenshaw ‘Mapping the Margins: Intersectionality, Identity Politics, and Violence against Women of Color’, *Stanford Law Review*, 43.6 (1991), 1241–1299; Dean Spade, *Normal Life: Administrative Violence, Critical Trans Politics and the Limits of Law* (Boston: Southen Press, 2011); E.L. Lombardi, R.A. Wilchins, D. Priesing, & D. Malouf, ‘Gender Violence: Transgender Experiences with Violence and Discrimination’, *Journal of Homosexuality*, 42.1, (2001), 89–101. For more on the history of cross-dressing and its legislation in the US see Clare Sears, *Arresting Dress: Cross-dressing, Law and Fascination in Nineteenth-Century San Francisco* (Durham, NC: Duke University Press, 2014). For a decolonial approach to trans history see Snorton, *Black on Both Sides*. It should also be noted that polyurethane foam was later used to cover silicone gel-filled testicular prostheses. Originally designed as implants for cis males, these implants were also queered and used in surgeries for trans men.

⁹² ‘There are fashionable brassieres to use as a cosmetic against the pattern of heredity’ – ‘La Belle Poitrine’, *Vogue*, September 1, 1944, pp. 167 – 168 (p. 167).

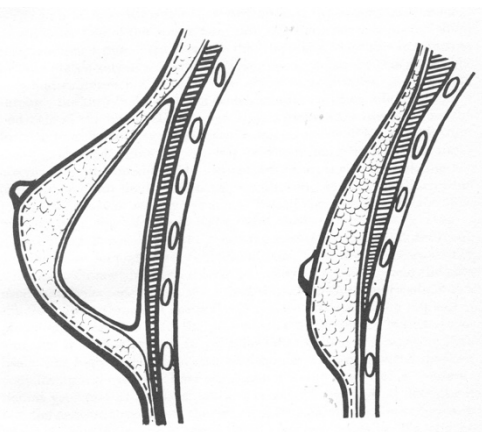
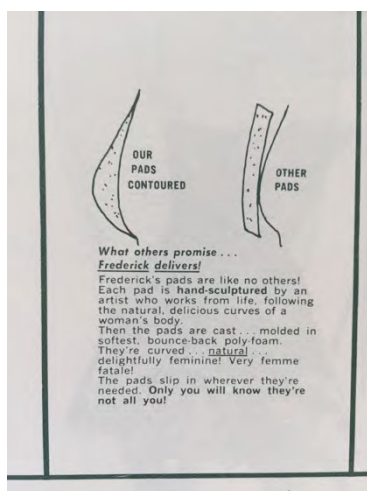


Figure 12: Frederick's of Hollywood Falsies, 1963

Figure 13: 'Schematic drawing showing flat chest before and after insertion of plastic foam, remolding breast into pleasant contour without interfering with glandular tissue' in Franklyn, *Developing Bosom Beauty* (1959)

Surgical diagrams such as those in Figure 13 illustrating the insertion of a cone-shaped implant under the flesh bear a close resemblance to diagrams and patents illustrating foam rubber inserts for bras (for example in Figure 12). In this rhetoric, the female body can be 'taken in' or 'padded out' like a garment, using the very same materials. Franklyn, for example, was keen to stress the ease of his operation. In his description of 'Breastplasty', slipping a Surgifoam implant through what he describes as a 'very small' incision in the fold under the breast is not dissimilar from the language used in Figure 5 and 12, in which Frederick's promises: 'the pads slip in wherever they're needed. Only you will know they're not all you.' Franklyn's textual and visual description detracts from the invasive nature of the procedure itself. Instead it implies the ease and action of compressing a foam insert into the small incisions in a bra to push foam inserts through for optional padding. Franklyn's description of the surgical procedure uses diminutive, gendered and infantilising language to distract from the intrusive act of inserting a foreign material into flesh.⁹³ The incision into the breast is 'nice' and 'tiny', the material is 'compressed down to a little ball'. Foam 'opens up like a flower' afterwards, and we see artifice transformed into nature as female anatomy is padded out with man-made fibres and stitched together with nylon. Franklyn's choice of language also alludes to how this patient's cleavage can now come into

⁹³ Franklyn, 1959 *Developing Bosom Beauty*, p. 81.

full bloom, mirroring the compendium of 'before and after' tales of self-actualisation and increased social mobility throughout his publication. He frequently stresses the power of foam's projectile movement as well as the ease of the procedure itself: 'this plastic [foam] material pushes the breast outward and upward, giving it a new, full and attractive curve, in a matter of minutes without requiring hospitalization.'⁹⁴ Foam moved outwards and upwards, supposedly giving the patient agency to push themselves onwards and upwards in terms of social mobility and passing for both cis and trans women.

In Franklyn's narrative of process, the nude photographs of women become central; 'even if she were to pose for nude pictures later, the line would be too faint to show up'.⁹⁵ American Studies scholar Virginia Blum explores the power of images in cosmetic surgery and 'the falling away of representation from its material referent'.⁹⁶ Like Baudrillard's thinking on the simulacra, she argues that the image dictates reality, superseding the original.⁹⁷ 'The image becomes the model for the original to emulate'.⁹⁸ Blum's and Baudrillard's thinking can be taken a step further and combined with Hollander's theory of 'seeing through clothes' and Entwistle's 'fashioned body'. Thus, in addition to being shaped by the 'material referent' of the representation of the ideal female body, the ideal unclothed female body becomes shaped also by fashion items worn on the surface of the skin, themselves shaped by changes in plastic materials and technology, which in turn impacted on the subcutaneous sculpting of female flesh.

There is, however, another factor to consider in this paradigm of the bombshell. Plastic foam's compressible materiality had agency, bouncing back, expanding outwards and upwards, pushing out female flesh into the desirable conical shape the curvaceous ideal dictated. The body, however, also had agency and its own movement. As material feminist Stacy Alaimo has noted, feminist theory and cultural studies of the body tend to centre on exploring discursive, rather than material, productions of the body, thereby casting the body as 'passive, plastic matter'.⁹⁹ This is why, she argues, it is important to employ interdisciplinary methods that combine critical theory with science studies when exploring

⁹⁴ Ibid., p. 71.

⁹⁵ Ibid., p. 81.

⁹⁶ Blum, 2003, p. 97.

⁹⁷ Jean Baudrillard *Simulacra and Simulation* trans. Sheila Faria Glaser. (Ann Arbor: University of Michigan Press, 1994)

⁹⁸ Ibid.

⁹⁹ Stacy Alaimo, *Bodily Natures: Science, Environment and the Material Self* (Bloomington, IN: Indiana University Press, 2010), p. 3.

trans-corporeality. Grindlay and Waugh, two US scientists working with polyvinyl alcohol (another type of synthetic sponge) in the 1950s offer a factual account of foam's agentic interaction with the body. This is helpful in connecting theory and materiality to foam's physical interactions with the body and for understanding the body as actant. Grindlay and Waugh published 'Plastic Sponge Which Acts as a Framework for Living Tissue' in the *American Medical Association Archives of Plastic Surgery* (1951).¹⁰⁰ The choice of title clearly makes a strong distinction between the implant's man-made material and the body's own tissues. They enthused, however, that the synthetic material was able to 'become part of the structure of living tissue', transforming into and merging with the living tissue's structure.¹⁰¹ The distinctions here became increasingly blurred. Synthetic foam's materiality mimicked flesh and flesh in turn colonized polyurethane foam. Flesh was becoming foam and foam was becoming flesh.

Grindlay and Waugh described polyvinyl foam's 'kinship with living tissue': it thrives on water, which tissue cells inhabit. They observed: 'perhaps tissue fails to recognise polyvinyl sponge as a foreign body, because tissue fluids enter it. Cells follow fluid, and what was inert becomes living.'¹⁰² Grindlay and Waugh reasoned from their studies that human tissue's tendency to inhabit and colonise these foreign structures was a good sign, that it demonstrated the body's acceptance of the synthetic material. This concurs with medical knowledge at the time. The body didn't immediately expel the foam implants in a foreign body reaction and was thought to be a positive sign. Similarly, concepts around toxicity and plastics, particularly in relation to their implantation in the body, changed over time: at this point they were not a concern.¹⁰³ It was not until later that the complications of foam implanted in the body became clear, such as loss of sensation in the nipple and inability to breastfeed, as well as painful hardening of implants, which for some patients eventually required amputation. These tests primarily dealt with the body's immediate visceral reaction, which appeared to be positive.

¹⁰⁰ John Grindlay and John Waugh 'Plastic Sponge which Acts as Framework for Living Tissue', *American Medical Association Archives of Plastic Surgery* 63 (1951), 288 – 297.

¹⁰¹ *Ibid.*, p.288.

¹⁰² Grindlay and Waugh, 1951, p. 296.

¹⁰³ For more on changing concepts and understandings of toxicity see Arthur Daemrlich, *Pharmacopolitics Drug Regulation in the US and Germany* (Chapel Hill, NC: University of North Carolina Press, 2004).

Provenance of Surgifoam

How did foams that were being used in everyday designed objects, including transportation upholstery, furniture, clothing and foundationwear, differ from those being implanted in human bodies, if at all? I wanted to find out where surgeons were sourcing their foams from. This is not covered in the established historiography, and needs to be addressed. Were women being padded from the same materials that surrounded them in their daily interactions with the designed world? In this section I investigate to what extent the much-publicised cosmetic surgeon Franklyn's attitude to materials sourcing and transparency differed from that of his well-respected AMA-approved plastic surgery colleagues who published in medical journals that were less easily accessible to the public.

Prior to discovering Surgifoam, Franklyn experimented with commercial plastic foams; however, he found these to be lacking due to 'poor cell structure' and the strong chemicals that were used to preserve them.¹⁰⁴ Openly detailing his unusual research journey to his readers, the self-claimed 'beauty-parlor' surgeon asserts in WWII he discovered the ideal implant properties of a synthetic foam not yet available on the US market.¹⁰⁵ He recalled examining a 'captured German fighter plane' on public display in Canada in 1943, where he claimed to be observing plastic surgery being carried out by the Royal Canadian Air Force in Toronto at the time.¹⁰⁶ Franklyn noted that 'the staff sergeant in charge of the plane explained that because the Germans had no access to rubber during the war, they had made an imitation foam rubber where in America we had made an imitation solid rubber'.¹⁰⁷ German cockpits were lined in this synthetic foam rubber and 'a piece of the upholstery had been cut away to show the imitation foam rubber beneath', which Franklyn observed 'looked like a revolutionary type of plastic sponge to me'.¹⁰⁸ Franklyn's decision to reveal the apparent German military source of his first foam implant experiments is striking. It neither problematises nor disguises the military-industrial origins of the material, or its wartime context as a relic from an enemy bomber plane. Instead, the cross-section display of the plane's materials indicates how military material culture is something tangible that is talked about. It demonstrates a North American public interest and curiosity in advancements in

¹⁰⁴ Franklyn, 1959, 1960, 1961.

¹⁰⁵ Ibid.

¹⁰⁶ Franklyn, 1959, p. 73.

¹⁰⁷ Franklyn, 1960, p. 14.

¹⁰⁸ Ibid.

materials and technologies developed in Germany, and a desire to interact with these artefacts. Troops who had been stationed in Germany and Korea returned with objects from those places and used them to tell stories at home. Furthermore, as Cynthia Henthorn has noted, once shunned as unreliable, plastic materials that had ‘stood the test of war’ were increasingly perceived by consumers in the postwar US as dependable, hygienic and functional, which might explain why Franklyn’s story gained traction in selling Surgifoam to women in the postwar US.¹⁰⁹

Franklyn claimed he obtained a square foot of this very same pilot’s seat ‘and as an experiment in [his] surgery, used small pieces of it to see if it would be tolerated in the tissues of the human body’.¹¹⁰ There is no mention here of rigorous animal testing: Franklyn instead goes straight to the human body. He enthused, ‘the results were amazing. The body did not react to it in any way and it helped enormously in filling out missing tissues.’¹¹¹ This anecdote, which could of course be subject to exaggeration, is, however, invaluable in providing a rare primary source that links developments in breast augmentation implants directly to wartime developments in plastic foams. Furthermore, Franklyn’s story, perhaps affected by the sensationalism with which he was prone to promoting his services, does in fact correlate with primary sources on the development of plastic foams.

Franklyn correctly identified the soft foam he found in the German plane as originating from IG Farben, detailing the damage to the factory from Allied bombing.¹¹² It is highly likely he is referring to the polyurethane foam that originated from Otto Bayer’s lab (as discussed in Chapter 2) at the Bayer Leverkusen plant, which was part of the IG Farben conglomerate during WWII.¹¹³ How did Franklyn have access to this military intelligence on foam? Did he read about it in *German Plastics Practice* (1946)? Inspired by ‘this plastic foam “cushion”’, he soon became aware that ‘there was no plastic material in the [US] that could match it for lightness and resilience.’¹¹⁴ After some research, however, he claims he discovered that

¹⁰⁹ See Henthorn, 2006, ‘Reconversion and the Military Endorsement’ and ‘Plastic World in the Making’, pp. 86 – 100.

¹¹⁰ Franklyn, *Developing Bosom Beauty*, 1959, p. 73.

¹¹¹ Ibid.

¹¹² Ibid., p. 73-74.

¹¹³ IG Farben, formed in 1925, was a merger of six German chemical companies, which included Bayer, Agfa, and BASF. During WWII IG Farben produced Zyklon B poison gas that killed over one million Jews. A factory was constructed close to Auschwitz Concentration Camp and over half of IG Farben’s workforce of 330,000 men and women working across its various subsidiaries in 1943 are estimated to have been slave labour or conscripts. The Allies seized the company at the end of the war because of its involvement in the Holocaust and in 1951 split the company back into its original six companies.

¹¹⁴ Franklyn, 1959, p. 73

German plastic companies had entered into a licensing agreement with a number of chemical manufacturers in the US to distribute ‘various types of German plastics’, including the plastic foam he was interested in.¹¹⁵ Franklyn ordered the material, experimented with it, then claims to have ‘refined it for surgical purposes into a polyester plastic foam called “Surgifoam”’.¹¹⁶ Franklyn gives his readers the impression that the material he is implanting within the breast is a new type of material that he has explicitly developed for use in the human body, free from the strong preservation chemicals he complains of earlier. He does not share the material’s chemical composition or the name of its manufacturer or supplier, nor where and how this foam was produced. Did Franklyn eventually source his plastic foams from Mobay, when it was formed as a merger between Bayer and Monsanto in the US in 1954? Franklyn’s public-facing comments on his sourcing of foam can help us trace its most probable provenance.

Franklyn vs. the AMA

Franklyn promoted his Surgifoam invention and Breastplasty operation in the medical and popular press, attracting the attention of respected plastic surgeons such as Conway and Webster, as well as the AMA, all of whom hold materials he published in their papers and archives.¹¹⁷ Franklyn did not share his papers with an archive. The AMA’s Bureau of Investigation papers indicate Franklyn’s wide appeal and material impact: he is the only named bust augmentation surgeon for whom they have dedicated folders. Whenever he published an article in a popular magazine there was a spike in national and international correspondence to the AMA asking for further information on his practice and credentials.¹¹⁸ An example is the August 1953 issue of *Pageant* magazine, its cover wrapped in a white sleeve emblazoned in red text: ‘In this issue - the first time in pictures: THE OPERATION THAT REMOLDS FLAT-CHESTED WOMEN’ (Figure 14). A paper band conceals the bustline of a

¹¹⁵ Ibid., p, 73

¹¹⁶ Ibid., p. 74

¹¹⁷ see ‘Augmentation Mammoplasty’ and Surgifoam advertorial in *General Practice Medical Journal of the West* November 1957 Vol. 20, No.11 pp. 11- 12; *Southern General Practitioner of Medicine and Surgery* April 1953 No. 4, pp. 70 – 76 ; Robert Alan Franklyn files, AMA Archives, Chicago, Illinois, 0288-13. Webster and Conway’s archives both hold clippings relating to Franklyn: see Jerome Pierce Webster Papers, 1888 – 1974, Series 9: Newspaper clippings, Box 199, Folder 1 and Herbert Conway, Box 33: Series V, Miscellaneous, 1948-1968.

¹¹⁸ Franklyn’s operation, as promoted in Henry Lee, ‘Breastplasty: the operation that remolds flat-chested women’ *Pageant* August 25 1953, 68 – 75, saw such a spike in correspondence at the AMA that they published a warning: see ‘The Business of Bolstering Bosoms’ Bureau of Investigation, *JAMA*, Nov 28 1953, 1200. See also Franklyn, cited in AMA News Release, Friday November 27 1953 RAF; Correspondence and Articles, particularly files for 1954 and 1959 (0288-01, 0289-01).

white female model dressed in a white swimsuit; to see her bustline requires a *Pageant* purchase and removal of the wrapper.¹¹⁹

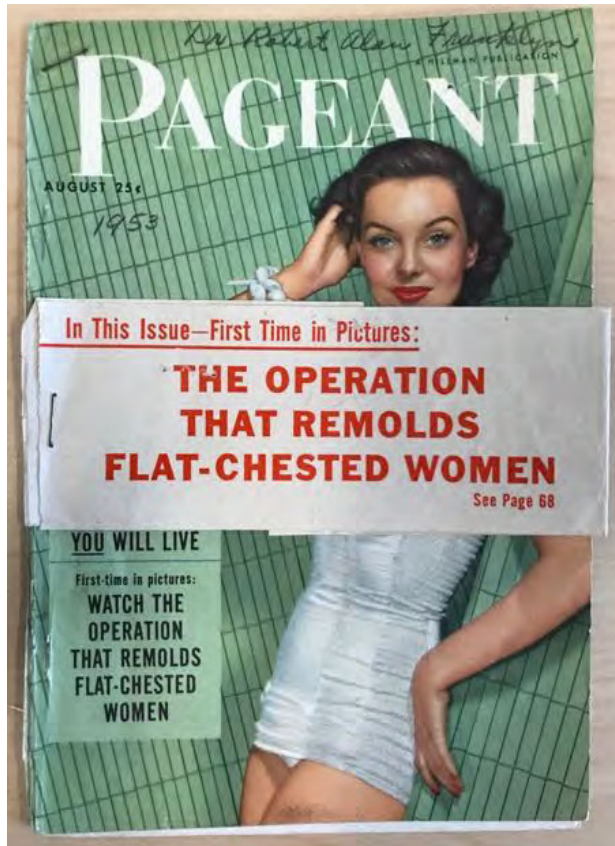


Figure 14: *Pageant*, August 1953

Inside, an article titled 'Breastplasty' introduces this 'new type of operation' developed by Franklyn and recently published under the same title in the medical journal *Southern General Practitioner of Medicine*.¹²⁰ The article, by journalist Henry Lee, began by claiming that over 4 million young women in the US suffered from 'micromastia' (immature breasts) and that since 'the fully developed breast has become a standard of female beauty [...] spinsterhood and unhappy marriages' could be 'traced' to this condition.¹²¹ Here Lee used the language of pathology to link women's failure to perform current heteronormative gender roles. As with the 'Counterfeit Bride', small breasts were to blame for women's

¹¹⁹ *Pageant* was launched in November 1944 and ran until February 1977. A US monthly, it claimed to model itself on *Reader's Digest* and featured articles on current affairs, including medical and health topics, and interviews with musicians, politicians and writers. It also prided itself on its visual material, often including (non-nude) glamour photography. Its print run in April 1949 totalled 400,000, this rose consistently and the magazine reached a wider readership as it was stocked in public spaces such as beauty salons. Anthony Slide, *Inside the Hollywood Fan Magazine: A History of Star Makers, Fabricators, and Gossip Mongers* (Jackson, MS: University Press of Mississippi Press, 2010) and 'April Fool' *Time* (April 11, 1949).

¹²⁰ Franklyn, in *Southern General Practitioner of Medicine and Surgery*, April 1953, No. 4, 70 – 76 – this includes the same images also used in *Developing Bosom Beauty*, 1959.

¹²¹ Lee, 1953, p. 72

marital failure: that is, if they were single, or their marriage was difficult. Falsies, noted by Lee as subject to ridicule, were not an answer. Franklyn, however, Lee suggested, had the solution to all these problems: his procedure would take only 10 to 15 minutes and often did not even require a hospital setting.¹²² Perhaps hoping to challenge and undermine the surveilled structure of the hospital and the costs this could involve, Franklyn argued that Breastplasty could be quickly performed in an office setting (which would have been unlikely to have been sterile). 'I want people to regard this kind of surgery with the same attitude as going into the beauty parlor or visiting the dentist.'¹²³ Breast augmentation was to be viewed as a simple, painless procedure, nothing more than an addition to a well-established health and beauty regime.

Franklyn quelled any concerns readers might have about foreign body reactions, reassuring them that his choice of material promised subcutaneous acceptance. The implants, concealed within flesh, melded into one with the body. Lee assured readers:

'as a matter of fact, because of [the implant's] porous construction, the foamed plastics tend to become a part of the body. Though they do not in any way affect the natural processes, they act as a framework for new tissues and blood cells which grow in and around them.'¹²⁴

Similarly to Maidenform's satin-covered Masquerade falsies, in which the foam was presumably covered to shield it from perspiration and make it look more attractive, Franklyn covered the foam implant in 'a nylon membrane'. The material's ability to be moulded into 'a closed pore system', further protected by a nylon covering, was absolutely essential and set it apart from the sponge rubber materials that had preceded it. Franklyn claimed that the implant's nylon sheath ensured its flexibility and retained its proper contour. He argued the great danger of other sponge rubber implants lay in their porous structure: if this was not covered in a fibrous synthetic material such as nylon, then body tissues would infiltrate the air holes, causing the material to shrink and harden. The breasts, inseparable from the implants themselves, would become painful and lumpy, requiring amputation.¹²⁵ Franklyn

¹²² Ibid., p. 85.

¹²³ Ibid.

¹²⁴ Ibid., p. 74.

¹²⁵ Franklyn's Surgifoam implants also required amputation with time – see AMA files.

also claimed his 'poly-plastic' invention, which he named 'Surgifoam', in line with similar 'scientific'-sounding domestic synthetics such as DuPont's Dacron and Orlon, was superior to previous synthetic foam implants such as Ivalon.¹²⁶ He asserted that his invention could be 'sterilised at high temperature and pressure', minimising risk of infection. Previous 'obsolete vinyl plastics', such as Ivalon, he argued, were sterilized by boiling, and would crumble under pressure, resulting in a loss of shape.¹²⁷

Surgifoam, Franklyn asserted, boasted many material advantages as an implant: inert, it was unlikely to set off a foreign body reaction; lightweight, flexible and compressible, making it easy for a surgeon to 'shape artistically', it could not be absorbed by the body (unlike human fat or other plastics), and was nonallergenic; it did not show up on X-rays, so that patients did not need to feel embarrassed should they not wish to disclose their operation; it was non-ageing, 'so that breasts will always remain youthful'.¹²⁸ Franklyn even macabrely claimed that Surgifoam was in fact so robust that it would outlive his patients: 'I can predict that a hundred years from today the only trace that will be left of some patients will be the two plastic foam sponges of Surgifoam that have been implanted in their bodies'.¹²⁹ Here plastic foam, of superior plastic materiality, apparently outlived the ultimate abject ageing body, that of the decaying corpse.

In 1953, the AMA took note of Franklyn's wild claims in both the medical and popular press. Bureau of Investigation papers reveal that they kept extensive files on his activity.¹³⁰ After the publication of the *Pageant* article the AMA was inundated with letters from male and female members of the public enquiring into Franklyn's services and credentials. The AMA took issue with his work for a number of reasons. First, Franklyn did not cite where he was getting his statistics for micromastia from. Second, he claimed he was essentially the only surgeon able to perform this important surgery. Third, he failed to produce or cite exhaustive animal experiments with the materials before their implantation into the human body. Fourth, Franklyn advertised his services in the classified section of phone

¹²⁶ Lee (1953). Other plastic foam materials that were implanted include Ivalon foam that was made of polyvinyl alcohol formaldehyde polymer sponge- or a polyethylene sac with Ivalon.

¹²⁷ Ivalon, made of polyvinyl, was found to be toxic when implanted. For a more detailed description of the 'Ivalon' sterilisation process see Armand Hartley, 'Surgery's New Miracle – Permanent Curves', *Confidential* magazine, New York, January 1956, pp. 18 – 19.

¹²⁸ Franklyn, in Lee, 1953, pp. 74 – 75.

¹²⁹ *Ibid.*

¹³⁰ See RAF, Series: 284 Franchises Frauds and rackets (inclusive) 1951-1981, 0288-12/0289-07; Correspondence and Articles.

directories.¹³¹ Fifth, Franklyn refused to disclose the technical specifics of the foam composition he was using to the AMA, responding that: ‘the substances used by me are not on the market — having ordered specifically from the supplier for test purposes.’¹³² The AMA retaliated in late November 1953, via a press release and an article in their journal, denouncing his widely publicised surgical procedure known as ‘Breastplasty’ and cautioning against his services, claiming he was likely to be using Ivalon, a material that was known to be problematic as an implant.¹³³

In spite of the AMA’s response to the coverage of Franklyn’s procedure in *Pageant* in 1953, articles in the popular (and some medical) press in praise of foam plastic implants proliferated, and so too did their impact on women’s bodies, as demonstrated by correspondence at the AMA Archives. Publications such as *Confidential* linked the operation to Hollywood, glamour and consumer goods, such as fashion accessories. *Confidential* boasted a print run of 4.6m, with each copy estimated to have averaged 10 readers, as it was a popular publication for men and women found in barber shops and beauty salons.¹³⁴

Audrey Minor wrote in *Confidential* (1953), ‘For years, movie stars have been switching the colour of their hair and fooling the boys with false eyelashes and just plain falsies.’ However, Hollywood was now subject to ‘a new science of fantastic fakery [...] built-in or built-up bosoms.’¹³⁵ Minor clarified that these alterations were subcutaneous and permanent:

‘These false fronts are not to be confused with the rubber kind you can purchase in a dime store and stuff into strapless dresses [...] the new curves are nature’s own,

¹³¹ ‘The Business of Bolstering Bosoms’, Bureau of Investigation, *JAMA*, Nov 28 1953, 1200

¹³² Franklyn, cited in AMA News Release, Friday November 27 1953 – American Medical Association Archives, Series: 284 Franchises Frauds and rackets (inclusive) 1951-1981, 0288-12/0289-07; Robert Alan Franklyn Files; Correspondence and Articles.

¹³³ See Franklyn, cited in AMA News Release, Friday November 27 1953, RAF, 0288-12/0289-07; RAF; Correspondence and Articles; ‘The Business of Bolstering Bosoms’ Bureau of Investigation, *JAMA* Nov 28 1953, 1200.

¹³⁴ Slide, 2010, p. 180. *Confidential*, founded in 1952 by editor Robert Harrison, who was experienced in publishing ‘cheesecake’ pin-up magazines, such as *Parade*, *Titter*, *Whisper* and *Flirt*, *Confidential* boasted a US print run of 4.6 million and targeted a white male and female readership. Unlike Hugh Hefner’s *Playboy* magazine, first published in 1953, *Confidential* did not include full nudity but was criticised by moral groups for focusing on sex, crime and violence. *Confidential* focused on Hollywood scandal stories, gossip and celebrity exposés. Cosmetic surgery and beauty treatments were also a frequent topic, focusing on their Hollywood context and speculating on celebrity clients. *Confidential*’s investigative journalism, however, also included topics such as exposing a polio vaccine health scare (*Confidential* 3. 4 (September, 1955)). For more on *Confidential* see also Henry E. Scott, *Shocking True Story: The Rise and Fall of Confidential, "America's Most Scandalous Scandal Magazine"* (New York: Pantheon, 2010).

¹³⁵ Minor, 1954, p. 14.

remodelled, stretched or trimmed on a hospital operating table by modern science's wonder boys, plastic surgeons.'¹³⁶

Minor compares a private cosmetic surgery hospital to a 'factory', where the body could be redesigned and overhauled – 'the old chassis can be remodelled'. Using terminology that references automobiles and industry, Minor paints an image of a secretive space 'behind closed doors' in the heart of Hollywood. In its 'Golden Age', Hollywood and the studio system of celebrity was referred to as the 'star factory': artists were owned exclusively by studios, who dictated their image.¹³⁷ Minor reported that behind the scenes,

'movie stars with drooping fronts can be wheeled into surgery for an uplift. Actresses too bountifully supplied can be whittled down to a more sedate size. Starlets born flat-chested register for the big build-up.'¹³⁸

Abject drooping (female) bodies are wheeled in, compared to ailing car bodies and engines in need of repair, or abundant flabby raw materials on an assembly line, shaped up and shipped out, in accordance with pervading beauty ideals for the heteronormative white female. In the 'star factory', when these reworked females are released from behind closed doors, 'results are so perfect not even a husband or an enquiring boyfriend can tell the difference'.¹³⁹ In Minor's article, foam results are so perfect they defy detection, making it impossible to tell what is 'real' and what is 'fake'.

As demonstrated, foundationwear designers and plastic and cosmetic surgeons equated the softness and pliability of foam with gendered social mobility. Women's requirement to be pliable and malleable in society, the home and the workplace, particularly in Hollywood, as well as in the entertainment and sex industries, was likened to the softness of foam. Their worth was dependent on how well male directors and agents felt they filled out their sweaters. '[A young starlet] knew that without something to fill tight sweaters she never would make the cinematic grade, that the girls who get places in Hollywood must look soft,

¹³⁶ Ibid.

¹³⁷ For more on the 'Star factory', 'Golden Age of Hollywood' and consumption of celebrity culture see: Dyer, 1998; Dyer, 2004; Gledhill (ed), 1991; Stacey, 1991; Eckert 1991; Gundle, 2008; Dyhouse, 2011.

¹³⁸ Minor, p. 14.

¹³⁹ Ibid.

appealing and well-upholstered.¹⁴⁰ In this system, women must be inviting to touch, friendly-looking and satisfactorily padded. As shown, promotional copy for chemical, furniture and foundationwear companies, as well as surgeons' accounts in medical journal articles and journalists' for the general press, including Hollywood gossip publications, women's magazines, local papers, national papers and men's magazines, all praised foam for its squidgy, compressible materiality, linking it to the malleable gendered female body and her accommodating role in society.

In postwar America, as troops returned from the front, women were actively encouraged to leave the workplace and return to the home. In his book *Design for Business* (1947), US design consultant Joshua G. Lippincott suggested that designers looked to female dress fashions for inspiration on what would sell in the domestic environment. Lippincott commented: 'a woman likes to be in harmony with her environment', and recommended a 'parallelism between a woman's clothes and the furnishing of her home'.¹⁴¹ As we have seen, for some cis and trans women the parallels were not simply between the furnishings of their homes and the fashionable outer layers that encased their bodies or cushioned them as they sat. These same exterior materials were increasingly infiltrating women's bodies, in designs to pad them into fashionable 'healthy' conical contours.

Newspaper articles such as Weldon Wallace's 'Spare Parts for the Human Machine' praised the parallel developments in surgery and industrial plastics.¹⁴² Implanting foreign materials in the body was nothing new, Wallace asserted; for centuries ivory had been used as a bone replacement and sheep intestines for stitching. He noted that recent wartime developments in plastic and orthopaedic surgery had, however, offered new possibilities that had been made material realities by developments in plastics: 'The modern development of industrial plastics has placed a variety of potentially useful new materials at the disposal of surgeons'.¹⁴³ Industrial materials were now being transferred to medical applications thanks to their properties as 'lighter, less irritating, more flexible and easier to shape than many older materials.' Wallace, like many of his contemporaries, was impressed by the ability of plastics to shift between the industrial, medical and domestic realms,

¹⁴⁰ Minor, 1954, p. 14.

¹⁴¹ Joshua G. Lippincott, *Design for Business* (Chicago: P. Theobald, 1947), pp. 54 – 55. Foam padded furniture was likened to the softness of the female body. For example, in 1946 Eero Saarinen designed an organic shaped chair, upholstered in foam, which he named the Womb Chair, manufactured by Knoll in 1948.

¹⁴² Weldon Wallace 'Spare Parts for the Human Machine' *The Sun Baltimore*, Wednesday September 2, 1953, p. 6.

¹⁴³ *Ibid*, p. 6.

commenting: 'a sponge plastic useful to housewives in the kitchen is being used by surgeons to plug up cavities in damaged bones.' The opportunities plastics offered for repairing bodies appeared endless.

Foam Provenance (AMA Approved Surgeons)

Articles on plastic foam as a material for bust augmentation in both the popular and medical press generally did not disclose the sources for these types of foams. The most notable exception is Franklyn, who openly spoke about his own foam discovery in a German fighter plane, its absence on the US market and his later sourcing of these foams direct from industrial suppliers. Once Franklyn had sourced the foam, he developed his own allegedly medical-grade material, which he aptly named Surgifoam, etymologically positioning it in the medical realm, separate from that of the military and industry. Similarly, in the second part of their two-part *JAMA* article, 'Augmentation Mammoplasty II', *PRS* March 1961, Edgerton and McLary recommended polyurethane foam by Scottfoam by Scott Paper Company, and Etheron. The Scott Paper company specialised in sanitary tissue products, an established line of business associated with hygiene and the body. It would thus have been familiar to many readers as a company of this kind and the denotations of comfort, cleanliness, trust and care this brought with it. In both these cases the female body is padded with foam materials that are presented as specifically intended for the body rather than for military or industrial use.

In reality, though, surgeons were experimenting with materials in the body that had originally been intended for industry. Conway's archive provides a useful insight into the inner workings of the industrial-medical complex. Conway originally sourced plastic foams for surgery from the Robbins Instruments Company, New Jersey, established in 1952 and still operating today. This specialist medical engineering company provided him with tools for his surgery such as derma-planing equipment. They also provided Conway with diisocyanate polyether, sold as Etheron, in sizes of 5x5x2.5" and 6x6x3".¹⁴⁴ Etheron came with preparation and sterilisation notes, as recommended by Dr. Elsa K. LaRoe.

Robbins promoted Etheron's materiality as ideal for breast implants. As will be demonstrated, their promotional copy is not dissimilar from that of companies such as Mobay, who targeted the furniture market. Robbins promised that Etheron 'contains millions

¹⁴⁴ Noel Robbins, Robbins Instruments Company, letter to Conway, January 29 1959, HCP, Box 7; Correspondence between Robbins and Conway, 1959.

of uniformly distributed inter-connected air cells and is not affected by chemical changes, [...] is completely non-ageing, [...] does not harden or shrink, [...] is well tolerated by human tissues.’¹⁴⁵ Furthermore, that the material boasted excellent elongation, being a ‘highly elastic material with excellent cushioning effects which are maintained in any temperature may be normally encountered’ and ‘exceptionally high tensile and tear strength: can be screwed, stretched and sutured without the fear of breaking’. It is of high ‘resiliency after flexing’ and works ‘against ageing’. Etheron, Robbins assured, ‘is internally and externally non-toxic and stable. Will not decay or mold through fungi, bacteria or other biological agents. Odorless and tasteless.’ The material’s alleged neutrality made it ideal for implantation. Robbins was seemingly unconcerned about the long-term effects or the agency of the human body as actant on foam.

Etheron’s materiality was pliable, non-ageing, inert, inviting and soft to touch, could be compressed but instantly bounced back, never lost shape, did not harden and was considered to be easily tolerated. The rhetoric around the materiality of Etheron and other plastic foams is that of an easily manipulatable supernatural material that performs just as the [predominantly white male] surgeon or engineer demands.

In 1959, Conway pushed Noel Robbins for the exact chemical composition of Etheron. Robbins replied that their makers of Etheron ‘would not care to give [him] the formula’.¹⁴⁶ This could demonstrate the Robbins company did not know much about the material they were selling on the basis that they were medical engineers, or that even if they did, they were unwilling to share its chemical composition. Judging from his papers, it is likely Conway wanted to know the formula so he could include it in a future medical journal publication and to better investigate potential carcinogenic threats.¹⁴⁷ The other consideration is that he perhaps wanted to know its chemical composition so that he could compare prices of materials with other suppliers, or ask a different supplier to formulate it for him. In September 1959 Conway contacted Monsanto to request samples of Etheron foam in the same dimensions as the Robbins foam, presumably to compare the materials. Monsanto forwarded his enquiry to Mobay, who replied: ‘we are not familiar with the name Etheron, but believe that it is a trade name for Urethane foam manufactured by one of the

¹⁴⁵ ‘Etheron Foam Physical Properties’, attached to Noel Robbins letter to Conway, January 29 1959, HCP.

¹⁴⁶ Noel Robbins, letter to Conway, October 8 1959, HCP.

¹⁴⁷ See HCP, Box 7, Correspondence between Robbins and Conway, 1959.

companies on the attached list'.¹⁴⁸ Twenty-nine North American companies are listed as 'commercial produc[ers] of urethane foam [who] can provide full information on foam and foam products'. Mobay also offered to test a sample of Etheron for Conway to confirm whether or not it was a urethane foam. He complied, and Mobay confirmed that the sample was a polyether urethane foam, and although they were not familiar with the trade name Etheron, 'a similar type of foam product can be obtained from any of the companies on the attached list'.¹⁴⁹ The list spans 27 US-based companies, predominantly located on the East Coast, and two Canadian companies (see Figure 15). It implies that no differentiation was made between industrial suppliers and 'medical suppliers' of foam, and that they were essentially the same material, just marketed under different names.

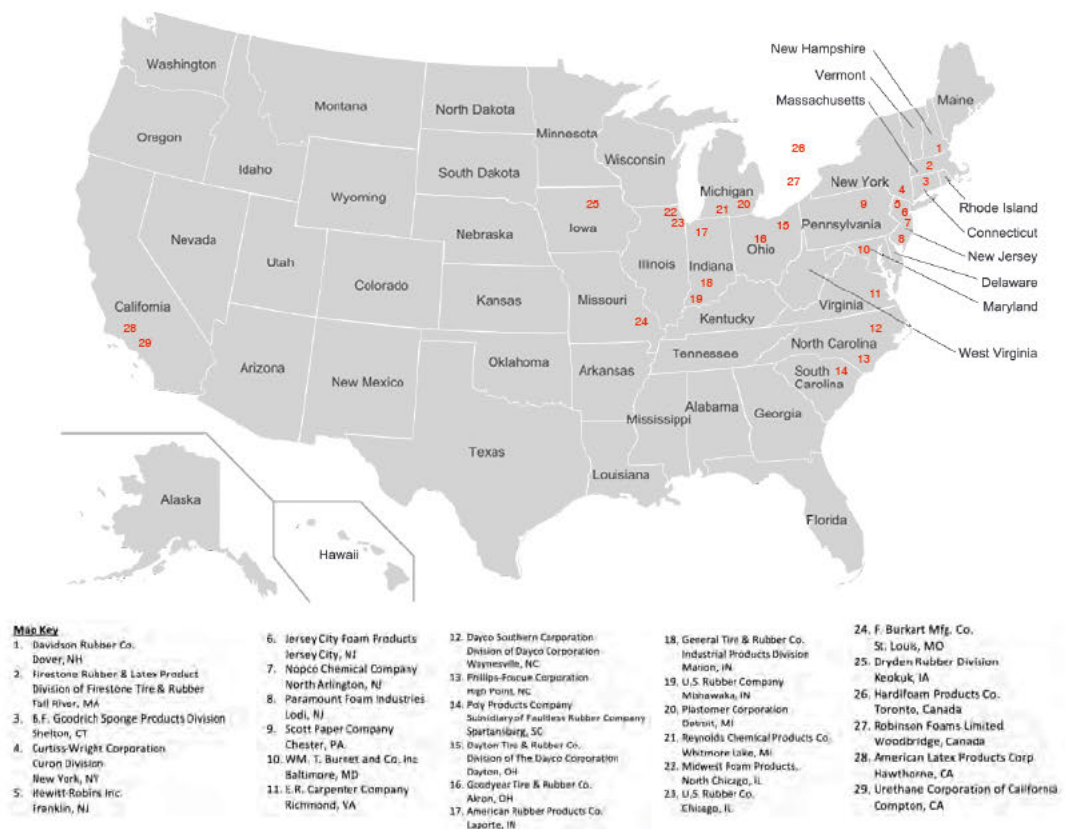


Figure 15: Map of 29 polyurethane foam suppliers recommended by Mobay to Conway

Mobay was not the only producer of urethane foam with whom Conway was in touch. In July 1960, Conway contacted The General Tire and Rubber Company, Akron, Ohio,

¹⁴⁸ D.H. Bryan, Mobay District Sales Manager, letter to Conway, November 18 1960, HCP, Box 7.

¹⁴⁹ Ibid.

requesting foam samples for experiments in corporeal applications, first in animal experiments and later in the female breast. General Tire obliged and sent him two samples of Polyfoam P-17 Grade, supplied by their Industrial Products Division at Marion, Indiana. Responding to Conway's inquiries, they noted they had no information on the carcinogenic properties of Polyfoam. Their reply includes a June 1960 article from *Air Engineering Magazine* titled 'Cancer from Polyethylene, Polyurethane, Polysilicone Production Processes?' and claimed that their specific foam did not have the same carcinogenic ingredients as those discussed in the article.¹⁵⁰ Conway replied enthusiastically, noting that 'as far as I know, no one has yet tried [General Tire Polyfoam] in the body.'¹⁵¹ Conway was keen to be the first to trial this material in the human body. Unlike Franklyn and Edgerton, Conway's published articles reveal neither the sourcing process nor the actual name of his foam supplier. The material is central to the process, giving form to his vision of the augmented bust, and yet its provenance and chemical composition were hidden from view.

In May 1962, Conway and Dietz, MD, Ohio published 'Augmentation Mammoplasty' in *Surgery, Gynaecology and Obstetrics*.¹⁵² Presumably this is the article Conway was researching when he contacted Robbins, Mobay and General Tire from 1959 to 1960. The piece mentioned Polyfoam sponge, 'furnished in blocks of 6 by 6 by 5 inches', however, it does not mention who manufactured this foam nor where it could be purchased. It also fails to detail the technical specifics of Polyfoam; for example, was it a polyurethane material or a polyvinyl? The material itself receives only a brief mention in a section on 'Technique'. The sourcing and chemical composition of the materials are entirely omitted. Instead, the authors choose to praise the material's malleability: 'the material is carved easily into the desired shape with a knife or heavy scissors.'¹⁵³

Foam's ability to be shaped into a conical prosthetic is privileged over provenance. 'The sponge is cut roughly to the shape of a truncated, eccentric cone. Recently, attention has been directed to the contouring of the prostheses to the shape of a virginal breast.'¹⁵⁴

¹⁵⁰ In keeping with understandings and concerns around toxicity and carcinogens at the time, the *Air Engineering* article deals with potential health issues relating to the material's *production* rather than long-term threats of the material after production. For more on changing understandings of toxicity in the US see Arthur Daemmrich, *Pharmacopolitics: Drug Regulation in the US and Germany* (Chapel Hill, NC: University of North Carolina Press, 2004).

¹⁵¹ Conway, letter to M.J. Sanger Head of Cellular material development, General Tire and Rubber Company, August 20 1960, HCP, Box 7.

¹⁵² Conway and Dietz, 1962, p. 576.

¹⁵³ *Ibid.*

¹⁵⁴ *Ibid.*

Conway and Dietz instructed that Polyfoam should be shaped by scissors into a conical shape, pushing the breasts outwards and upwards in a similar fashion to that of the bullet bra and pointed falsies available in the early 1960s US, an aesthetic also followed by Franklyn. As discussed earlier, understandings of what constituted a 'virginal breast' fluctuated over time and were affected by (interdependent) changes in technology and fashion.¹⁵⁵ The female breast was pathologised, and what was presented by male medical practitioners as the 'healthy' or desirable 'maiden-formed' breast was clearly shaped by technologies and fashions of the time. This is particularly significant, as here we see two respected AMA surgeons in a reputable medical journal recommending the use of foam to sculpt conical prostheses for implantation within a professional medical context to adhere to the prevailing contemporary notions of fashion. Unlike Franklyn's articles, addressed to the general public, Conway and Dietz's article is likely to have been read by a national and international readership of medical professionals. Although Conway and Dietz claimed that 'an ideal prosthetic for augmentation mammoplasty [...] is not yet available', they effectively legitimise, endorse and recommend the material by concluding 'it was not necessary to remove any of the 30 [plastic foam] implants in this series of consecutive cases'.¹⁵⁶ Similarly to Franklyn, Conway and Dietz repeatedly praised polyurethane foam's ability to be sculpted into conical 3D shapes.

These conical objects meant that women's bodies became sites of permanent auto-design: 'upgraded' by surgeons shaping 'spare parts', or prostheses, from polyurethane foam in keeping with fashionable and pathologised ideals. Objects resembling falsies were implanted in women's bodies. As this chapter has also discussed, women's bodies were frequently compared to weaponry: conical bullet bras were key in the shaping of the bombshell. Similarly, object-centric advertisements in this period compared women's bodies to items in domestic interiors, while furniture was anthropomorphised into women's bodies, an example being Eero Saarinen's Womb Chair.¹⁵⁷

¹⁵⁵ For more on the pathologisation of women's bodies, particularly in relation to the youthful breast, see for example Gilman, 1999 who also writes on the racialised aspects of the 'virginal' breast; Haiken, 1997; Jacobson, 2000.

¹⁵⁶ Conway and Dietz, 1962, p. 579.

¹⁵⁷ For a visual history of designed objects resembling women's bodies see Jessica Strang, *Working Women: An Appealing Look at the Appalling Uses and Abuses of the Feminine Form* (New York: Harry N. Abrams, Inc., 1984). For scholarship on the Womb Chair see Cammie McAtee, 'Taking Comfort in the Age of Anxiety: Eero Saarinen's Womb Chair' in Robin Schuldenfrei (ed.) *Atomic Dwelling: Anxiety, Domesticity, and Postwar Architecture* (London: Routledge, 2012), pp. 3-25. The scope of the thesis prevents me from going into further detail here.

As discussed, another point of cultural comparison was with the automobile body, or chassis: women's bodies were wheeled into surgery for a 'refit'.¹⁵⁸ Gay Deceivers, a company specialising in falsies famously advertised under the slogan of 'we fix flats' in 1934, selling shapewear with the language of a car repair garage.¹⁵⁹ In 1946, Cadillac, famed for their exaggerated tailfin designs, added an aggressive artillery shell-inspired pointed front-bumper to a new version of the 1942 Sixty Two Series, to protect the car's body by denting any other cars that came near it. In the 1950s, these 'conical bullet-shaped projections' became known as Dagmar bumpers, or simply Dagsmars, named after the eponymous female white buxom blonde TV personality (Figure 14).¹⁶⁰ Dagsmars were eventually placed higher on the front grille and became even more pronounced. In 1957, the bumpers gained black rubber tips, making the comparison between car body and female body more prominent, before being toned down again for the 1958 model and entirely removed from the 1959 model.¹⁶¹

'Seemingly Swedish' Dagmar (born Virginia Ruth Egnor) was celebrated for her curves and penchant for a figure-hugging low-cut décolletage and bullet bra, and appeared in her own show, *Dagmar's Canteen*, on NBC from 1951 to 1952, alongside Jack Paar. In 1951, *Life* magazine crowned her a 'national institution'.¹⁶² A popular TV presenter of the time, known for playing the sassy yet 'dumb' sexy blonde, Dagmar was reduced to her bustline and transformed into a protruding part of a car. The car was anthropomorphised into a sexualised female body, and conversely women's breasts whose primary function had been discussed by male surgeons and medical practitioners in relation to lactation, entirely lost its autoerotic function. In this patriarchal rhetoric that left women's personal sensation of touch unconsidered, women's breasts functioned only as an erotic object for the male gaze.¹⁶³ Dagsmars played a part in what historians of car design in this period have termed the 'style wars', essentially a competition between US car manufacturers in the postwar period (1948 -1959) to make their once streamlined cars increasingly fantastic, adorned with

¹⁵⁸ For an earlier history of the automobile's impact on the streamlining of women's bodies and vice versa see Adrienne Berney, 'Streamlining Breasts: The Exaltation of Form and Disguise of Function in 1930s' Ideals', *Journal of Design History*, 14.4, Technology and the Body (2001), 327-342.

¹⁵⁹ 'Is Bra secret to a bigger bustline?' *The Westport News*, Friday July 18th, 1975, 56.

¹⁶⁰ Paola Antonelli, *Safe: Designs on Risk* (New York: Museum of Modern Art, 2005), p.29.

¹⁶¹ Paul Ingrassia, *Engines of Change: a History of the American Dream in Fifteen Cars* (New York: Simon and Schuster, 2013).

¹⁶² *Life*, 31.3, July 16, 1951.

¹⁶³ For lactation as primary function see for example Herbert Conway, 'Mammaplasty; analysis of 110 consecutive cases with end-results' *PRS*, 10.5 (Nov.1952),303-15 (p.306); Gilman, 1999; Berney, 2001.

ornamentation of 'wild extremities', including exaggerated tails, pointed noses, fins, bumpers and pillars.¹⁶⁴ The once smooth, streamlined car body became adorned with incremental visual cues referencing fighter planes, a capitalist symbol of postwar US prosperity and consumer choice.¹⁶⁵ As this chapter has demonstrated, the relationship between the shaping of women's bodies and car parts functioned not just on a symbolic level. Conway's papers show that women's bodies were being built up by AMA-approved surgeons using materials from furniture and automobile suppliers to suit a more exaggerated, streamlined conical ideal that could equally be found protruding from the front of a car bumper, revealing a military-industrial assemblage of postwar US body auto-design.



Figure 16: Dagmar autographed calling card, c.1952

¹⁶⁴ See Esme Hawes, 'Making the Modern Consumer' in Brendan Cormier and Lizzie Bisley (eds) *Cars: Accelerating the Modern World* (London: V&A Publishing, 2019) pp. 94 – 115 and David Gartman, 'Harley Earl and the Art and Color Section: The Birth of Styling at General Motors' *Design Issues*, 10.2 (Summer, 1994), 3-26.

¹⁶⁵ Hawes, 2019.

Such experimentation with, and application of, industrial materials in the subcutaneous designing of women's bodies did not just happen on a national scale.¹⁶⁶ Conway's papers reveal an international network of surgeons with an interest in plastic foam breast augmentation who communicated with Conway and asked for his recommendations. The following paragraphs will demonstrate how US plastic surgeons' experimentation with polyurethane foam, as well as mounting concern about the material's ill effects, had an influence internationally. Just as Franklyn's articles in the popular press generated interest and response from the general public (demonstrated by correspondence held in the AMA's archives), the archival papers of AMA-approved surgeons such as Conway reveal that medical interest from qualified surgeons increased internationally with each specialist peer-reviewed publication.

In November 1958, Dr. Francisco Duran Acosta, director of Clinica de Cirugía Plástica Insurgentes, Mexico City, visited Conway in New York where he was shown Ethern sponge: Conway recommended it as the ideal material for bust augmentation. Acosta had been working with the material since Conway recommended it, but his patients had experienced foreign body reactions, as well as hardness and decrease in volume. In addition to seeking Conway's advice on research and developments in implantable materials, he sought out pastoral support: 'in both cases [hardness and loss of volume] the patients get angry'.¹⁶⁷ Conway assured Acosta: 'we have had no complications with Ethern synthetic sponge material for augmentation mammoplasty which have necessitated the removal of the sponge'.¹⁶⁸ He stressed that 'it is very important that the cavity be dissected widely so that the sponge is not compressed too much after insertion'.¹⁶⁹ Here Conway maximizes foam volume by minimizing female flesh; Acosta is encouraged to remove as much flesh as possible in order that the foam can sit more comfortably in the void without too much pressure and compression from surrounding human flesh; foam is prioritised over flesh; plastics become more desirable than the body.

¹⁶⁶ Franklyn also boasted of sharing his plastics R&D on women's bodies with Russian businessmen enquirers, who were particularly interested in his nylon-sheathed Surgifoam invention for mammoplasty. Franklyn commented '[this] amused me as it gave a picture of a lot of discontented Russian women seeking improvement where Nature had failed.' Whitney Bolton (column) *The Philadelphia Inquirer* 17 Feb 1958, p. 7.

¹⁶⁷ Dr. Francisco Duran Acosta, letter to Conway, October 12 1962, HCP, Correspondence.

¹⁶⁸ Conway, letter to Acosta October 19 1962, HCP, Correspondence.

¹⁶⁹ *Ibid.*

Following the publication of their journal articles, medical doctors such as Conway and Edgerton received national and international enquiries about the sourcing of materials they were using in breast augmentation surgery. In September 1962, Dr. Alexa von Klossowski, a female doctor based in Berlin, wrote to Conway in response to his article 'Augmentation Mammoplasty'. She noted that this method was unknown in Germany and requested more information and a sample of 'polyetherurethane' [sic] material or the suppliers' details.¹⁷⁰ Responding to her request, Conway recommended obtaining polyetherurethane from the General Tire and Rubber Company, Akron, Ohio. By doing this, Conway was further supporting the powerful plastics companies in the US Midwest and East Coast by recommending their materials to surgeons working abroad. Conway informed Klossowski that General Tire's materials were 'not expensive'.¹⁷¹ Indeed, pricing is a priority in Conway's reasoning; his article effectively argues that materials made for the automobile and furnishing industries were at low risk of foreign body reaction providing they were correctly sterilised prior to implantation. Conway's responses as a result of his May 1962 article, such as that to Klossowski, show that he was further recommending materials he himself had only recently been recommended via a list of commercial manufacturers of urethane foam in the US provided by Mobay's District Sales Manager, D.H. Bryan. These were companies who were working with Mobay Chemical Company supplies.¹⁷² This further demonstrates that US plastic and cosmetic surgeons' choice of materials for shaping gendered bodies was affected by non-medical actors within industrial plastics development, such as sales managers seeking to widen the application of their products to the medical field. Before the 1976 Medical Device Regulation Act there was no formal testing protocol for new plastic materials to pass before they were implanted in the human body, and the FDA held no jurisdiction over this. The AMA were therefore unable to pursue legal action. Many of these materials are still in circulation today and have been 'grandfathered in': this is significant in that materials designed in the lab for military and industrial applications later found their way into women's bodies, a site they were not explicitly designed for – and continue to be in circulation today. As discussed earlier, chemical companies such as Mobay boasted in their promotional materials that their man-made materials were superior, as they were designed

¹⁷⁰ Dr. Alex Klossowski, letter to Conway, September 3 1962, HCP.

¹⁷¹ Conway, letter to Dr. Alexa Klossowski, September 7 1962, HCP.

¹⁷² (By the time Klossowski writes to Conway he is already experimenting with his next material – silastic – noting that this gives better results, however, it is not yet available for general distribution.) I will discuss this in Chapter 5.

in labs for a specific purpose – for example, upholstery or packaging military equipment – whereas natural rubber sap was not; but it should be pointed out that plastic foams were *not* explicitly designed for use in the body.

The degradation of early plastic foams in the body had disastrous effects. Evidence of their fragility can also be seen in museum collections, where the foam used in foundation garments and furniture has hardened or disintegrated. See for example, the foam-padded Maidenform 'Pre-Lude' bra from 1957 in Figure 17. The foam has hardened and appears to be staining everything with which it comes into contact. Known as off-gassing, cellulose nitrate gas affects surrounding materials, drawing colours out (see for example the stains around the straps, as well as the stains on the paper). We can also see particles of foam that have disintegrated with time and formed in the box. Figure 18 is of a polyurethane foam sample kept by NMAH's conservation department to demonstrate how this material hardens and crumbles with time. The impact of the passing of time on the foam, conserved in a sealed plastic bag, is remarkable. It shows how polyurethane foam is not immortal, as surgeons such as Franklyn made it out to be; instead it is just as susceptible to the ravages of time, ageing and decay as human flesh.



Figure 17: Maidenform 'Pre-Lude' Bra, 1957-1958 (photographed in 2018)



Figure 18: Polyurethane Foam sample, Conservation Department NMAH (photographed in 2018)

A political material used by the military and industry, plastic foam technology continued to develop throughout the postwar period. This chapter has examined how sculpting of the body into the hyper-feminine curvaceous ideal to gain acceptance, recognition and the social mobility promised by the American Dream was pursued by cis and trans women.¹⁷³ Favoured by foundationwear brands and cosmetic surgeons alike, plastic foam was admired for its flexibility and softness and compared to flesh. Foam's materiality shaped the fashionable 'sweater girl' and curvaceous bombshell through foundationwear and conical brassieres such as those sold by Frederick's of Hollywood. The chapter has argued how these designs in turn impacted on the pathologised, desirable healthy female

¹⁷³ Howard, 1955, p. 9 (JPW).

figure. The same materials that were being used to shape the female body externally were now being used to shape her internally.

Employing material feminist methods and foregrounding materiality, this chapter has explored how the human body reacted to the implantation of interconnected celled foams; human tissue intercepted these cavities. Human tissue served as biological actant, ultimately consuming the foams, squeezing out all air bubbles within and causing implants to harden and become lumpy, causing great pain and discomfort to the recipient. No longer in the desirable soft and flexible state plastic foams apparently offered but transformed into its alternative condition of hardness and rigidity, eventually open-celled implants required surgical amputation. Other side effects included the loss of sensation in the nipple and an inability to breastfeed.

Cosmetic surgeons compared their role to that of sculptors, and sculpted implants of foam to produce the contemporary fashionable bombshell, her look in turn being informed by the materials available. As implant technologies and R&D into these changed, so too did the desirable shape, reciprocally. This chapter has illuminated how complex networks of military-industrial materials R&D impacted on the shaping of the female body, first on its surface and then within it.

Chapter Four: Silicone on the Surface: Military-Industrial R&D and Peacetime Conversion

Carol Doda, a petite white bottle-blond cocktail waitress on the San Francisco go-go circuit, established her reputation as a dancer by donning one of Rudi Gernreich's 'monokinis', a new style of topless swimsuit. On 22 June 1964 Doda mounted the piano at the Condor Club in San Francisco, having discarded the nipple tassels, also known as 'pasties', worn by burlesque performers in the preceding decades to avoid censorship, banishing the element of tease and performing her number with her breasts exposed from start to finish. This was revolutionary, and Doda shortly afterwards secured her position as 'Queen of the San Francisco exotic dancers', as she was known on the go-go dancer circuit, by having a pint of silicone injected into each breast, an equally novel act.¹

Soon after this, in October 1964, the *San Francisco Chronicle* crowned Carol Doda 'the first topless dancing act of widespread note in America'.² She starred in the Monkees' feature film *Head* (1968) as liquid flesh personified; cast as Sally Silicone (see Figure 1), a 'busty blonde bombshell' draped in a mink coat she sat beside an out-of-shot boxing ring.³ It was reported that Doda's bust was insured for \$1.5 million, and that she eventually earned the equivalent of \$4,000 a week in 2017 terms.⁴ In a 1965 interview, shortly after receiving the silicone shots, Doda commented: 'I believe in self-improvement. If you don't make yourself better you might just as well be dormant.'⁵ In total, Doda invested \$12,000, the current equivalent of \$98,544, on silicone injections, enlarging her bust to a 44DD and gaining much publicity as the proud bearer of what one journalist at the time described as 'the New Twin Peaks of San Francisco', in reference to the city's well-known geographical landmark.⁶

¹ Rachel Shteir, *Striptease: The Untold History of the Girlie Show* (New York: Oxford University Press, 2004).

² 'Miss Carol Doda: Originator of the Topless', *San Francisco Chronicle*, 31 October 1964, p.34.

³ *Head*, dir. by Bob Rafelson, (Columbia Pictures, 1968)

⁴ Sam Roberts, 'Carol Doda, Pioneer of Topless Entertainment, Dies at 78', *New York Times*, November 11 2015, available at: <https://www.nytimes.com/2015/11/12/arts/dance/carol-doda-pioneer-of-topless-entertainment-dies-at-78.html?mcubz=0> (accessed 18 September 2017); 'Topless Insured for \$1 Million' *Jet*, 16 March 1972, 30. For more on the practice of insuring women's bodies see Elizabeth Matelski, *Reducing Bodies: Mass Culture and the Female Figure in Postwar America* (New York: Routledge, 2017).

⁵ David Perlman, 'Analysis of the Bust Injections', *San Francisco Chronicle*, November 15, 1965, pp. 1-15 (p. 15).

⁶ Roberts, 2015.



Figure 1: Carol Doda as Sally Silicone in *Head*, dir. Bob Rafelson (Columbia Pictures, 1968)

In the next two chapters I ask: how did silicone, a substance once hailed as an American industrial and military miracle, end up as a material for augmenting women's bodies, such as Carol Doda's? In this first chapter, I focus on silicone's military-industrial origins and its immediate postwar launch on the commercial market. Here I drill into the more intricate and complex aspects of the silicone story that have been overlooked to date.⁷ I ask, and seek to answer, a number of important questions. Where did silicone come from? Who developed it? What industrial applications did it have? How was it used by the Armed Forces? How did chemical company advertising department staff and sales directors pursue new commercial markets in the postwar US? How did silicone develop from military-industrial applications to gendered corporeal applications in the postwar US? What impact did the gender of actors have in these decisions? What impact did silicone's materiality have on decisions to associate it with, and use it on, and with, women's bodies in the postwar US? This chapter examines silicone's provenance, its R&D and its changing meanings and applications by using a variety of archival primary sources ranging from chemistry

⁷ For examples of the established scholarship and narrative on cosmetic surgery and silicone breast enlargement see Elizabeth Haiken, *Venus Envy: a History of Cosmetic Surgery* (Baltimore, MD: Johns Hopkins University, 1997); John Byrne, *Informed Consent* (New York: McGraw Hill, 1996); Nora Jacobson, *Cleavage: Technology, Controversy, and the Ironies of the Man-Made Breast* (New Brunswick, NJ: Rutgers University Press, 2000); Matelski, 2017. These all focus on Dow Corning, as does Earl Warrick's *40 Years of Firsts: the Recollections of a Dow Corning Pioneer* (New York: McGraw Hill, 1990).

engineering textbooks and journals to promotional material from chemical companies and women's magazine articles and advertisements.

The chapter uses previously unexplored conflicting oral histories of chemists working for the competing companies Corning Glass Works (CGW) and General Electric (GE), archived at Science History Institute (SHI), to trace silicone's complex development and story. Histories of cosmetic surgery and corporate histories of Dow Corning repeat an Anglophone and US-centric victor narrative that the company was 'First in Silicones' (the Dow Corning slogan).⁸ Unlike this chapter, these histories do not employ archival methods to investigate silicone's provenance, which has resulted in simplistic histories and a repetition of the same victor narrative: silicone was one of the 'wonder materials' of WWII, and Dow Corning was the company behind it.⁹ It is important to question why these histories have not used rigorous archival methods to investigate what silicone's R&D story says about military-industrial power structures that are again repeated and reinforced in the retelling of this historical victor narrative. Why is archival research not part of the scholarship's value system? When we look more closely at some of the histories of silicone it becomes apparent that they, too, were written by chemists working for Dow Corning.¹⁰ This chapter uses primary sources to trouble Dow Corning's nationalist victor narrative, perpetuated in histories of cosmetic surgery, and to reveal the international actors in silicone's R&D. It argues that the joint venture between Corning Glass Works and Dow Chemical, Dow Corning, profited from the urgency of US armed forces sanctioning and contracts to accelerate the large-scale production of silicone, putting them at a unique advantage. Dow Corning continued to benefit from this unique status in the postwar period. After WWII, the US armed forces cancelled Dow Corning's contracts for silicone, the large-scale production of which had originally been developed to enable the cogs of wartime machinery to run with increased efficiency.

The second half of the chapter illustrates Dow Corning's postwar investment in R&D and marketing to redevelop and rebrand its formerly military material to new markets, specifically addressing the role of women's bodies within this. In keeping with the material

⁸ Ibid.

⁹ See for example Elizabeth Haiken, 'Modern Miracles: The Development of Cosmetic Prosthetics' in Katherine Ott, David Serlin and Stephen Mihm, *Artificial Parts, Practical Lives: Modern Histories of Prosthetics* (New York: New York University Press, 2002); Haiken, 1997; Byrne, 1996; Warrick, 1990.

¹⁰ Warrick, 1990.

feminist approach of the thesis, the second half of this chapter builds on the first half's exploration of silicone's military-industrial provenance. Addressing the assertion by material feminists Stacy Alaimo and Susan Hekman (2008) that 'feminist theorists of the body want definitions of corporeality that can account for how the discursive and the material interact in the constitution of bodies', it explores the postwar interactions between Dow Corning's silicone and the female body, from the discursive to the material.¹¹ Critical feminist theories of the body are explored in relation to the gendered nature of the discourse on the postwar history of silicone, and will provide new in-depth perspectives on the role women's bodies and corporeality played in the promotion and domestication of Dow Corning's silicones. This chapter argues that new polymeric materials such as silicone had no histories or identities, and their creation therefore plays out according to unequal power structures in ways that reproduce existing inequalities. It is therefore important to address the origins and provenance of silicone to better understand the systems of corporate power embedded within it from its inception: this chapter and the next will demonstrate its impact on later developments and applications. Particular attention is given to the role of silicone's materiality and how this highly industrial material became gendered and applied to cosmetic applications. This involved domestic, medical and cosmetic markets, moving from the surface of women's skin to inside their bodies, culminating in the establishment of the Dow Corning Center for Aid to Medical Research.

Silicone Definition and Provenance

Silicones are synthetic compounds containing the elements silicon and oxygen, and organic groups where the ratio of silicon is sufficient to measurably affect the properties.¹² As a material, silicone is a complex and chemically inert synthetic organic compound. Its molecular forms vary, and it can be either a liquid, a solid, a resin or a man-made rubber. It can also be made into sponge.

The basic material from which silicones are formed is quartz, i.e. silica, or silicon dioxide, SiO₂. This is the chief component of white sand. In the form of large crystals or fine grains, it is one of the most abundant materials in the world.¹³ Silica found an early

¹¹ Stacy Alaimo and Susan Hekman, 'Introduction: Emerging Models of Materiality in Feminist Theory', in Stacy Alaimo and Susan Hekman (eds.) *Material Feminisms* (Bloomington, IN: Indiana University Press, 2008), pp. 1 – 22 (p.7).

¹² Rob Roy MacGregor, *Silicones and their Uses* (New York: McGraw-Hill, 1954), p. v.

¹³ Denis McWhan, *Sand and Silicon: Science that Changed the World* (Oxford: Oxford University Press, 2012).

application in the manufacture of glass around 3500 BCE.¹⁴ One of the first known reflections on the nature of silica as a material is in Roman scholar and natural philosopher Pliny the Elder's *Naturalis Historia*, written in AD 77. Pliny suggested that silica was a distinctive form of ice resulting from extreme freezing.¹⁵ In this chapter, silica, running through the sands of time, became instrumental in creating a material that could lubricate wartime technology to make it run faster.

The history of silicone is challenging to trace in its entirety, but it is important to do this to gain a better understanding of its industrial-military-industrial origins. Histories of cosmetic surgery fail to address the complex history of silicone and how this in turn impacted on its use on the gendered body. Its military-industrial origins are, if at all, mentioned only in passing in these histories.¹⁶ In order to attempt to trace the history and origins of silicone, I have turned instead to the oral histories carried out and collected by the SHI and the brief histories of silicone that precede detailed explanations of their chemical composition, production and application in publications aimed at engineers. It is important to note, however, that these descriptions are not unbiased. They were often published by experts in the silicone industry who were employed by a specific company, and this can influence their accounts. In *Silicones and their Uses* (1954) Rob Roy MacGregor (a Dow Corning chemist) noted:

'No apology need be made for the fact that many of the products are identified as being produced by the Dow Corning Corporation. Most of them are prepared by other manufacturers as well, but, because of his personal connection, the writer has had more complete access to Dow Corning records. The object has been to describe silicone projects in general.'¹⁷

In this chapter I show how Dow Corning succeeded in establishing itself as the 'world's leading silicone company' by propagating a heroic victor narrative that eliminated the competition. What little secondary literature there is on silicones focuses on Dow Corning,

¹⁴ Ibid.

¹⁵ Ibid.

¹⁶ There are exceptions: cosmetic surgery historian Haiken (1997; 2002) has done some foundational work to acknowledge silicone's military-industrial origins before its application in the body, however this is limited to a very brief mention. See Haiken, 1997, p. 246; Haiken, 2002, p. 180. Byrne, *Informed Consent*, 1996, also mentions this briefly.

¹⁷ MacGregor, 1954, p. xiv.

and perpetuates this over-simplified victor story of Dow Corning as a narrative of success, or as they marketed themselves, 'First in Silicones'.¹⁸ However, silicone's history presents a complex trajectory of international development and global power politics, outlined here.

Silicone's Early International Development

Silicone's development begins in 1899 with Frederic Stanley Kipping, a British chemist who had studied in the Munich University laboratories of Adolf von Baeyer, founder of German chemical firm Bayer.¹⁹ Kipping and his students carried out much of the pioneering work into the development of silicon polymers (silicones) from 1899 to 1944, during his tenure as Professor of Chemistry at the University of Nottingham. The established written narrative on Kipping's early work, as seen in a variety of primary sources ranging from chemistry engineering textbooks to industry journal articles and later cosmetic surgery writing, as well as secondary sources, is one of 'accidental discovery'.²⁰ It claims he had unintentionally chanced upon a substance that would later 'revolutionise both industry and medicine', describing the results of many of his experiments as 'a series of uninviting glues'.²¹ Dow Corning chemist Franklin Hyde complicates this established narrative that is perpetuated in the brief histories of silicone often provided as introductions to engineering texts, adding that Russian chemist Kusma A. Andrianov contributed to the organosilicon field, developing the Grignard reaction with esters. Published in 1938, Andrianov's work was later taken up by Dow Corning's chemists Rob Roy McGregor and Earl Warrick in the 1940s.²² Hyde also noted that German chemist Friedrich Woehler had coined the term 'silicone' in 1863, which appears to be omitted from the aforementioned texts, perhaps because they focus on Anglophone sources and actors, creating a clear linear Anglophone narrative.²³ Hyde further acknowledged that significant contributions had been made by chemists Albert Ladenberg (Germany) and Charles Friedel (France), who also made organosilicon compounds (essential

¹⁸ See Warrick, 1990; Dow Corning trade literature at NMAH and SHI.

¹⁹ Robert N. Meals and Frederick M. Lewis, *Silicones*, Plastic Application Series (New York: Reinhold Publishing Corporation, 1959).

²⁰ See for example S. Fordham, *Silicones* (London: George Newnes, 1960); Peter J. Morris, *Polymer Pioneers* (Philadelphia, PA: Beckman Center, 1989); Elizabeth H. Oakes, *A to Z of STS Scientists* (New York: Facts on File, 2002), pp. 163 – 164; Simona Morini, 'Beauty and Health: A New Aid to Plastic Surgery: Silicone' *Vogue*, March 15, 1971, pp. 84-87, 114-115; F. Ashley, S. et al., 'The Present Status of Silicone Fluid in Soft Tissue Augmentation', *PRS* 39.411 (1967) 411 - 420 (p. 419).

²¹ See for example Fordham, 1960; Morini, 1971, p. 115; Ashley et al., 1967, p. 419.

²² J. Franklin Hyde, Oral History Interview (1986), SHI p. 22 – citing K. A. Andrianov, "Synthesis of Alkyl-Substituted Ortho-Esters of Silic Acid," *Journal of General Chemistry*, USSR, 8 (1938), 552-556.

²³ F. Woehler, *Leibig's Annalen*, 127,51 (1863), 263, cited in Hyde, 1986, 22. It is worth noting here that Kipping only used these silicon-related terms later on.

for making sealants and in silicone research) in the early 1870s.²⁴ Walter Dilthey made a major contribution to the field in 1905 with cyclic diphenyl compound, a gelatinous material that has the power to become crystalline,²⁵ and Leo Sommer and his students, who worked on silica gels, also made significant advancements in this area, publishing in 1946.²⁶

The work of esteemed German silicone chemist and scholar Walter Noll (1968) offers a more global perspective than that of his American peers, who tended to present silicone as an all-American wonder material.²⁷ For instance, in Germany, too, some silicone research was initiated at the start of the war. Noll argues that unlike the situation in the US, however, in Germany the war and the control of research impeded developments.²⁸ The versatility of silicone products in armaments, especially in aircraft manufacture, resulted in an accelerated effort towards their development in the US during WWII.

Dow Corning: ‘First in Silicones’?

Silicone chemist Fordham (1960), however, offers a competing narrative to Noll’s. He asserts that ‘the true history of silicones’ began in the period 1931 to 1940 when US company Corning Glass Works (CGW) employed their first organic chemist, James Franklin Hyde.²⁹ Perhaps what Fordham means is that this is when the *commercial* history of silicone began. CGW was concerned that new synthetic transparent materials such as Pollopas could develop as competitors for glass, and hired Hyde to investigate whether organic silicon chemistry had any commercial potential to establish their share of the flourishing polymer market.³⁰ Before WWII, Hyde had abstracted and translated *Glastechnische Berichte* (Glass Technical Reports) from German into English for *Chemical Abstracts* and *Ceramics Abstracts*. Hyde’s challenging of the Anglophone narrative of silicone’s history and development, as discussed earlier, is likely to have provided him with a solid knowledge of international developments and networks within glass chemistry and production and the culture of

²⁴ A. Ladenberg, *Leibig’s Annalen*, 164 (1872), 300. C. Friedel and J.M. Crafts, *Annales de Chimie et de Physique*, [iv.] 9 (1866), 5. Cited in Hyde, 1986, 22.

²⁵ Walter Dilthey, *Berichte*, 38 (1905), 4132, cited in Hyde, 1986, 22. Based at School of Chemistry and Physics, Penn. State College.

²⁶ F.C. Whitmore et al., ‘Organosilicon Compounds. Synthesis and Properties of Alkyltrimethyl – and Alkyltriethylsilanes,’ *Journal of the American Chemical Society*, 68 (1946), 475-481.

²⁷ Walter Noll, *Chemistry and Technology of Silicones* (New York: Academic Press, 1968) presents a more global and independent perspective on silicone R&D than his American peers. Amongst many other countries, he also covers Japan – This will be covered more extensively in Chapter 5. That said, Noll, like his other silicone peers, does not mention silicone’s use in the cosmetic augmentation of gendered bodies.

²⁸ Noll, 1968, p. 19.

²⁹ Fordham, 1960.

³⁰ Ibid.

sharing research.³¹ It seems that after WWII the complexities of scientific developments and their often global networks are glossed over in material and corporate histories in favour of a simplistic, nationalistic narrative.

In his new position at CGW Hyde contributed his knowledge of polymers, with the abundance of silica at his disposal, to further developments in silicon chemistry, opening a new era for polymeric development.³² Hyde revisited Kipping's work when researching experiments in silicon chemistry, soon discovering that his 'uninviting glues' had unique properties with great potential for industrial products, including architectural materials.³³

Much of the Anglophone historiography of silicone is focused on Hyde and Dow Corning; however, Noll offers a competing narrative. He suggests that in the late 1930s US, General Electric simultaneously began research on silicones.³⁴ The narrative provided by Noll (who does not appear to be closely affiliated with either company) correlates with oral histories held at SHI.³⁵ In 1937 a silicone publishing and patent race ensued, in which General Electric (GE) chemist Eugene Rochow made methyl silicone (in 1940) before either Kipping or Hyde. At this point, Hyde had not yet published or patented his work on silicones. There is no evidence in the archives to suggest that at this time, only two years before the US entered WWII, there was any discussion about using silicone for aviation.

By the early 1940s, the collective research efforts pointed to the potential for increasing industrial applications for silicone materials. Silicone turned out to have rubber-like properties, prompting further research during the rubber shortages in WWII. Synthetic alternatives to rubber were highly sought after in a military context, as US Government

³¹ Hyde, 1986, p. 21.

³² Silas Braley, 'The Use of Silicones in Plastic Surgery: a Retrospective View', *PRS* 51.3, (March 1973), 280-288.

³³ Hyde, 1986, p. 24. One of Hyde's earliest tasks, around 1931, was to develop a material that could hold together the individual 18" x 26" glass panels that featured in a 'fifteen by forty foot architectural window over the bank of swinging doors at the RCA Building New York, over the Sunken Garden'. Hyde, 1986, p. 19.

³⁴ Walter Noll, 'Historical Survey', in Noll, 1968, p. 19.

³⁵ Oral histories with chemists from both companies record that in late 1937 a pivotal meeting occurred between representatives at CGW and GE, after which the latter also began silicone research. Here accounts diverge: Hyde and Warrick presented this visit and what happened after as akin to industrial espionage (see Hyde (1986) p. 24; Earl Warrick, Oral History (1986) SHI, p. 11). It should be noted here that CGW and GE had a history of collaboration - GE chemist Eugene Rochow described CGW as 'virtually a branch - a department - of General Electric' (Eugene Rochow, Oral History (1995) SHI p. 24). Rochow and Charles Reed of GE, offer a different take on the story, as does German chemist Walter Noll. See Rochow, 1995, Charles Reed Oral History (1986), SHI; and Noll (1968). The scope of the thesis prevents me from going into further detail here.

agencies and chemical companies hoped that they could contribute to greater wartime material autarky for the US.³⁶ The race to register patents now accelerated.

Rochow was issued a patent in October 1941, a few months before the US joined WWII.³⁷ Hyde recalls that, following the US entry into WWII after Pearl Harbour on December 7 1941, 'secrecy orders were placed on all patents and publications [...] and so they were not available until the war ended in 1945'.³⁸ At this point GE tried to challenge a number of CGW patents but concluded that it would be most cost effective for both companies to cross-license their patents until the 1950s and then work separately, rather than pay mounting legal fees.³⁹ CGW and GE's patent race is an integral part of the history of silicone, as it contests and complicates silicone's history and the victor story perpetuated by CGW, later to become Dow Corning. It also demonstrates the complex nature of the origins of these new materials and how problematic it is to simply assign a specific material to one person, one company or even one country.⁴⁰ What this history reveals and points to is the complexity of plastics history, and the fact that much of this history needs to be revised, disentangled and complicated in order to demonstrate how the histories of chemistry and materials, far from being easily attributed to one specific 'victor', are produced via a complex web of individual actors and, as the next chapter will show, a number of these actors became involved in silicone's cosmetic application to the shaping of women's bodies.

CGW's attempts to collaborate with GE may have been unsuccessful; however, their other major business courtship efforts were not. Unlike GE, CGW actively sought to communicate and collaborate with companies it felt could provide the expertise, materials

³⁶ In his oral history GE chemistry engineer and MIT graduate Charles Reed describes the 'US synthetic rubber program' efforts between MIT and Dow and Bradley Dewey, pushing for synthetic rubbers R&D to meet the wartime demands of material autarky. Reed, 1986, SHI, 14.

³⁷ Eugene G. Rochow, 'Polymeric Methyl Silicone,' U.S. Patents 2,258,218-2, 258, 222, issued 7 October 1941. Cited in Hyde, 1986, 26.

³⁸ J. Franklin Hyde, phenylethyl silicone patent: 'Organo-Silicon Polymers and Method of Making Them' U.S. Patent 2,371,050 filed 19 August 1940, granted 6 March 1945. Other patents include J. Franklin Hyde, 'Methyl Silicon Halides and their production' U.S. Patent 2,413,049, issued 24 December 1946 (application filed 3 July 1942) cited in Hyde, 1986, 27. Hyde also received a patent for 'Organo-Silicon Polymers and Method of making them', US Patent 2,371,050, issued 30 March 1943 (application filed 19 August 1940). Hyde, 1986, 26.

³⁹ Reed, 1986. Warrick reflected that in the end the two companies decided that since they had so many overlapping patents, 'or that were in fields of each other's, that neither one would be able to operate without license from the other'. Warrick, Oral History, 1986, 23.

⁴⁰ This argument is often made in STS. See for example Trevor J. Pinch and Wiebe E. Bijker, 'The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other' *Social Studies of Science* 14 (August 1984), 399-441; Matthew Wisnioski, *Engineers for Change: Competing Visions of Technology in 1960s America* (Cambridge, MA: MIT Press, 2012); Stuart W. Leslie, *The Cold War and American Science* (New York, NY: Columbia University Press: 1997).

and equipment it was lacking, essentially buying them up and merging with them, thus eliminating potential competition.⁴¹ As a result it also further strengthened their profile over that of GE.

Hyde recalls that CGW was

‘anxious to sell [Hyman G.] Rickover [navy engineer and then assistant chief of the Electrical section of the Bureau of Engineering in Washington, DC] something. They wanted to sell electrical tape, and Rickover wanted more power out of small motors.’⁴²

The US Navy wanted Hyde’s 990A resin for application to electric motors insulated with glass tape. At the request of Rickover, who was hoping to source material solutions to improve the performance of US Armed Forces equipment, Hyde collaborated with Warrick and McGregor to produce the first polydimethylsiloxane (a type of silicone) fluid in 1940 and some early examples of silicone rubber.⁴³ The limited quantities produced by CGW were insufficient for the Armed Forces’ requirements. Since silicone synthesis was associated with organic chemistry rather than glass-making, CGW sought the assistance and established expertise of the Dow Chemical Company for its further development.⁴⁴ Warrick claims that as a direct result of Rickover’s interest, and the promise of military contracts that this held, the formation of the Dow Corning joint venture went ahead quickly.⁴⁵ Rickover famously barked: ‘we need it [silicone fluid] tomorrow’.⁴⁶ Dow Chemical’s William R. Collings and his experienced staff ‘swung into silicone research, product development, pilot production and

⁴¹ For example, by 1935, CGW, traditionally an inorganic company, felt increasingly out of their depth with Hyde’s organic research and their new Fibreglass Department, so they contacted Owens Illinois, experts in fibreglass, with whom they merged to establish Owens-Corning Fiberglass in 1938, which saw them gain the prestigious Mellon Fellowship, which added more research power to their silicone projects. Earl Warrick and Rob Roy McGregor, who later became key figures in Dow Corning and silicone research, were amongst the first Mellon Fellows working for CGW in 1938. The fellowship was particularly significant in strengthening CGW’s resources, as equipment and processes available to scientists were very limited at the time.

⁴² Hyde, 1986, 26. Hyman Rickover, later promoted to Admiral in 1953, was a highly influential figure in WWII and Cold War US Armed Forces history, and later led the Manhattan Project. Harold Boeschstein, who headed the Owens-Corning merger, was responsible for interesting the Navy in electric motor insulation, according to Warrick, Oral History, 1986, 10.

⁴³ Warrick, 1990, p. 21; Jerome T. Coe, ‘GE Silicones: 1940 – 1964: From Shaky Start to Successful Business’ in *Unlikely Victory: How General Electric Succeeded in the Chemical Industry* (New York, NY: American Institute of Chemical Engineers, 2000) pp. 27 – 44 (p.28).

⁴⁴ Braley, 1973, p. 281.

⁴⁵ Warrick, 1986, 10.

⁴⁶ Warrick, 1990, p. 21.

sales.’⁴⁷ GE were also keen on collaborating with Dow, but unlike CGW they had not attracted Rickover’s interest. The Dow Corning joint venture, with the added approval of Rickover, was a highly advantageous and strategic move, merging the expertise of two skilled industrial companies and ensuring the company’s success for the next 40 years.

This success was further consolidated by the fact that the product that would be in greatest demand in the US war effort was a silicone grease sealant for aircraft that prevented engine failure at high altitudes. This product was named DC4 Dielectric Compound. At relatively low cost, it would enable US aircraft to fly the longer distances at the higher altitudes that were now required to reach Japan after the Pearl Harbour attack. Military demand for DC4, as well as 990a resin, required full pilot-plant production effort, and this benefited from the wartime priority allocations for materials needed for new plant construction and the use of magnesium, both provided by the military, putting Dow Corning at yet another competitive advantage.⁴⁸

Another advantage of the merger was the appointment of Collings as chief executive of Dow Corning. Formerly the manager of Dow’s Cellulose Products Division, Collings had already led the successful development of a new polymer product. Dow had a notable amount of experience in commercialisation, in which CGW was lacking. GE chemist Charles Reed reflected in 1986: ‘it is very interesting to note that the relative market positions of the two companies that finally emerged in the early 1950s remained unchanged until today. Dow is around twice the size of GE.’⁴⁹ Dow Corning profited from the unique joining and sharing of expertise.

That merger was expedited in 1943, encouraged by Under Secretary of War Robert P. Patterson; CGW and the Dow Chemical Company joined forces to establish the Dow Corning Corporation formally, focusing exclusively on the silicone materials needed for the war effort. It should be noted here that it was exceptionally rare for a company to be pressured by a US government official to form a joint venture, due to anti-trust legislation; however,

⁴⁷ Coe, 2000, p. 28. It is worth noting that the British Government had been involved in joint efforts with the US Navy to solve the problem of high-altitude ignition loss in jet aircraft, demonstrating the urgency of the issue and the joint transatlantic Allied effort to find a solution. However, the problem was ultimately solved in the US by DC4 Compound. After the war Dow Corning’s Shailer Bass was invited by the British government to share developments and applications in silicone in the hope that it might help solve issues the British government was having with its own equipment, including radio and radar equipment developed during the war. Warrick, 1990, p. 103.

⁴⁸ Coe, 2000, p. 28.

⁴⁹ Reed, 1986, p. 30.

silicone's importance to the war effort outweighed this concern, and it appears this exceptional permission was never revoked, unlike similar petrochemical mergers that took place after WWII.⁵⁰ Thus in 1944 Dow Corning announced the first commercial production of silicones in the US (see Figure 2).⁵¹

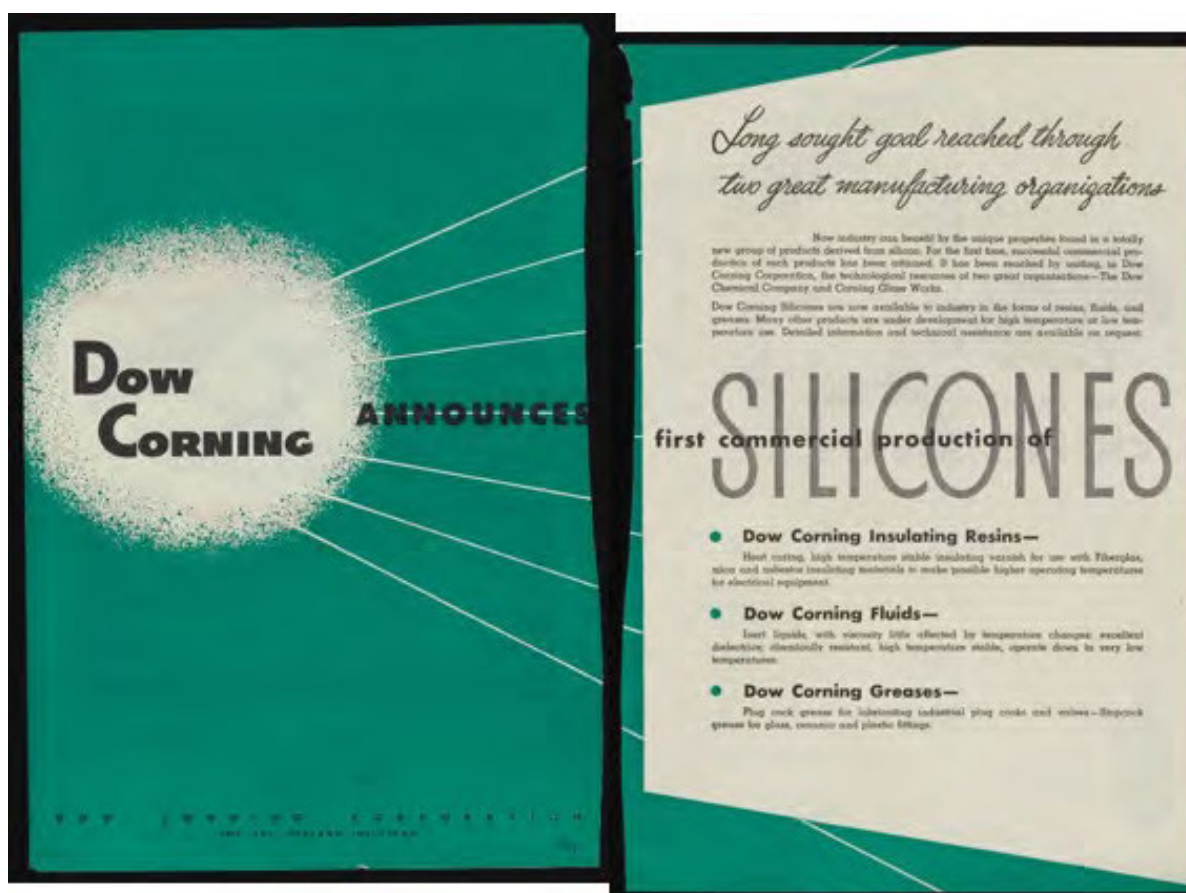


Figure 2: 'Dow Corning Announces First Commercial Production of Silicones', 1944

The Dow merger was highly successful in establishing Dow Corning's role as 'silicone victor'. Dow Corning combined CGW's silicone research prominence with Dow Chemical's established experience of the chemical business, its knowledgeable personnel and its facilities.⁵² Dow was very experienced when it came to exploiting new products, especially

⁵⁰ This was quite the opposite of Chapter One's discussion of the Nye hearings and DuPont's experience of working for US government. For more details on the unusual circumstances of this government-sanctioned joint venture see Warrick, 1990, p. 43. In 1964 the United States Department of Justice brought anti-trust action against Mobay. This essentially forced Bayer to buy Monsanto's shares of the company so that it was no longer a joint venture, as this was deemed too powerful by the US Government.

⁵¹ Dow Corning consistently present themselves as first: see Dow Corning trade literature 1943 – 1946, NMAH TLC; SHI.

⁵² Coe, 2000, pp. 27 – 44, (p. 27).

when it came to the burgeoning new field of polymer products.⁵³ Under government contract, Dow Corning was granted priority access to materials to build its factory and production line. As this chapter has shown, although the research origins of CGW's silicones 'expanded concurrently' with those of GE, it is Dow Corning who came out as the 'victor' on the other side, benefiting from the merger and from US armed forces contracts. They were therefore able to enter new markets after WWII once production facilities were no longer needed by the US Armed Forces who had sanctioned their construction.

During the war, sales of these and other military applications enabled Dow Corning to report a profit in its first year of operation. By the close of WWII, silicone was used as a sealant wherever the US Armed Forces employed electrical transformers. Dow Corning Corporation soon became one of the largest silicone manufacturers in the world.⁵⁴

Peacetime Technology Transfer

At the close of the war, Armed Forces contracts were cancelled, and Dow Corning lost its sole wartime customer, the US government. Silicones, and the production facilities that had been established, remained without a market, leading to significant investment on the part of manufacturers into investigating alternative uses.⁵⁵ Dow Corning changed its approach, reorienting to peacetime market development, searching for applications in which silicone's unique properties would justify the high initial prices, that ranged from \$5 to \$6 per pound.⁵⁶ Dow Corning's R&D on non-defence applications of silicone eventually created more than 5,000 products.⁵⁷ A key discovery was made when silicone was tested on animals and found to be chemically inert, indicating its potential for corporeal applications.⁵⁸

⁵³ Reed, 1986, p.30.

⁵⁴ Fordham, 1960, p. 2.

⁵⁵ Fordham, 1960; Warrick, 1990. Alternative uses also included silicone as an inert edible coating for bakers and silicone fed to cows to line their stomachs and supposedly prevent them from bloating.

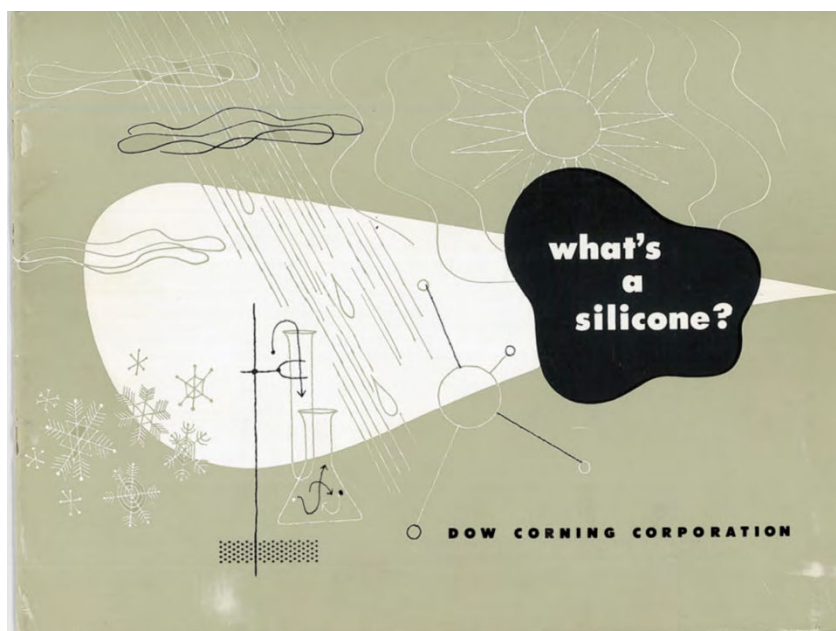
⁵⁶ Coe, 2000, pp. 27 – 44, (p. 28).

⁵⁷ Paul E. Chasan, 'The History of Injectable Silicone Fluids for Soft-Tissue Augmentation' *PRS*, December 2007, pp. 2034 – 2040 (p. 2035).

⁵⁸ For scholarship on the commercial power of the postwar spin-offs, see Stuart W. Leslie, 1993; Cynthia Lee Henthorn, 'Commercial Fallout: The Image of Progress and the Feminine Consumer from World War II to the Atomic Age, 1942-1962', in Alison Scott and Christopher Geist (eds), *The Writing on the Cloud: American Clutter Confronts the Atomic Bomb* (Lanham, MD: University Press of America, 1997), pp.24-44; Cynthia Lee Henthorn, 'Reconversion and the Military Endorsement' in *From Submarines to Suburbs: Selling a Better America, 1939 - 1959* (Athens, OH: Ohio University Press, 2006), pp. 86 – 88; Ruth Schwartz Cowan, *A Social History of American Technology* (New York: Oxford University Press, 1997); for more on military-industrial connections and the body see David Serlin, *Replaceable You: Engineering the Body in Postwar America* (Chicago, IL: University of Chicago Press, 2004); Nicholas de Monchaux, *Spacesuit: Fashioning Apollo* (Cambridge, MA: MIT Press, 2011); Matthew J. Hersch, 'High Fashion: The Women's Undergarment Industry and the Foundations of American Spaceflight', *Fashion Theory*, 13. 3 (2009), 345-370.

Silicone was subsequently marketed as safe for human digestion; Dow Corning's silicone defoamer products were used in wine, fed to cows in agriculture to remedy bloating and used as non-stick coating ('Pan Glaze') for bakers to accelerate production and prevent unnecessary wastage from sticking and burning.⁵⁹ In its postwar commercial applications, silicone was now moving closer to the body.

Dow Corning's president Eugene Sullivan invested in public relations and communication in the hope that this could stimulate interest and orders. In 1945, Sullivan hired Lou Putnam, and his assistant John Church, to set up and manage an in-house advertising department. Having already tested out a conventional approach to communication (see Figure 2), Putnam soon employed a more creative approach to selling silicones. Silicones were a relatively recently developed material, and their story was yet to be told in advertising. In 1952, Putnam oversaw his most extravagant piece of salesmanship to date, *What's a Silicone?* a comprehensive indexed guide mailed out to potential clients at universities and research labs, as well as to the general press.⁶⁰ Clearly aimed at seducing a predominantly heterosexual, white and male readership of chemists and engineers, silicones were introduced as a devastatingly flawless new breed of superhuman female (see Figure 3). It is worth analysing the copy and imagery in some detail.



⁵⁹ *What's a Silicone?*, Dow Corning Corporation, 1952. See also Dow Corning trade literature at NMAH TLC and SHI.

⁶⁰ In 1953, a year later, 'Tall Tales and Fabulous Facts: Dow Corning Silicone News, New Frontier Edition' (SHI) followed this. It drew on stories 'our forefathers told of men like Davy Crockett, Paul Bunyan and Pecos Bill'. 'The giant strength, ingenuity and native humor they put into these frontier heroes made their own overwhelming task of taming a wilderness seem more feasible'. Hoping to achieve maximum appeal amongst engineering departments dominated by men, Putnam suggested Dow Corning's research and development of silicone is like the colonial expansion of the American frontier.

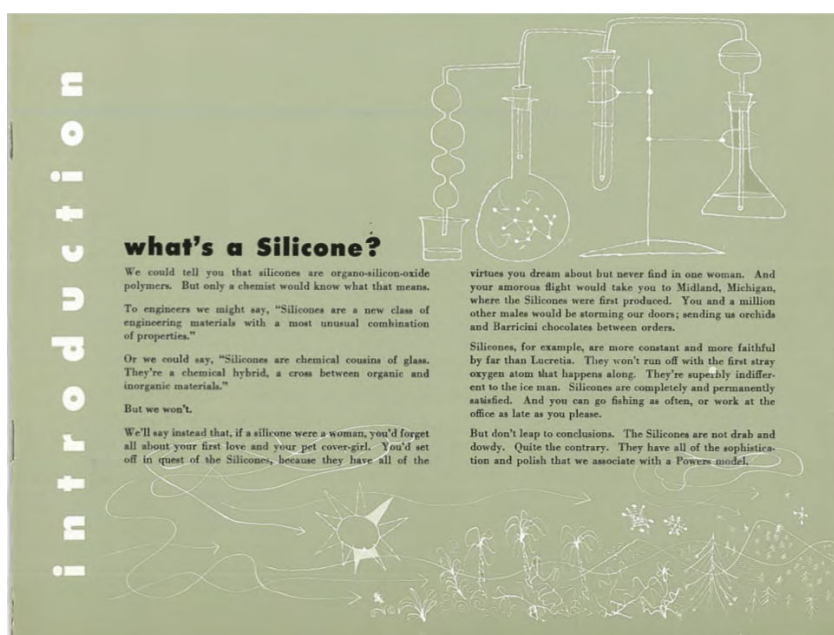


Figure 3: Introduction, Dow Corning, *What's a Silicone?* (1952)

The introduction to *What's a Silicone?* in Figure 3 starts by appealing to two of the key groups of Dow Corning's prospective clients: chemists and engineers. First, silicones are introduced in language that a chemist can understand. Second, silicones are introduced in engineering jargon. A third definition is provided using easily relatable familial terms – 'silicones are a chemical cousin of glass' – geared towards a less expert audience, such as the mainstream press departments to which it was also sent. In this moment silicone has been transformed from an unfamiliar foreign substance into something related to a material we are all familiar with: glass. No longer an unknown, it is a 'chemical hybrid': a combination of organic and inorganic materials.

Dow Corning further anthropomorphises its latest material development. Having already presented silicone in kinship with glass, silicones are brought to life and gendered as female. 'The Silicones' are endowed with the power of stirring male workers into urgent action. The Silicones promise the full package: 'all of the virtues you dream about but never find in one woman'.⁶¹ The Silicones' material perfection requires no compromise.

Critical theory of the body, such as that of material feminist thinker Elizabeth Grosz, is helpful in slowing down our reading and deconstructing of the dominant postwar US ideology in this salesmanship. In *Volatile Bodies*, Grosz writes: 'Patriarchal oppression [...]

⁶¹ *What's a Silicone?*, 1952.

justifies itself, at least in part, by connecting women much more closely than men to the body and, through this identification, restricting women's social and economic roles to (pseudo) biological terms'.⁶² Many critical scholars of science and technology, including Donna Haraway and Sherry Ortner, and of the body, such as Alexandra Howson, have also written on the ways in which in Western culture and society women's bodies are more closely linked to nature, particularly within scientific discourse.⁶³ According to this rhetoric, women's bodies are compared to raw materials that can be moulded and changed in accordance with male fantasies and dominant heteropatriarchal ideology. Responding to Alaimo's call for greater interdisciplinarity, material feminist critical thinking on the body is particularly helpful in discussing this booklet. It is important to consider how a male team of advertising professionals at Dow Corning gendered silicone's inert fluid viscous materiality as female, particularly in relation to later discussions of silicone's physical impact on women's bodies.

What's a Silicone? reproduces the gender power inequalities of the chemical company environment it was produced in. By comparing silicones to women, Dow Corning's copy asserts that its readership is male and heterosexual. This correlates with the statistics provided by Amy Bix in *Girls Coming to Tech! A History of American Engineering Education for Women*. She notes that in the US in the 1950s, men with degrees in engineering represented approximately 10 to 15 per cent of all male college graduates, whereas women graduating in engineering totalled 0.2 per cent or less of all female college graduates.⁶⁴ Male readers were thus in a position of power when it came to learning about and understanding new developments in materials. The copy suggests, however, that women and their bodies, on the other hand, were available to have this power exerted on them. Grosz argues that misogynist thinking, informed by essentialism, naturalism and biologism, confines women to a limited position by relying on the assumption that due to specific 'biological, physiological and endocrinological transformations, women are somehow *more* biological, *more* corporeal, and *more* natural than men.'⁶⁵ This line of oppressive binary

⁶² Elizabeth Grosz, *Volatile Bodies: Toward a Corporeal Feminism* (Bloomington: Indiana University Press, 1994), p. 14.

⁶³ Alexandra Howson, *The Body in Society* (Second Edition) (London: Polity, 2013); Sherry Ortner, 'Is Female to Male as Nature is to Culture?' *Feminist Studies*, 1.2 (Autumn 1972), 5-31; Donna Haraway, *Simians, Cyborgs and Women: the Reinvention of Nature* (London: Free Association Books, 1991).

⁶⁴ Amy Bix, *Girls Coming to Tech! A History of American Engineering Education for Women* (Cambridge, MA: MIT Press, 2013), p. 115.

⁶⁵ Grosz, 1994, p. 14.

thinking others women's bodies, reasoning that since women have the biological capacity to menstruate, lactate and give birth, they are therefore closer to nature and its wilderness.

This

'coding of femininity with corporeality in effect leaves men free to inhabit what they (falsely) believe is a purely conceptual order while at the same time enabling them to satisfy their (sometimes disavowed) need for corporeal contact through their access to women's bodies and services.'⁶⁶

The PR team at Dow Corning, a male-dominated chemicals corporation, brought its latest material offering to life by anthropomorphising it into a female form. In this fantastical copy, male engineers are encouraged to throw rational thought to the wind, act on their emotions and embrace their corporeality, all in order to come closer to a false embodiment of imagined female perfection through man-made materials. Their need for lived corporeality and contact is only made possible and legitimised through a controlled material fantasy of othered female corporeality.

Putnam and Church created a glamorous identity for the Silicones: they are 'not drab and dowdy'; instead they are '[sophisticated] and polished'. Shiny, smooth and inviting to touch, their viscous materiality in fluid form can be seen as making the clockwork of white heteropatriarchal society run smoothly.

'The Silicones [...] don't change their make-up or their disposition every time you turn around. They're always the same. They won't suddenly freeze-up on you, not even in Alaska. And they don't lose their shape all of a sudden when it gets a little hot.'⁶⁷

The Silicones are predictable and controllable. The copy suggests that unlike their fleshy counterparts, they are not prone to the gendered binaries of emotional instability, hormonal irregularities, vanity-fuelled make-up touch-ups or sudden fits of (sexual) frigidity. They are determined.

⁶⁶ Ibid.

⁶⁷ *What's a Silicone?*, 1952.

The Silicones never give up their synthetic identities: once formed they will stay flawlessly in shape, unaffected by changes in climate. Here it is useful to reflect on material feminist Heather Davis' explorations of the stubbornness of polymeric materials. She reflects: 'plastic – is not a uniform material but it holds onto its identity under virtually all conditions – which is why it is a fascinating object'.⁶⁸ Plastics, once formed, retain their identity, and though they degrade, they do not biodegrade.

Breaking into a sweat or losing their cool is not something the Silicones do. A product of rational science, the Silicones are strangers to the patriarchally induced horror of women's bodily betrayals and their vulnerability to uncontrollable visceral, formless flows of viscous seepage and secretion.⁶⁹ The Silicones are new and improved: non-threatening, non-leaking entities, free of contagion and disorder, that can be controlled by man, not nature. By representing the female as 'other': oozing, unpredictable and 'closer to nature', Grosz suggests that this serves to distract from male fragility and strengthen the image of the hard, 'cultured', white, male body – one that is in control, infallible and invulnerable to seepage.⁷⁰ The Silicones are liquid, but they do not lose their shape, and remain desirable. The implication in Figure 3 is that the Silicones' visceral materiality is a desirable one: unlike its human female counterparts it is sterile, controllable, a product of masculine science and logic, rather than 'nature', and made to order.

'Top of all that, and unlike any woman that ever lived, Silicones don't grow old. They are untouched by the passage of time. Their life-span is at least ten times that of comparable organic materials.'⁷¹ Unlike their mere mortal counterparts, the Silicones never age; their synthetic composition sets them apart from other 'subordinate' 'organic materials'. Within Dow Corning's binary narrative, women's bodies are closer to nature and thereby the flesh and blood materiality of the body. According to this misogynist ideology, women's behaviour and productive output are ruled by the natural forces of the body, making them wilder and less in control of themselves. This binary suggests that since women have a 'more' corporeal nature, they are therefore also more prone to artifice and

⁶⁸ Heather Davis, 'The Queer Futurity of Plastic', talk at Sonic Acts Academy, 28 February 2016, De Brakke Grond, Amsterdam, available at: <https://vimeo.com/158044006> (accessed 5 March 2017).

⁶⁹ For more critical theory on the perceived threat and disorder of women's 'formlessness' and leaking bodies see, for example, Elizabeth Grosz, 'Women's Corporeal Flows', in *Volatile Bodies*, 1994, pp. 202 – 210; Julia Kristeva, *The Powers of Horror: An Essay on Abjection* (New York: Columbia University Press, 1982); for an overview to theory on this see Howson, 2013.

⁷⁰ Grosz, 'Women's Corporeal Flows', 1994.

⁷¹ *What's a Silicone?*, 1952.

mechanisms to control and shape the body.⁷² The Silicones, a product of the postwar plastics dynasty, are promoted by Dow Corning with a promise to stop the clock and gain control over the relentless force of time on the body. These supernatural gendered polymers are presented as having the power to shield off the grotesque memento mori of decay, abjection, and the bodily betrayal that is ageing.⁷³ In Western discourse, unlike the 'silver fox', women's ageing bodies are regarded as abject and unsightly; they no longer serve a productive output.⁷⁴ In comparison, the lifespan of silicones is said to outlive that of similar 'organic materials'. The connotation here is that women's bodies are also considered as organic, and thus lesser, materials. Throughout the Dow Corning text, women and silicone materials are used interchangeably. Paradoxically, in relation to misogynist dichotomies of nature and women's bodies, the material that is presented as the ultimate female, and that can fix her many flaws of formlessness, is in fact fluid itself. In this case silicone's materiality, however, becomes a desirable trait. It is clean, sterile, industrial, controllable and, most importantly, created by men.

'That's right, now that you mention it, we haven't said anything about the physical form of the Silicones. As far as that's concerned you can take your pick. We make them in the form of fluids and oils, greases and compounds, resins, varnishes and rubbers.'⁷⁵

All these physical forms are materials for making. Agency is given to the male reader, who can choose from a range of industrial viscous, sticky and pliable materials. As feminist theorist Anne Balsamo notes, everything we know about the female body is grounded in discourse and representation; however, this discourse is not completely divorced from the material manifestation of the 'flesh and blood' entity.⁷⁶ Putnam's decision to introduce 'the

⁷² See also Anne Balsamo, who writes about the coming apart of gendered bodies in *Technologies of the Gendered Body: reading Cyborg Women* (Durham, NC: Duke University Press, 1997), p. 23.

⁷³ For more on the concept of bodily betrayals see Howson, 2013.

⁷⁴ For scholarship on ageing and gender in Western discourse see Susan Sontag, 'The Double Standard of Ageing', *Sunday Review* September 23 1972, pp. 29-38; Pamela Church Gibson, 'No-One Expects Me Anywhere: Invisible women, ageing and the fashion industry', in Stella Bruzzi and Pamela Church-Gibson (eds.) *Fashion Cultures: Theories, Explorations & Analysis* (London: Routledge, 2000), pp.79 -90; Julia Twigg *Fashion and Age: Dress, the Body and Later Life* (London: Bloomsbury, 2013); Jeanette King, *Discourses of Ageing in Fiction and Feminism: The Invisible Woman* (Basingstoke: Palgrave Macmillan, 2012).

⁷⁵ *What's a Silicone?*, 1952.

⁷⁶ Balsamo, 1997, p. 23.

Silicones' as a breed of obedient hard-working domestic sexy 'superwomen' who maintain their shape is highly emblematic of its time. This text goes beyond language and representation, and this chapter and the next will show that silicones were in fact used in the creation of the 'ideal' / 'improved' female. Putnam's anthropomorphic rendering of the Silicones from polymeric material to female flesh serves as a foreshadowing of the ways silicone's materiality became gendered female flesh.

Borrowed from Industry

Reflecting on silicone's advancement in the immediate postwar period, *Vogue* journalist Simona Morini framed silicone and its conversion to the cosmetic and corporeal realm as 'borrowed from industry'.

'Either injected as a liquid or inserted through an incision, as a sponge, diaphanous sliver, or a carved rubbery chunk, silicone is the sensational discovery physicians have borrowed from industry after having experimented for centuries – often unsuccessfully – with precious metals, alloys and in the last century, with plastics to replace obliterated tissue in the human body.'⁷⁷

In a similar fashion, Silas Braley, who was to become Dow Corning's greatest spin doctor, liked to present the company in a democratic, almost philanthropic, light. He reflected on the immediate postwar period and silicone's conversion:

'[in spite of US Government cancelled contracts] the information gathered during the [WWII] years indicated that there *should* be civilian uses of these new [silicone] materials, and the silicones began to be used in new applications: for furniture polish, for high temperature paints, for high temperature rubbery insulation, for waterproofing and for mold release compounds – to name a few.'⁷⁸

Here the message is one of patriotic duty to the US public. In Braley's promotional narrative, now that 'Uncle Sam' no longer needed silicone, its secrecy order was lifted and the company was finally free to share its materials R&D with the public, who *should* have

⁷⁷ Morini, 1971, p.86.

⁷⁸ Braley, 1973.

access to it. Braley aims to appeal to a range of demographics simultaneously. On the one hand he taps into the patriotic affection for the US Armed Forces of one section of the US public, a perspective that is likely to have been popular in the immediate post-WWII years; on the other he appeals to a new generation of ‘baby-boomers’ who were distrustful of authoritarian figures and structures, assuring them that they *should* have every right to access these new and exciting materials that had been hoarded by the military for too long. Braley’s recollections describe democratic military-industrial-civilian material adaptation, later known as spin-offs, used to justify and distract the taxpayer from costly federally funded R&D projects.⁷⁹ Cynthia Henthorn explores how companies capitalised on military endorsement in their reconversion to peacetime materials production. She argues that the ‘techno-corporate order’ felt that the ‘test of war’ served as a powerful promotional tool. The logic behind this was that if a material or product had stood the test of war, its postwar popularity was inevitable. Conversion/reconversion selling points thrived on the thinking that ‘the “miracles” credited with winning the war had freed Asia and Europe and thus could easily emancipate the American housewife’.⁸⁰ Dow Corning stressed its military contracts in order to emphasise its credibility.

In the postwar period, articles and advertisements in popular publications targeting a female readership, such as *Vogue*, introduced silicone as a miraculous, practical and problem-solving substance ‘borrowed from industry’.⁸¹ It is noteworthy that *Vogue* also ran advertisements by Dow Corning. Therefore it would be in the publication’s commercial interest to include favourable articles promoting the company’s latest products and ventures into the cosmetic, corporeal and domestic realms.

Silicone made its first appearance in *Vogue* in a feature titled ‘Changes for 1954’. An anonymous staff writer wrote about

‘revolutionary hand-lotion containing silicones (which are chemically related to glass) used in industry as water repellents and lubricating agents. Thin, cologne-like, the lotion forms a sort of invisible glove to protect hands from water, dirt, and detergents. Things

⁷⁹ For more on the politics of Cold War spin offs see Stuart W. Leslie, 1997; Henthorn, 2006.

⁸⁰ Henthorn, 2006, p. 86.

⁸¹ See for example ‘Features/Articles/People: Changes For 1954’ *Vogue* (Jan 1, 1954) p. 127. *Ebony* magazine also covered and advertised haircare products containing silicone; however, this was slightly later, in the 1970s. See, for example, ‘Long Aid Bergamot Hair Conditioner’, *Ebony*, August 1975, p. 42.

simply bounce off it! One application lasts through several hand washings; dirt comes off, lotion doesn't.'⁸²

Silicone, an obscure and highly industrial substance that had been in demand by the US Armed Forces was now simply a substance borrowed from industry. Introduced again in relation to glass, silicone was no longer an unknown material presented as a non-threatening R&D innovation of wartime. It saturated the domestic and corporeal realm, via cosmetic and household products, and was marketed to women. Dow Corning, and popular women's magazines aimed at a white readership, reassured the public that silicone could now be trusted; its properties were associated with the power to protect and act as a safety barrier, shielding against interactions with undesirable elements.⁸³ Henthorn's extensive study of US advertising between 1939 and 1959 also notes that in the postwar US, the endorsement of a product by the Armed Forces tended to endow it further with a variety of hygienic benefits.⁸⁴ These benefits can be seen as also celebrating the inertness, or 'safety', of a product, thereby domesticating it and bringing it closer to the body. Silicone was instant, inert like glass; it sat superficially on the skin's surface and was a popular way of guarding hands from washing up liquid and dirt whilst cleaning. Here we see women's hands become like domestic ball bearings – a shift from women as silicone to women as machine parts.

The substance's allegedly transformative and protective properties were celebrated and featured in everyday household items, ranging from suede and fabric protector sprays to waste-paper baskets and moisturisers. In the same rhetorical vein as the promotion of nylon and the other miraculous materials of industry that preceded it, silicone was hailed as emerging 'from the mineral world of coal and tar derivatives'.⁸⁵ Another secret of nature unlocked by man, this most recent addition was endowed with the power to conserve, protect and care for precious surfaces: satins, suedes, raincoats, as well as housewives'

⁸² 'Features/Articles/People: Changes For 1954', p. 127.

⁸³ Plastic became the material solution, from Barbie dolls to implants. The reasoning behind the supposed safety and superiority of these plasticised products was inextricably bound to US postwar culture's war on germs. For more on the war on germs see Ellen Lupton, *The Bathroom, the Kitchen and the Aesthetics of Waste: A Process of Elimination* (Cambridge, Massachusetts: MIT List Visual Arts Center, 1992).

⁸⁴ Henthorn, 2006.

⁸⁵ *The Invisible Protectors* (1956) Dow Corning promotional film, available at: https://archive.org/details/0570_Invisible_Protectors_The

hands and husbands' post-shave faces.⁸⁶ In this example, silicone products are offered for both men and women.

'Invisible Protectors', a 1956 Dow Corning promotional film for silicone, presents Syl-Mer and Syl-Flex silicone fabric and leather protection sprays as the ultimate solution to 'keeping apparel, furniture, shoes new looking'.⁸⁷ When a white female neighbour, knocked backwards by a little boy's ball – 'what's the life expectancy of a couch with a four year old around?' – spills coffee on the new sofa whilst visiting for a 'furniture viewing', the male narrator laments the lack of silicone protection:

'Scrub away, girl! That sofa was new; depressing isn't it? The couch and the friendship will never be the same. Let's move on to happier days, today, with Dow Corning Silicone – Dow Corning in Midland, Michigan, the world's first and largest silicone plant.'⁸⁸

This was a slogan that Dow Corning was able to boast owing to the company's military-industrial inception and Rickover's crucial commission of silicone to enable US bomber plane engines to run more smoothly at higher altitudes.

Silicone also began to appear in advertisements for well-known cosmetics companies. This 1959 advertisement for Re-Nutriv face cream by Estee Lauder boasts 'a goldmine of beauty': silicone was marketed as valuable, rare, protective, rejuvenating and glamorous (Figure 4). Its precious droplets are captured in a golden jar, nestled alongside the essence of two of the ocean's now most endangered creatures: turtles and sharks. Re-Nutriv promised 'to keep you looking younger, fresher, lovelier, than you ever dreamed possible' thanks to its 'treasury of some of the world's most costliest ingredients'. Silicone did not just preserve the surface of everyday items and environments, it was also presented as an innovative protective material capable of the luxurious preservation of youth.

⁸⁶ 'Features/Articles/People: Changes For 1954', p.127.

⁸⁷ *The Invisible Protectors*.

⁸⁸ *Ibid.*



Figure 4: Estee Lauder Re-Nutriv advertisement (1959)

Dow Corning Center for Aid to Medical Research

The first step towards the use of silicone as an implant came in 1953, when Braley compounded Silastic S-9711 and its extrudable counterpart Silastic-2000.⁸⁹ These were the first silicone rubbers created expressly for medical use. Soon after this John Holter, an engineer whose baby had hydrocephalus, wrote to Dow Corning enquiring about the material, and developed one of the first silicone medical devices: the silicone hydrocephalic shunt tube, first implanted in 1955. Silastic rubber's satisfactory biosafety record was

⁸⁹ Warrick, 1990, p.166.

fundamental to the success of the Holter valve's implantation and acceptance by the body. At the time the result was groundbreaking, as implanted materials tended to be expelled by the body within a short space of time. When medical practitioners discovered that silicones were not rejected by the body, Dow Corning was soon inundated with requests for new medical designs. Mel Hunter had been handling medical requests in his role as Dow Corning Director of Research. In 1955, following the success of Holter's design, however, correspondence markedly intensified; McGregor and Braley were brought in to develop Hunter's work. Braley reflected that the demand for medical-grade silicone became so high that Dow Corning 'felt a social obligation to work in [the medical] field'.⁹⁰ This philanthropic rhetoric positions Braley's presentation of Dow Corning's move into the medical realm as a higher moral calling for the company, rather than as an interest in a commercially viable market.

The spread into new markets had already been noted by the Dow Corning researcher McGregor (a former Mellon Research Fellow in the last half of the 1940s) in 1954, when he reflected on the company's efforts to find new markets for silicone:

'[W]hat had been started as a search for further knowledge proved to be the groundwork for technological advances that have proved helpful to industry, and in so doing have contributed to improving our standard of living.'⁹¹

In this rhetoric, what was good for industry was good for improving postwar standards of living, and thereby the body.

In 1959, McGregor, as director, and Braley, as executive secretary, established the Dow Corning Center for Aid to Medical Research (DCCAMR) within the corporation's Research Department.⁹² According to Braley, the Center was set up with the aim of collating 'all known information of the medical uses of silicones, and to answer (to the best of its ability) any questions that came to Dow Corning'.⁹³ As organic chemists, neither McGregor nor Braley had any medical qualifications. This may not have been unusual at the time, as

⁹⁰ Braley, 1973, p.283.

⁹¹ McGregor, 1954.

⁹² Braley, p.283. See also Warrick, 1990, p. 185.

⁹³ Braley, p.283.

engineers were often called in to design prostheses for surgeons.⁹⁴ It is noteworthy, however, that two organic chemists were entering the corporeal field, directing a centre dedicated to medical research and sending out plastic materials for sampling to medical communities across the US and internationally without (at this point) Dow Corning having ever carried out in-house medical tests themselves. Before the 1976 Medical Device Regulation Act there was limited federal legislation in the US on the implantation of medical devices.⁹⁵

Actors including Dow Corning staff Warrick, McGregor and Braley and journalists such as Morini presented a heroic narrative of Dow Corning as a philanthropic entrepreneur. Warrick wrote that the company ‘felt an obligation to [make] an important contribution to medical science.’⁹⁶ McGregor and Braley decided to publish a newsletter to distribute amongst medical practitioners ‘around the world’. They were keen to promote the medical use of silicones on an international scale.⁹⁷ They also met with physicians and surgeons to discuss how silicones could be used in medical applications. Dow Corning strove to provide samples to interested medical practitioners, but was not equipped to offer finished products to the medical community on a large scale. Though commercial manufacturers had access to Silastic rubber they were not interested in producing small-scale elaborate items with low profit margins for Dow Corning to sell to the medical industry, nor were they able to fabricate these in a sterile environment. Dow Corning subsequently discouraged medical research into devices and materials that it was unable to provide on a large scale, or that did not prove to generate sufficient demand. The company sought to avoid expensive research efforts being wasted on medical projects with little potential. Dow Corning was a commercial enterprise, and economic efficiency prevailed over medical philanthropy (whatever they claimed about ‘social responsibility’).

⁹⁴ See, for example Katherine Ott ‘The Sum of Its Parts’, pp. 1-44 (p. 20); Katherine Ott, ‘Hard Wear and Soft Tissue: Craft and Commerce in Artificial Eyes’, pp. 147-170; David Serlin, ‘Engineering Masculinity: Veterans and Prosthetics After WWII’ pp. 45-74; in Ott, Serlin and Mihm (eds.), 2002.

⁹⁵ The materials and devices developed before 1976 were later simply ‘grandfathered in’. Medical Director of recently reopened Johns Hopkins Hospital Transgender Health Clinic Dr. O’Brien-Coon told me that surgeons today still work with materials from this legacy. He explained that since there are such stringent regulations in place for researching, developing and testing new materials in the body, it appears that many commercial companies do not want to risk the investment. They claim it is too expensive to carry out research on brand new materials today so surgeons, engineers and medical staff work with already existing, or ‘grandfathered in’ materials. Companies are no longer allowed to send out samples of untested materials. This is in stark contrast to what DCCAMR were doing.

⁹⁶ Warrick, 1990, p. 185.

⁹⁷ It should be noted here that DCCAMR provided samples on an international scale but is not likely to have been familiar with local legislation on plastic implants.

The market research department was called in to consider the issue and ruled that Dow Corning would fabricate and sell medical products, particularly those made of Silastic that promised sufficient demand to ensure that the effort was profitable. Warrick claims the first products developed were blocks of silicone rubber and sponge of various hardnesses (surgeons carved the required shapes from the blocks for human implantation), scleral bucklers (used for detached retina procedures) and a small range of silicone rubber tubing (for blood pumps and the Spitz-Holter valve).⁹⁸ These items were all produced at Dow Corning's Midland, Michigan plant in the silicone rubber product engineering laboratory, headed by Del Youngs and Paul Skalnican, local engineers trained by Dow Corning in the postwar period, who also had some sales experience.⁹⁹ Producing a limited range of small-scale medical products, Dow Corning did not have the resources to sell to and service the widely dispersed medical community, so they contacted a selection of medical device manufacturers and distributors who boasted substantial marketing operations. A distributor contract was agreed with Becton-Dickinson, a leading company among these.¹⁰⁰ Braley, who later became director of the DCCAMR, reflected on McGregor's 1950s observations on silicone's transfer from military to commercial use: 'not only did these technological advances [in silicones] contribute to our standard of living, but they would contribute also to our actual physical well-being by their implantation into the human body'.¹⁰¹ Industrial materials developed to realise architectural designs and accelerate and improve the technologies of WWII were now being remarketed as materials with which to build, repair and shape the body.

This chapter has used original archival materials to provide an in-depth history of silicone's R&D, complicating the story of Dow Corning as 'First in Silicones'. By looking more closely at archival materials, it offers an alternative value system based on granular archival research that challenges the established victor narrative, offering new material feminist perspectives on silicone and its development. It argues that this methodology and approach is essential to understanding the industrial-military-industrial, and gendered, power structures inherent in silicone's development, which would later impact on its corporeal

⁹⁸ Warrick, 1990, p. 187.

⁹⁹ *Ibid.*

¹⁰⁰ *Ibid.*, p. 186.

¹⁰¹ Braley, p.281.

applications. It has provided an in-depth and complex history of the material and shown how histories have been simplified and victor narratives repeated in an unreferenced way, thereby cementing and perpetuating the military-industrial power structures that led to their success. The chapter has shown how large-scale production was originally accelerated and funded by the US Armed Forces' requirements to make the mechanics of war run smoothly. Silicone was needed to make US bomber planes fly at higher altitudes and reach Japan at greater speed. The response to this need saw the exceptional merging of two powerful industrial companies as Dow Corning. It has argued that exceptionality of this merger was due to Admiral Rickover's US Navy demands. Particular attention has been given to considering silicone's materiality and its changing use and meanings. Silicone was used to improve and remedy faulty equipment, making it move faster, supporting its function under duress: silicone was thus a material promising enhanced performance.

At the end of WWII the cessation of its only customer contracts required a new commercial approach to justify its price. This chapter has argued that silicone in its commercial forms was a new material from the laboratory for which Dow Corning felt an identity had to be created. As with nylon, women's bodies played an important role in the glamorising and domestication of this identity. Dow Corning successfully researched, developed, manufactured and marketed variations of its materials for industrial, domestic, cosmetic and medical use. Industrial chemists, chemical company managers, sales executives and in-house advertising department staff, as well as journalists, celebrated silicone as a 'wonder product' of American industry that had materialised from WWII. As well as being promoted as safe, digestible and inert, silicone also became a desirable and precious material. Its reinvention and commercial launch, however, show the inherent gendered biases and ideologies of the time and its fluid novel materiality became gendered, shaped by the unequal dominant heteropatriarchal power structures that created it. A close examination of *What's a Silicone?* (1952), using critical feminist theory relating to corporeality, has explored how gendered power dynamics shaped the changing meanings of silicone and its materiality. This chapter has shown how silicone was increasingly becoming flesh-like, anthropomorphised, and cosmetically associated with women's beauty and bodies. By the mid-1950s, silicones no longer just rested on the skin's surface – they were being implanted within it.

As the next chapter will demonstrate, synthetic materials born of the US military-industrial complex were being increasingly redeployed in the human body via plastic surgery, a technology itself born of wartime economies and accelerated by the need to mend bodies broken by conflict. For the most part Dow Corning's corporate history has erased its involvement in research into applications of silicone as a material for cosmetically augmenting gendered bodies. Chapter 5 - Silicone Beneath the Surface: Fluid Othering examines previously undiscovered archival material to show what was happening beneath the surface, both in the US and on a wider international scale. It investigates silicone's materiality and its role in the artificial augmentation of women's bodies.

Chapter Five: Silicone Beneath the Surface: Fluid Othering

1964: Silicone Committee

1964 was a pivotal year in the history of silicone: it was when Carol Doda first shimmied across the Condor's white baby grand and paid lip service to the transformative qualities of silicone shots, cooing: 'now a girl can be as large as her dreams'.¹ Doda hit the US headlines, her pro-silicone stance – 'science has invented all these new wonderful things, why shouldn't we use them?' – reported by the media from the West to the East Coast.² With the total number of women in the US receiving silicone shots for breast augmentation, as well as to the buttocks, legs and face, from the late 1950s to mid 1960s estimated by medical professionals to range between 20,000 and 50,000 (a precise number is difficult to identify due to the sometimes underground and illegal nature of the practice), the Federal Food and Drug Administration (FDA) in Washington, DC started to take note.³

Implantable silicone materials proved challenging for the FDA to categorise in concrete legal terms, as this depended on an interpretation closely intertwined with the viscosity or firmness of the material. Was the silicone material a liquid (drug) or an object (prosthetic)? Silastic (a type of silicone rubber) used in artificial heart valves (amongst other implants) was considered a medical device by the FDA. Therefore it could not be governed by the FDA, as there was limited legislation at this time regulating implantable medical devices, meaning that it fell outside FDA jurisdiction. Silicone's fluid materialities could slip through cracks in the FDA's regulations. For example, although it was fluid upon injection, once inside the body silastic had the power to transform instantly from liquid to prosthetic. This slippery visceral material, both fluid and object, was opening up novel approaches to

¹ Doda in 'Escalation', *Newsweek*, October 25 1965, p. 110

² Carol Doda cited in Sam Hudson, 'The Silicone Bosom Revisited' *Sir!* March 1968, p. 84. See also Hal Schaefer, 'The Owl Steps Out' *San Francisco Chronicle*, 20 June 1964, p. 32; 'Nude Discotheque with Carol Doda' *Playboy*, 12.4 (April 1965); Alan Levy, 'A Morality Play in Three Acts', *Life*, 11 March 1966, pp.79-87; 'The Broadway Boys All Sing This Song – Doda Doda' *San Francisco Chronicle*, 1 August 1965, p.116; David Perlman, 'Analysis of the Bust Injections', *San Francisco Chronicle*, November 15, 1965, pp. 1-15,

³ Plastic surgeon Norman Anderson, in his 18 December 1990 testimony, described some 50,000 women in the US who had been injected with silicone in this period. Hearings before the Human Resources and Intergovernmental Relations Subcommittee of the Committee on Government Operations, June 11, 1991, cited in M. Sharon Webb, 'Cleopatra's Needle: the History and Legacy of Silicone Injections', Food and Drug Law Third Year Paper (1997) Harvard University. Available at: <http://nrs.harvard.edu/urn-3:HUL.InstRepos:8889460> (accessed February 15, 2018) and Nora Jacobson, *Cleavage: Technology, Controversy and the Ironies of the Man-Made Breast* (New Brunswick, NJ: Rutgers Press, 2000); Rhoda S. Narins, MD, Kenneth Beer, MD. 'Liquid Injectable Silicone: A Review of Its History, Immunology, Technical Considerations, Complications, and Potential', *PRS*, September 1 2006, 77S - 84S, estimate that approximately 20,000 to 40,000 women were injected in the US by 1965.

designing the female figure. It was not until the 1976 US Medical Device Regulation Act that the FDA was granted federal jurisdiction over the regulation of medical devices, including implants. Silicone fluid, however, could be interpreted as halfway between a drug and a device.

In 1964, under mounting pressure from the FDA and increasingly controversial press coverage of black-market silicone scandals (these will be discussed in greater detail later in the chapter), Dow Corning decided to register a New Drug Application with the FDA for 360 Medical Grade Silicone. *Vogue* contributor, and author of *Body Sculpture: Plastic Surgery from Head to Toe* (1971), Simona Morini wrote that once silicone entered the 'FDA complex machinery, it turned into a national headache'.⁴ Morini, and some of her contemporaries, felt that silicone was probably safe, and that the FDA was an inefficient authoritarian and bureaucratic institution that was being overly cautious. Now jammed in the cogs of the FDA's 'complex machinery', silicone was no longer fluid, an industrial lubricant that propelled military and industrial efficiency and advancement, but instead was ensnared in the system, unable to progress into the corporeal at its previous unchecked speed. New drugs could not be permitted to be marketed to the public until they had been proven safe and valuable, and it was alleged that new drug applications 'may well remain on FDA officials' desks for years.'⁵ Silicone was a controversial material, and opinion, in both popular and medical coverage, was divided. However, a number of 'baby-boomer' journalists were questioning the FDA's 'puritanical' stance, arguing that these authority figures were somehow proscribing something that was good for their generation and their freedom over their own bodies, sexuality, appearance and choices.⁶

In keeping with the FDA's protocol, in 1964 Dow Corning set up an Investigation Committee team, known as the Silicone Committee. Morini described Silas Braley, DCCAMR's Director, as 'affable and easy-going but adamant when it comes to keeping track

⁴ Simona Morini, 'Beauty and Health: A New Aid to Plastic Surgery: Silicone', *Vogue*, (Jan 15, 1971), pp. 82 - 85, 116 – 117; p. 84.

⁵ *Ibid.* As we shall see throughout this chapter, both popular and medical publications voiced frustration at the FDA's lengthy review processes. Opinions on silicone were divided. Some doctors, such as Murray, believed that it was a 'miracle material' for congenital defects, and that if used cautiously could be applied successfully to the body. Commercial physician Orentreich felt that silicone was safe if injected in small doses over prolonged periods. Others, such as Charles Vinnik (a Las Vegas physician who had witnessed en masse the horrors of botched silicone injections amongst both show-girls and housewives), were intent on having it banned.

⁶ See Morini, 1971; Simona Morini, *Body Sculpture: Plastic Surgery from Head to Toe* (New York: Delacorte Press, 1972); *W, Esquire, Vogue, Harpers Bazaar*. Elizabeth Haiken, *Venus Envy: a History of Cosmetic Surgery* (Baltimore, MD: Johns Hopkins University Press, 1997), p.254, has also written about this.

of every pint of the fluid, which is shipped only to an investigating committee of eight physicians – seven plastic surgeons and one dermatologist'.⁷ ANT methods and archival work enabled me to identify that the initial members were medical doctors, working in medical contexts:

- Franklin Ashley, Chief Plastic Surgeon, UCLA
- Ralph Blocksma, Chief of Plastic Surgery, Butterworth Hospital, Grand Rapids
- Reed Othelbert Dingman, Chief Plastic Surgeon, University of Michigan
- Milton Edgerton, Chief Plastic Surgeon, Virginia Medical Center (previously based at Johns Hopkins Hospital for over 20 years)
- Dicran Goulian, Chief Plastic Surgeon, New York Hospital-Cornell Medical Center
- Joseph E. Murray, Professor of Surgery, Harvard Medical School; Plastic Surgeon, Brigham Hospital, Boston
- Norman Orentreich, Clinical Associate Professor of Dermatology, NYU Medical Center; Orentreich Clinic founder
- Thomas Rees, Associate Professor of Clinical Surgery, Institute of Plastic and Reconstructive Surgery, NYU Medical Center

In practical terms, since Dow Corning does not have an archive open to public research, my primary source research on silicone shots began by trying to locate the papers of all eight members of the Silicone Committee. The only surviving and relevant archived papers I was able to locate are those of Murray and Edgerton. Although Goulian left no papers, his supervisor, with whom he worked closely, Chief Surgeon Herbert Conway, Division of Plastic and Reconstructive Surgery, New York Hospital-Cornell Medical Center, did. In contrast to Silicone Committee members Edgerton and Murray's papers, Conway's appear less edited. To the best of my knowledge, Conway's papers have not been consulted before in relation to cosmetic surgery. They offer a rare glimpse into the inner workings of the Dow Corning Center for the Aid to Medical Research (DCCAMR), cosmetic and plastic surgeons and the culture of silicone samples for use in feminisation surgery.

⁷ Morini, 1971, p. 86.

Unlike the established scholarship on cosmetic surgery, I draw heavily on a wide range of archival materials to present an alternative in-depth history of silicone, paying attention to key issues that have been sidelined in the past, such as international postwar power networks between petrochemical companies and surgeons, Japanese medical research on silicone, and the lived experience of transgender women, particularly trans women of colour. I argue for the importance of employing a rigorous and interdisciplinary archival approach, building on original material from medical archives, by drawing on previously unexamined materials sourced from court and military papers to illustrate silicone's complex postwar international network of actors and its impact on the shaping of a hyper-feminine, gendered ideal. Elizabeth Grosz writes:

'we need to understand the body, not as an organism or entity in itself, but as a system or series of open-ended systems, functioning within other huge systems it cannot control through which it can access and acquire its abilities and capabilities.'⁸

This chapter offers an exploration of these systems, particularly in relation to the industrial-military-industrial complex that silicone emerged from, its materiality and its relationship to women's bodies in the postwar US. For a thesis concerned with how US postwar systems of power and inequality became internalised through materials and their application to women's bodies, it is telling that this chapter is very homosocial, focusing almost entirely on men's agency and men's desires, such as those for profit and sex. Material feminist Alaimo writes: 'networks require analyses that can grapple with their reality, narrativity and collectivity'; this is challenging 'given that scholars are trained for the most part, to engage in only one of these three modes of investigation'.⁹ Indeed, this chapter's examination is interdisciplinary, intersectional, inter-archival, complex and contradictory, particularly in my exploration of the way that US doctors and scholars approached Japanese research and their equivocation about the use of silicone for silicone injections, predominantly in the mammary area. It is only by persisting with this grappling, though, that it can begin to unravel and untangle the systems with which silicones and women's bodies were enmeshed

⁸ Elizabeth Grosz, *The Nick of Time: Politics, Evolution and the Untimely* (Durham, NC: Duke University Press, 2004), p. 3.

⁹ Stacy Alaimo, *Bodily Natures* (Bloomington, IN: Indiana University Press, 2010), p. 9.

in the postwar US. For these reasons, the chapter does not consistently follow a chronological order, as it negotiates sets of actors, geographies and themes in order to show silicone's reality, narrativity and collectivity in the greater depth it needs.

This chapter moves from Chapter Four's exploration of silicone *on* the (skin's) surface to a deeper exploration of silicone *beneath* the (skin's) surface. By interrogating untapped archival sources, it questions established American Anglophone-centric and often racist narratives of the history of cosmetic surgery by drawing on international primary sources to paint a bigger picture and reveal complex international networks. When and where did silicone's earliest applications for breast augmentation take place? Who made decisions about its application to the female body? How did silicone's materiality figure in these decisions? Who were the women who were having this work done? How did silicone impact on the shaping of trans and cis women's bodies? My research challenges the US-centric narratives perpetuated in established and recently published scholarship.¹⁰ It seeks to present a fuller and more multifaceted picture, employing interdisciplinary methods and unexplored archival sources to uncover a complex international network of military and industrial materials research, petrochemical companies, cosmetic surgeons, the media, cis and trans women's bodies and celebrity culture. This second chapter on silicone builds on the first, going deeper into these networks. Overall, I argue for the importance of employing interdisciplinary methods and archival research to better understand how this highly industrial material, originally funded by an impetus for autarky, began to shape gendered and racialised bodies in an apparently instantaneous way, first through injections and later as implants.

Following health issues that were experienced with foam implants, silicone was promoted as being chemically inert, and thus safe, and an instant booster for shaping the body. Unlike foams, silicone shots could be administered directly into the body using a needle. They promised a new kind of inert materiality, from viscous to rubber-like. Plastic foams and rubbers had been prone to crumbling and becoming brittle or rigid, but silicone now promised a soft, glistening alternative, from the viscous to the rubbery. In the postwar US, Dow Corning promoted silicone's use in the food and agriculture industry: silicone was presented as a chemically inert 'miracle' material that was safe for corporeal use. Its visceral

¹⁰ Haiken, 1997; John Byrne, *Informed Consent* (New York: McGraw Hill, 1996); Jacobson, 2000; Elizabeth Matelski, *Reducing Bodies: Mass Culture and the Female Figure in Postwar America* (New York: Routledge, 2017).

materiality was praised as most closely imitating that of malleable flesh. Plastic surgeon William St. Clair Symmers reflected:

‘The needs of ethical surgery have long encouraged the search for a bland material that can be placed in human tissues safely and easily, with the object of altering outward appearances while avoiding undesirable effects, immediate or later. Successive foreign substances have been described over the years as meeting these requirements: without exception each has eventually proved unsatisfactory, even dangerously so. One of the latest of these substances is silicone fluid (dimethylpolysiloxane), which in pure form or mixed with other compounds has been injected into the tissues to act as prosthesis.’¹¹

Silicone was the latest discovery in a long quest for materials that would be accepted by the body as a replacement for flesh. Its novel materiality held the promise of fluid turned prosthetic; it could enter the body via a needle and then set internally to transform into an object.

Silicone was not the first liquid substance from industry to be injected into the body. In the late nineteenth century, Austrian doctor Robert Gersuny pioneered the use of paraffin for breast augmentation, injecting it in its soft form directly into the breast in cis and trans women.¹² Patients and doctors soon discovered, however, that these injections resulted in just as many, if not more, complications than their internal application to any other body part, as paraffin had the tendency to migrate and form lumps.¹³ Elizabeth Haiken notes that the surfacing of these unsightly side effects meant that by WWI the practice of subcutaneous paraffin injections had ‘become largely abandoned’.¹⁴ My own research into primary medical sources reveals a plethora of materials being injected into the body to achieve a fuller bust. ‘Paraffin waxes, beeswax, silicon wax, silicone fluid, shellac, shredded oiled-silk fabric, silk tangle, glazier’s putty, spun glass, and epoxy resin’ are all materials

¹¹ W. St. C. Symmers MD, ‘Silicone Mastitis in “Topless” Waitresses and Some Other Varieties of Foreign-body Mastitis’ *British Medical Journal* (6 July 1968), 19 – 22 (p. 20).

¹² Sander Gilman, *Making the Body Beautiful* (Princeton, NJ: Princeton UP, 1999), p.255. Gilman addresses trans people and paraffin, other scholars have not. See also p.249 for more on Gersuny. The history of paraffin and cosmetic surgery is well-rehearsed – see also Haiken, 1997, and Matelski, 2017.

¹³ Khoo Boo-Chai, The Complications of Augmentation Mammoplasty by Silicone Injection (Singapore) *British Journal of Plastic Surgery* 22.3 (July 1969); Haiken, 1997; Jacobson, 2000.

¹⁴ Haiken, 1997, p. 236.

identified in specimens taken from foreign-body mastitis (inflamed breast tissue) between 1946 and 1968.¹⁵ Unlike paraffin, silicone was believed to be chemically inert. It also fits into a wider history of US WWII military-industrial materials R&D. This chapter charts silicone's development from military-industrial material to controversial shaper of women's bodies, a role it still performs for many today.

Fluid Othering: Challenging the Established US Narrative on Bust Injections

It is difficult to pinpoint when, where, and by whom the first liquid silicone breast-enlargement injection was administered. Established US-centric scholarship on cosmetic surgery mirrors sensationalist and racist primary sources in the US popular press, indicating that this took place around the end of WWII, and largely locates the origins of subcutaneous silicone shots in Japan.¹⁶ It claims that transformer coolant crates disappeared from Yokohama harbour, stolen by 'the Japanese', and found their way into local women's breasts; by doing so this scholarship others it. John Byrne's writing (1996), which has been heavily cited, is typical of this narrative:

'In the aftermath of World War II, transformer coolant made of silicone was suddenly disappearing from the docks of Yokohama harbour in Japan. The silicone fluid was used by cosmeticians to enlarge small breasts of Asian prostitutes who knew that a more Western appearance would enhance their appeal to American servicemen.'¹⁷

Instead of employing a rigorous archival approach that uses papers from members of the Silicone Committee, many scholars such as Kathy Davis (1995), John Byrne (1996), Elizabeth Haiken (1997), Nora Jacobson (2000) and Elizabeth Matelski (2017) continue to reinforce an unevicted and racist rhetoric in their account of the origins of silicone shots for bust augmentation in Japan, ignoring the professional development of the medical applications

¹⁵ Symmers, 1968, p. 19.

¹⁶ For a selection see Haiken, 1997, p. 246; Matelski, 2017, p. 33; Byrne, *Informed Consent*, p. 41; Rhian Parker, *Women, Doctors and Cosmetic Surgery: Negotiating the "Normal" Body* (London: Palgrave Macmillan, 2010), p. 196; Susan Zimmermann, *Silicone Survivors: Women's Experiences with Breast Implants* (Philadelphia, PA: Temple University Press, 1998), p. 23; Jacobson, 2000, p.80; Kathy Davis, *Reshaping the Female Body* (London: Routledge, 1995), p. 20; Toni Kosover, 'Fill Her Up', *W*, 3 (November 1972), p.20; Deborah Larned, 'A shot—or two or three—in the breast', *Ms.*, (September 1977), p.55; Morini, 1971; Deborah Schalk, 'The History of Augmentation Mammoplasty', *Plastic Surgical Nursing* 8.3 (1988), 88; Mimi Swartz, 'Silicone City', *Texas Monthly*, 2.8 (1995), pp. 69–100; John Byrne, 'Beauty and the Breast: How Industry Sold Implants to Women', *Ms.* (June 1996), pp.45–46. Laura Miller critiques Byrne and Haiken in 'Mammary Mania in Japan', *Positions: East Asia Cultures Critique*, 11. 2 (Fall 2003), 271 – 300, pp.281-282 and *Beauty Up: Exploring Contemporary Japanese Body Aesthetics* (Berkeley, CA: University of California Press, 2006) pp. 82 – 83.

¹⁷ Byrne, *Informed Consent*, 1996, 41. Byrne is cited by Matelski and Jacobson.

of silicone in Japan. They repeat the racialised rhetoric established by US cosmetic surgery and plastic industry actors in the 1950s and 1960s, such as Braley, who, for example, told *Science News* in 1968 that the practice of silicone injections for bust augmentation originated in Japan, with ‘up to a pint of silicone injected into each breast’.¹⁸ Braley was not alone in his claims: these were also corroborated by medical professionals, chemical company staff and journalists.¹⁹

There are, however, also a small number of equally unsubstantiated references to silicone shot treatment originating in Switzerland and Germany.²⁰ In addition, self-proclaimed ‘Hollywood beauty doctor’ Robert Alan Franklyn (see Chapter 3) cited Ludwig Lenz as a pioneer in the field and named silicone subcutaneous injection ‘Cleopatra’s Needle’ after Lenz’s further development of the technique in Egypt.²¹ Lenz worked at Magnus Hirschfeld’s Institut für Sexualwissenschaft (Berlin, Germany 1919-1933), a private sexology research centre in Berlin, where he was head of the gynaecological department from 1925 to 1933. Lenz is said to have performed the first gender confirmation surgeries.²² If paraffin was used to augment the body, then silicone would logically follow as the next material to be trialled in the body, not just in the US and Japan, but also *internationally*: it offered similar viscous materiality but with the added bonus of being perceived as chemically inert. This theory, however, is not commonly articulated in the established US-centric scholarship.²³ Furthermore, these alternative geographic origins have been largely overlooked. Perhaps they did not quite capture the imagination of either the US public at the time or scholars working on the history of breast augmentation.²⁴ Furthermore, the

¹⁸ Silas Braley, ‘Illegal, Immoral and Dangerous’, *Science News*, 93. 7 (Feb. 17, 1968), 173. It is important to note here that this article mistakenly refers to Braley as a doctor; however, his only qualifications was BS – (Bachelor of Science) and yet he frequently published on silicone’s medical benefits in respected medical journals including *PRS* and *JAMA*.

¹⁹ See, for example, Wallace Turner, ‘Silicone Inquiry Shows Wide Use: Illegal Breast Injections Are Reported on Coast’ *New York Times*, Sunday April 28, 1968; Liquid Silicone Used in Reconstructive Surgery’, *NYU Med Center News*, 4. 5 (February, 1968), JMP, Box 1, Folder 33; Franklin L. Ashley et al., ‘The Present Status of Silicone Fluid in Soft Tissue Augmentation’ *PRS*, 39.4 (1967), 411-20; Braley, 1968, p.173. Braley also others silicone shots in ‘Letters to the editor: silicone fluids with added adulterants’ *PRS* 45.3 (March 1970), 288.

²⁰ See for example Narins and Beer, 2006; ‘Liquid Silicone Used in Reconstructive Surgery’ in *NYU Med Center News*, Vol. 4, No. 5, February, 1968 (Murray Papers); private correspondence with David Orentreich MD, son of SC member Norman Orentreich, Friday 16 February 2018.

²¹ Robert Alan Franklyn, *The Art of Staying Young* (New York: Frederick Fell, 1964), pp. 118- 119.

²² In 1939, his citizenship was revoked and he fled to Cairo, where he continued his practice and research. After the war he practised between Egypt and Baden-Baden, Germany.

²³ Jacobson, 2000, (p. 81), is the exception, noting the similarity between silicone shots and ‘the idea that had guided paraffin injections’.

²⁴ Though Gilman, 1999, briefly mentions Lenz in relation to rhinoplasty, he does not mention his work on breast injections. In Haiken’s case this may be as she was writing a foundational history of cosmetic surgery covering broad timelines and topics, so it is unlikely she could have researched this aspect in detail. Or, as in Matelski’s case, this can also come from the limitation of choosing to stay focused within one discipline: predominantly media studies.

scholarship on silicone injections is largely Anglocentric and uncritically perpetuates the established narrative that actors such as Braley, working for Dow Corning, shared with the press, attesting to a lack of rigorous archival research or critical engagement with the material. This chapter will also use archival material to challenge Byrne's (1996) much-cited claim that Dow Corning had no knowledge of breast injections prior to 1963. Because they employ neither ANT nor a material-centred approach, these scholars make bold assertions such as: 'even though silicone was created in the United States, its use in breast injections did not originate here. That application began in Japan shortly after World War II, when American forces still occupied the country'.²⁵ One thing is clear in mythologised and racialised narratives such as these: silicone is definitely an all-American wonder product; however, it was 'the Japanese' who stole it from the military and industry and manhandled it, experimenting with female bodies before it was deemed 'safe'.²⁶ This chapter seeks to present new undiscovered archival material to problematise, challenge and complicate this established narrative of fluid othering.

The connotation of these stories is that 'the Japanese' were 'stealing' from the occupying US forces and pumping vats of military-industrial materials into the bodies of an unsavoury 'subclass' of the population: Japanese female sex workers. They suggest that local Japanese women did not meet the white American hyper-feminine busty ideal that prevailed in the US at the time, and that their gendered and racialised corporeal shortcomings needed to be repaired or corrected before their bodies would be desirable enough to cater sexually for the occupying American servicemen. Laura Miller has discussed the impact of the Allied Occupation on the shift in erogenous zones in Japan. Pre-WWII, the ideal female form had traditionally centred on the kimono, which accentuated the nape of the neck as well as the hips and ankles.²⁷ The influx of American culture during the postwar Allied occupation, including the arrival of the curvaceous white Hollywood ideal and tight-fitting Western-style clothing, began to change this focus.

There is an urgent need to challenge and address the racial stereotype that has been (and still is) perpetuated in the established scholarship on cosmetic surgery and gendered

²⁵ Zimmermann, 1998, p. 23.

²⁶ See Zimmermann, 1998; Byrne, *Informed Consent*, 1996; Haiken, 1997.

²⁷ Laura Miller, 2003, pp 271 - 300 (p. 279); Laura Miller 2006. Miller also highlights that nape appreciation in Japan remained popular in the mid-1980s, see Kittredge Cherry, *Womansword: What Japanese Words Say About Women* (Tokyo: Kodansha International, 1987).

bodies. This fails to problematise or interrogate the primary sources, thus perpetuating postwar US power structures that uphold misogynist and racist ideology, failing to challenge and expose it. How can histories of cosmetic surgery and the body that allude to feminist thinking do so if they fail to employ an international approach, or employ an inclusive approach to women's bodies that addresses cis and trans bodies, as well as women of colour? Histories of bust augmentation such as those by Haiken, Byrne and Zimmermann focus on the cis white female as an unmarked norm. Furthermore, they are over-reliant on non-academic, largely unreferenced sources, resulting in inaccuracy and mythologisation.²⁸

Laura Miller (2006) notes that there are gaps and unexplained discrepancies in the established historical narrative of silicone: she cites Byrne and Haiken as attributing the first silicone injections to Japan.²⁹ My own research has found that there are many more US-based scholars who repeat this myth.³⁰ This is puzzling, as they also cite an American osteopath, Harry Kagan, who is known to have begun experimenting with silicone injections a decade earlier in 1946, using Dow Corning 200 Fluid, a material intended for industry and military use (see Figure 1).³¹ Kagan appears to be one of the earliest known advocates of silicone shot treatment, firmly linking it to the US, but this is glossed over in the established scholarship. The dates correlate, since Dow Corning first announced its launching of silicones onto the US commercial market in 1944. Why have Americanist scholars not entertained the idea that Japanese doctors, just like their American, German and Austrian peers, were already familiar in the 1930s with the practice of injecting paraffin in cosmetic surgery? This technique was popular in many other countries, too.³² This is another demonstration of the importance of considering how an emphasis on materiality offers different perspectives. Silicone had similar material properties to paraffin, with the added advantage of presenting as chemically inert, so, as with previous material developments, it appeared to be an improved successor for cosmetic surgery. To date, scholars have not considered the interdisciplinary complexities of the silicone story, and have failed to investigate the

²⁸ In contrast, for an interdisciplinary, intersectional, decolonial approach to the history of medicine and sexuality see C. Riley Snorton, *Black on Both Sides: A Racial History of Trans Identity* (Minneapolis, MN: University of Minnesota Press, 2017); on sexuality see also C. Riley Snorton, *Nobody Is Supposed to Know: Black Sexuality on the Down Low* (Minneapolis, MN: University of Minnesota Press, 2014).

²⁹ Byrne *Informed Consent*, 1996; Haiken, 1997. Laura Miller, 2003, pp.281-282; Laura Miller, 2006, pp. 82 – 83.

³⁰ See footnote 16.

³¹ Harvey Kagan, 'Sakurai injectable Silicone Formula', *Archives of Otolaryngology* 78 (1963), 663–68. In 1958 German MD R. Kaden, at the Haut Klinik im Rudolf Virchow-Krankenhaus, Berlin, also began experimenting with silicone injections, using DC 200/100. See R. Kaden, 'Verwendung des Silikonoels bei Faltenbildung', *Aesth. Medizin*, 17.10 (1968), 217 -220.

³² See Symmers, 1968; Beer, 2006. Other countries mentioned include France, Italy, Israel, Brazil, Singapore.

international network it depended on, leaving many questions unconsidered and unanswered.

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DOE CORNING FLUIDS
TYPE 550-50 CSTKS.
Z * - 75 *
A * - 70-100 *
4 * - 250 *
5 * - 400 *

DOE CORNING CORPORATION
MIDLAND, MICHIGAN

Figure 1: DC 200 Fluid (1946)

Using a range of previously unexplored original archival material associated with Silicone Committee doctors and ocularist Walter Spohn (who received plastic samples from Dow Corning and lesser-known companies such as Surgitek), as well as military, court, FDA and AMA papers, I seek to challenge the established American-centric racialised narrative of the development of silicone, which presents Japanese research as subpar when archival sources reveal that it was actually very similar to what was happening in the US. Germany, Italy, the Czech Republic, Singapore, South Africa and many other geographical contexts also feature in the archives. The established narrative presents a US / Anglophone-centric victor story. It favours Dow Corning, neglecting to mention how General Electric was instrumental in silicone's early development and that Dow Corning was faced by medical implant

competitors such as Surgitek, as well as Japanese companies and brands such as Shin-Etsu. In this chapter I will tackle the complex international networks silicone encompasses, focusing on Japanese-US relations within this. I will use archival material to argue that medical research structures in Japan were, contrary to the established scholarship, similar to those in the US, and can be understood as competitive rather than ‘unsophisticated’: a number of these companies are still in operation today.

What if the coolant vats were not stolen by Japanese men, but were taken by American Armed Forces medical officers and servicemen?³³ This seems an equally valid scenario, and yet it has not generally been considered in the established scholarship. Former medical law history student Sharon Webb is the exception, describing in a paper how her father, Charles Webb MD, a US medical officer in Japan during the occupation, was acquainted with an army master sergeant who administered breast injections to local women for a fee.³⁴ The sergeant obtained syringes illicitly from the US military medical facilities and used what Dr Webb identified as cooling fluid that was readily available on the base. According to him, this behaviour met with no official censure. He did not know the exact chemical composition of the cooling fluid; however, we do know that Dow Corning exclusively supplied the US Armed Forces with silicone fluid.³⁵ Even if the fluid were not silicone, Webb suggests that the technique of breast injection with military chemicals was familiar to some army personnel.³⁶

Shimadzu Seisakusho Ltd

As part of the process of unravelling silicone’s arrival in Japan, it is important to note that Dow Corning, founded in the US in 1943, presented itself as the world’s first commercial supplier of silicone. As previously discussed, Admiral Rickover gave military orders for Dow Corning’s production and supply of dimethylsiloxane, which was used throughout the US Armed Forces as an aviation engine lubricant. In 1945, silicone was exported from the US to

³³ For examples of ‘what if’ scholarship see Amy Stanley, ‘Writing the History of Sexual Assault in the Age of #metoo’ *Perspectives on History*, 24 September 2018.

³⁴ See Webb, 1997.

³⁵ ‘Personal communication, Charles R. Webb, M.D., 1990’ cited in Webb, 1997.

³⁶ In 2018 and 2019 I repeatedly attempted to contact Sharon Webb for further clarification, contacting her on Twitter, as well as via the various companies her name is listed as advisor for. I have been unsuccessful so far. I have also corresponded with military archivists at the US National Archives and Records Administration (NARA), Bureau of Medicine and Surgery (BUMED) and the US Navy Museum but have sadly not had any leads so far. I tried searching for records of theft of silicone and military court hearings within these institutions. These archives were also unable to locate military records for a Charles Webb MD (I was hoping to be able to do better searches of court records once I knew where he was stationed).

Japan, and, as with all other materials, was controlled by the Allied Occupation Forces there. Access to silicone production in Japan was restricted by these forces and regulated by figures including General Douglas MacArthur, the Supreme Commander for the Allied Powers (SCAP).

In March 1950, Yosuke Suzuki, President of Kyoto-based Shimadzu Seisakusho Ltd., presented a 'Plan for Execution of Industrialisation Experiments' to SCAP's Economic and Scientific Section, Industrial Division for 'Experimentation on Industrialisation of Silicone Production'.³⁷ In February 1949, Suzuki wrote that he had completed studies on the industrial-scale manufacture of silicone and had succeeded in setting up a pilot plant of small capacity. 'Having thus had full confidence in the production, we wish to start a trial industrialisation of the same, in which we propose to turn out every month 600 kg of silicone in the first year beginning in March 1951.'³⁸ Suzuki's application to SCAP sought their approval to scale up production and an ¥11,000,000 grant to support Shimadzu Seisakusho Ltd for 'the industrialisation experiment'.³⁹

In addition to controlling development programmes for materials such as silicone, SCAP also managed one of its largest programmes, that of Public Health and Welfare. This was headed by US Army Colonel Crawford Sams, who managed the welfare work of 150 American doctors and put in place a Japanese medical welfare system modelled on the American one.

Shin-Etsu

Kyoto-based Shimadzu, established in 1875, remains a major firm in advanced tech development today. A manufacturer of precision measuring instruments and medical equipment, it was not the only company to begin silicone research shortly after the US entered Japan. Shin-Etsu Chemical Co. Ltd, the largest chemical company in Japan, that originally set up in Tokyo in 1929 as a specialist in nitrogen fertiliser, claims that, like

³⁷ 'Plan for Execution of Industrialisation Experiments: Yosuke Suzuki, Seisakusho Ltd' RG 331 (Allied Operational & Occupation Headquarters, World War II) Supreme Commander for the Allied Powers (SCAP), Economic and Scientific Division, Industrial Production and Construction Branch, Topic File 1945-1950, Box 7173, National Archives, Washington DC, Declassified authority 775018.

³⁸ Ibid.

³⁹ Ibid. On April 25th, 1949 the US occupation government fixed the value of the yen at 360 yen per 1 USD. That exchange rate was maintained until 1971. Thus 11,000 yen would be equal to approximately 30,555.56 USD in 1949 'Japan – Money, Weights and Measures', in S. H. Steinberg, *The Statesman's Yearbook 1950*, (New York: Macmillan, 1950), p. 1179. Equivalent to around \$30,555.56 in 1949 has a relative inflated worth of \$331,406.76 today. The CPI (consumer price index) comes from the US Bureau of Labor Statistics (BLS) *Measuring Worth*. Available at: <https://www.measuringworth.com/dollarvaluetoday/more-info.php>. (accessed 16 March 2020).

Shimadzu, it began basic chemical research on silicones in 1949.⁴⁰ Warrick offers a competing narrative, claiming that Shin-Etsu was amongst a group of Japanese military and electrical companies that explored silicones during the war after discovering and studying them in downed American fighters and bombers.⁴¹ This would date their research into silicones a little earlier, to the US air raids in Japan between 1942 and 1945. By 1953 Shin-Etsu had started commercial production of silicones, and in current publicity claims to have been the first Japanese firm to venture into the silicone business.⁴²

Two years earlier, on his 1951 visit to Japan and Shin Etsu's factory, Shailer Bass, a Dow Corning chemist, noted that Shin Etsu's WWII studies of silicone in fallen US aircraft were so advanced that they had already replicated and applied the direct process for producing silicones and were also manufacturing silicon.⁴³ Warrick took a different view: he claimed that Shin Etsu's success had been enabled by entering a licensing agreement with General Electric two years later in 1953, followed by one with Dow Corning in 1957.⁴⁴ As with Dow Corning in the US, Shin-Etsu was also investigating silicone's potential as an implantable medical and cosmetic material.⁴⁵ From 1951, Dr Shirakabe, of Shirakabe Hospital, Osaka, and Yakuo Fujimoto, the hospital's Chief of the Technical Service Department, collaborated with the Shin-Etsu Chemical Company on the development and production of their own silicone formula for bust enhancement.⁴⁶ Shirakabe claims that the Monsanto Chemical Company in the US acted as consultant on the project, further indicating an international network of involvement.⁴⁷ As part of this complex unfolding of

⁴⁰ 'History', *Shin-Etsu Silicone*, Available at: <https://www.shinetsusilicone-global.com/info/development.shtml> (accessed 4 March 2018).

⁴¹ Warrick, 1990, pp. 108, 239.

⁴² 'History', *Shin-Etsu Silicone*.

⁴³ Warrick, 1990, p. 108. Unlike Hyde, McGregor, Warrick and Braley, Bass was originally employed by Dow Chemical as an organic chemistry PhD from Yale University.

⁴⁴ Warrick, 1990, p. 239.

⁴⁵ Japan was a key country in Dow Corning's quest for securing international joint venture operations. In 1965, Paul Sawada of Shin-Etsu met with Bill May at Dow Corning's Tokyo office to begin negotiations for what was to become their Japanese government-sanctioned joint venture, Shin-Etsu Hadotai, specialising in semiconductor silicones. In 1966, Dow Corning also set up a joint venture and licensing agreement with Toray Silicone Co. Ltd, making them one of the first American companies to receive an equal partnership in postwar Japan (Warrick, 1990, p.240). Eugene Rochow also visited Shin-Etsu in 1964 and spent some days there working on silicone, see Rochow, SHI OH, 105. These were two of the major silicone companies in Japan; Tokyo Shibaura Electrical Co. and Fuji Kobunshi also made silicone (Walter Noll, *Chemistry and Technology of Silicones* (New York: Academic Press Inc., 1968), p.20).

⁴⁶ Correspondence between Herbert Conway M.D. and Takeya Shirakabe M.D., 1960 – 1961, HCP, Box 7: Series I, Correspondence.

⁴⁷ FD Smith, manager, Monsanto Chemical Company, letter to Conway January 4, 1961, HCP, Box 7: Series I, Correspondence.

the US's attitude towards breast augmentation, Monsanto later distanced themselves from this claim:

'[W]e are surprised to learn of Monsanto's identification with the development of a new plastic material used in [breast augmentation] surgery, designated as a modified silicone. The fact that it is a silicone leaves doubt as to our association therewith, since we do not manufacture this type of product. There is, however, the possibility that the Shinetsu [sic] Chemical Company [...] received from Monsanto certain raw materials of our manufacture which they have incorporated in a product.'⁴⁸

By November 1960, nine years after the development of their own silicone formula, Shirakabe Hospital declared it had successfully used its secret Shin-Etsu silicone augmentation formula in over 2,000 patients, most of whom were female, for breast enlargement.⁴⁹

US – Japan Silicone Technology Transfer: Herbert Conway and DCCAMR

The Shin-Etsu / Shirakabe narrative is recorded in correspondence between Herbert Conway MD and Takeya Shirakabe MD. Conway is an important figure in this complex story of the US/Japanese relationship to silicone (he is also prominent in the development of foam for cosmetic surgery). To my knowledge, I am the first to work with this material. Far from a narrative of stolen vats of silicone at Yokohama Harbour, Conway, an invited guest of the Japanese Society of Plastic and Reconstructive Surgery, in fact engaged in mutual, although limited, exchange of R&D. A prominent and internationally established figure in his field, in September 1960, Conway, who had an active interest in silicone, visited Shirakabe Hospital, one of many stops on his tour in Japan. Conway was particularly interested in what local cosmetic surgeons demonstrated and described as 'modified silicone'. He recalled: 'this was

⁴⁸Ibid.

⁴⁹Yakuo Fujimoto, letter to Conway, November 9 1960, HCP, Box 7: Series I. Shin-Etsu, however, were not the only company in Japan to produce their own formula of bust-enhancing injectable solution. There were a number of other branded materials available in Japan in the postwar period. They include paraffin-like materials: Organogen and Bioplex (these were mostly associated with beauty parlour services). Silicones: Elicon first produced by Koken Kogyo Co. Ltd (dimethylpolysiloxane) and Zeflon, as well as Linsacrite zelm (phonetic) (98% liquid silicone + 2% snake oil). (Listed materials taken from Tsuguo Naruke 'Breast Cancer in a Patient After Injection of Synthetic Material into the Breast for Cosmetic Purposes', *Nippon Iji Shinpo* (Japan Medical Reports) Special Edition No. 2386 (January 17 1970)), translated from the Japanese for Dow Corning. Sent out in correspondence from Braley to the Silicone Committee, June 14 1971, JMP, Box 1, Folder 33. The scope of the thesis prevents me from going into further detail here.

a thick, jelly-like, somewhat rubbery, clear plastic which was injected into subcutaneous tissues from a syringe through a needle of about 20 gauge.⁵⁰

He continued, 'I saw examples [of female breast enlargement patients] in which the material had been injected two years earlier. It had become firm and had not caused any reaction in the tissue'.⁵¹ It appeared that the body had neither rejected the material, nor had it migrated or disintegrated. At the time this would have been considered a major success and revolutionary breakthrough. Historically, materials that were problematic for the body tended to be rejected and expelled by the body after a short period of time, whereas the injected silicone Conway observed in Japan did not seem to cause any immediate adverse effects. Conway recognised the enormous commercial potential of such a seemingly inert injectable material for augmentation, and was frustrated to find that the surgeons refused to provide him with any further details of its composition. 'They would not tell me the exact name of the material or its chemical make-up, nor where it could be obtained. These cosmetic surgeons actually told me that this was "secret information."' ⁵² Conway's correspondence is peppered with annoyance at the refusal of Japanese surgeons he interacted with to readily share the formula or samples with him during his visit. Local surgeons were protective of their formula and wanted Conway to pay to access their knowledge and skills.

Conway returned to the New York Hospital intent on reproducing the silicone injections he had seen in Japan without paying Japanese surgeons for access to their research. He recalled: 'one of the surgeons in the crowd informed me later that [Dow Corning] had been consulted by the Japanese firm which supplied the material'.⁵³ Shortly afterwards, Conway contacted Dow Corning to investigate further. Many years of regular correspondence and exchange ensued between Conway and Dow Corning.⁵⁴ This was not the first time Conway had approached the company: by 1959, he had already registered his interest in silicone. McGregor and Braley, however, asked him for clarification about its intended use and sent him limited information. It was only after his visit to Japan that Conway became more specific in his queries and requests, and in return Dow Corning

⁵⁰ Conway, letter to McGregor, Dow Corning, October 24 1960. HCP, Box 7, Series I.

⁵¹ Ibid.

⁵² Ibid.

⁵³ Ibid.

⁵⁴ Ibid.

became more responsive to the details of discoveries he shared. McGregor asserted that DCCAMR was inundated with correspondence, and although Conway experienced a delayed response to his initial inquiry he was assured this was 'occasioned by pressure of correspondence rather than by lack of interest'.⁵⁵

Conway's correspondence with DCCAMR is particularly valuable as it presents a rare, and newly discovered, perspective on the complex social, medical and industrial networks and internal processes behind silicone's application as a cosmetic shaper of female flesh. It also demonstrates a culture of plastic material sampling, and documents the development of the implantation of polyurethane foam and injection of silicone in the US and internationally, from start to finish. Conway initially wrote to Rob Roy McGregor, Director of DCCAMR; however, he largely dealt with Braley, Executive Director at the time.

Braley was popular in the general press, where he was presented as a 'youthful, sophisticated and sympathetic' figure, crowned by Morini as 'silicone's guardian'.⁵⁶ In short, he was described to a female readership as elegant, charming, protective and patriarchal: white 'All-American' Braley was represented as the opposite of othered foreign 'quacks'. His role as silicone's guardian raises questions: was Braley really protecting women's bodies from the harms an insufficiently tested material could have on their bodies? Or was he simply acting to guard Dow Corning silicone's best business interests? Morini described him as 'a brilliant chemist who feels for silicone an almost anthropomorphic affection'.⁵⁷ Braley was fascinated by the possibilities of military-industrial materials R&D: 'the use of silicones in medical applications is a happy example of the medical and industrial fraternities working together to adapt an industrial synthetic material to the needs of the patient'.⁵⁸ Medicine and organic chemistry were now working together to make the body plastic. Silicones, a technology whose large-scale production accelerated in wartime by satisfying the needs of the US Armed Forces, were instrumental in the founding of a powerful materials company merger that lasted beyond its original purpose and fostered R&D into commercial civilian applications, permeating the industrial, corporate, commercial, cosmetic, domestic realms and eventually entering the medical and corporeal context.

⁵⁵ Ibid.

⁵⁶ Morini, 1971, p. 86. See also 'The Silicone Injection Story Updated' *Harper's Bazaar* 100 (May 1967), p. 148; 'Yes, You Can Have a Bigger Bosom!' *Cosmopolitan*, January 1970, p.66.

⁵⁷ Morini, 1971; 1972.

⁵⁸ Braley, 1973, p.281.

Conway's previously unexplored papers reveal that Braley and McGregor shared Conway's interest in further investigating the silicone formula rumours from Japan.⁵⁹ They informed Conway that Dow Corning's Japanese distributor shared his frustration and failure to obtain more precise information. Just over a year into Conway's correspondence, in November 1960, DCCAMR was already working with a group of doctors, led by James Barrett Brown of St. Louis, on the application of silicone rubber sponge to soft tissue reconstruction, the implication being that it had potential application for breast augmentation.⁶⁰ DCCAMR claimed they were further investigating 'the possibility of developing an injectable fluid that will set up subcutaneously': however, their labs had not fully accomplished this yet. Conway was promised samples as soon as they became available and were 'sufficiently far along to make it worth testing'.⁶¹ At this point silicone, in all its materialities, fluid, rubber or foam sponge, was not yet subject to any formal FDA jurisdiction or testing: plastic materials, an increasingly burgeoning field in medicine, were difficult for the FDA to legislate on according to established regulations, as they were neither drug nor device. The DCCAMR had only been established a year earlier, in 1959.

In addition to answering correspondence, the DCCAMR was set up to respond to, and supply, researchers' requests for small samples of 'silicone fluid, resins, tubing, block, sponge, simple, molded parts, etc'.⁶² These were sent out free of charge. If any items were asked for in larger quantities than the laboratories could meet, then Dow Corning would try to locate a manufacturer who could supply them. These additional sourcing services were also provided free to researchers internationally. I have found evidence of MDs working with silicone samples in countries including Israel, Poland, Germany and Singapore.⁶³ Those who were unable to obtain samples would resort to other means, such as experimenting with industrial grade silicone or even, in Australia in the late 1960s, cutting open silicone implants to use the gel inside for injections.⁶⁴

⁵⁹ McGregor, letter to Conway, October 29 1959; Braley, letter to Conway, November 10, 1960 HCP, Box 7, Series I.

⁶⁰ Braley, letter to Conway, November 10, 1960, HCP.

⁶¹ Ibid.

⁶² Braley, 1973, p. 283.

⁶³ See correspondence in JMP and HCP, as well as R. Badura et al., 'Investigations of Intravenous Application of Silicone Oils' *Med. Weteryn.* 3 (1968),151-4; (Wroclaw, Poland); R. Kaden, 1968: '100 patients were injected with a total of 180 ml of a rather thin silicone oil of the type DC 200, viscosity 100 centistokes (Dow Corning, Midland)', p. 217. N. Ben-Hur MD, Department of Plastic and Maxillofacial Surgery, Hadassa University Hospital, Jerusalem, 'Local and Systemic Reactions to the Injection of Liquid Silicone (dimethylpolysiloxane) in the Experimental Animal and their Correlations to Man', *Harafua* 74, (1968) 417. This used dimethylpolysiloxane silicone 350 centistoke viscosity, Dow Corning (JMP).

⁶⁴ M. Spira and S.B. Hardy, 'Preliminary Report. Soft Tissue Augmentation with Silicone Gel'. In: *Transactions of the Fifth International Congress of Plastic and Reconstructive Surgery*. (Melbourne: Butterworth,1971), cited in Marcus Castro

It should be noted, however, that Dow Corning not only posted samples to those who requested them, but also sent samples and booklets out in large-scale mailouts, hoping to attract doctors' interest – and their research funds. Since silicones had been developed 'under a veil of secrecy' during the war, when the war ended people in the US and internationally did not know much about the material.⁶⁵ Silicone research also attracted the funding and support of federal grants: see for example, 'the Present Status of Silicone Fluid in Soft Tissue Augmentation' (1967), which was supported in part by a US Public Health Services Grant, thereby legitimising the research.⁶⁶ As has been noted by STS scholars of the Cold War US, securing federal and defence funding for R&D projects was immensely lucrative for labs, and was certainly factored into decisions on what was being researched.⁶⁷ It is worth noting that Braley is listed as second co-author, although he has no medical qualifications. Furthermore, the article's introduction, which was vetted by Braley, states that 'silicone fluids have been used as medical prosthesis for at least a dozen years, particularly in Europe and the Orient', thereby effectively distancing Dow Corning and the US from the practice of silicone breast injections.⁶⁸ Dow Corning later funded research into its materials, much as it did for the Silicone Committee, paying for members' associated expenses and providing them with materials. Dow Corning worked hard to ensure it was expanding its markets, both nationally and internationally.

Their free distribution of silicone samples and booklets was designed to encourage engineers, including those working with surgeons, to experiment with new prototypes and come up with new ways to use silicone, effectively outsourcing their R&D. This was common practice in the ever-expanding plastics industry and had been since at least the late 1930s: in *Tupperware: the Promise of Plastic in 1950s America* (1999), Alison Clarke writes: 'it was in the interests of manufacturers and plastic chemical companies alike to pursue product development and expand the use of plastic in the consumer market'.⁶⁹ Clarke describes the role of sample makers working for chemical companies such as DuPont, who were hired to

Ferreira MD, Victor Spina MD and Kyoshi Iriya MD Department of Plastic Surgery and Department of Pathology of the University of São Paulo Medical School, Sao Paulo, Brazil 'Changes in the Lung Following Injections of Silicone Gel' *British Journal of Plastic Surgery* 28 (1975) 173 – 176.

⁶⁵ Warrick, 1990, p. 103.

⁶⁶ See Ashley, Franklin, et al., 1967, (USPHS Grant GN-11426).

⁶⁷ See Stuart W. Leslie, *The Cold War and American Science* (New York: Columbia University Press, 1997); Matthew Wisnioski, *Engineers for Change: Competing Visions of Technology in 1960s America* (Cambridge, MA: MIT Press, 2012).

⁶⁸ Ashley, Franklin, et al., 1967, p. 411.

⁶⁹ Alison Clarke, *Tupperware: the Promise of Plastic in 1950s America* (Washington, DC: Smithsonian Press, 1999), p. 27.

research and prototype potential products and relay their findings directly back to the company. Indeed, correspondence reveals that Dow Corning, like other plastics and chemical companies of the pre-WWII and postwar period, also employed salesmen who travelled the country with medical samples, literature and demonstrations in order to encourage further product development. At times demand for orders outstripped production capacity, and Wayne Koning, Supervisor of the Hospital/Surgical Products Division at Dow Corning, assured Murray, 'we will not be supplying our salesmen with demonstration samples until we can fill all of your orders.'⁷⁰ Salesmen with demonstration samples were put on hold, as demand for Dow Corning medical products was already higher than Braley and his department had expected. In postwar America, plastics were increasingly entering all aspects of everyday life, no longer requisitioned by the US Armed Forces, and chemical companies were keen to exploit and explore the potential of their material production facilities for commercial everyday use. Plastics samples were sent out by petrochemical companies such as DuPont, Dow Corning and Dow Chemical to engineers, universities, hospitals and even to artists.⁷¹

Conway's correspondence with DCCAMR reveals that Dow Corning was actively investigating the chemical composition of subcutaneous bust augmentation shots, known as 'liquid flesh' or 'fleshy injection' in Japan and popularly referred to in the US press as the 'Sakurai' formula.⁷² As Miller has noted, US actors, including chemical company directors, doctors and journalists, insinuated that Japanese research into silicone for medical and cosmetic use did not meet the superior standards of Western medical practice, a racist perspective that is perpetuated in contemporary Western-centric, Anglophone histories of cosmetic surgery. Conway's private correspondence, however, offers a previously unconsidered alternative narrative that challenges this view. It reveals US surgeons' and

⁷⁰ See, for example Wayne Koning Supervisor, Hospital/surgical Products Division at Dow Corning letter to Joseph Murray, January 13 1969, JMP, Box 1, Folder 33.

⁷¹ A broad culture of sending out plastic samples played an important part in the rapid distribution and use of applications in postwar America. For further evidence see Spohn Papers at NMAH for medical plastic samples, NMAH Trade Literature collection for trade catalogues, many of which include actual plastic samples. In a conversation with me and the curator Abraham Thomas in March 2018, Californian sculptor David Best who was exhibiting at the Smithsonian's Renwick Gallery, informed us that he and fellow artist friends were regularly sent plastic pellets to experiment with by DuPont in the 1960s. Samples were also known to go 'missing' and Conway and Goulian repeatedly wrote in to request additional samples after some had gone 'missing' or been 'undelivered'. Samples and silicone deliveries were often unaccounted for: in 1967 Dow Corning and three members of staff were indicted for illegally sending silicone across state lines to Harvey Kagan in 1964.

⁷² 'Sakurai' formula, attributed to Japanese medical doctor Rin Sakurai, is rumoured to have originated in 1946 in Japan. See Harry D. Kagan, 'Sakurai Injectable Formula: Preliminary Report', *Archives of Otolaryngology*, 78 (November 1963), 53 – 58, (p. 53); Jacobson, 2000, p. 80; Organogen, largely made of petroleum, was advertised as a 'fleshy injection' in 1950s Japan.

silicone manufacturers' frustration with Japanese manufacturers and their users, such as Shirakabe Hospital, and Shin-Etsu's unwillingness to provide them with the formula.

Shirakabe and Fujimoto were only prepared to share their research with Conway in exchange for a fee. In the correspondence, Conway, McGregor and Braley express outrage that Shirakabe and Fujimoto want to be paid for sharing their research. Shirakabe and Fujimoto are 'othered' for their lack of cooperation and there is a sense of disbelief that they are refusing to hand over the formula at the insistent request of US doctors and chemical companies. Conway, McGregor and Braley appear to see themselves as superior to Shirakabe and Fujimoto and are intent on transferring the Japanese research to US markets without paying for it. Refusing to pay for access to Japanese medical research, they engaged in correspondence, pooling their limited knowledge of Japanese advancements, in addition to exchanging lay and medical articles (privately translated from languages that included Japanese, German, Polish and Czech), communication and leads, attempting to map and chart silicone's development as a soft tissue augments. Ultimately, Conway, McGregor and Braley sought to replicate Shirakabe and Fujimoto's discovery. Dow Corning had an active interest in pursuing this research; breast augmentation injections would certainly promise a financial reward.⁷³

In early January 1961, Conway received another letter from Braley. This letter differed from previous ones: a small plastic pocket was stapled onto it (see Figure 2). It held a sample sliver of a new type of silicone developed at DCCAMR's lab in Midland, Michigan. Braley wrote:

'we have never been able to track down any firm information concerning the rumours we've had of a Japanese injectable silicone for facial and mammary augmentation. Your letters have told us much more than we have been able to discover ourselves.'⁷⁴

Braley rewarded Conway's effort to share this information with DCCAMR by including a sample that attempted to simulate the material Conway had described seeing in Japan just a

⁷³ Pooling resources and circulating translated articles is a practice that continued into the Silicone Committee – see HCP, JMP.

⁷⁴ Braley, letter to Conway, January 4, 1961, HCP, Box 7: Series I, Correspondence.

few months earlier. Conway's overseas observations were becoming manifest in materials R&D.

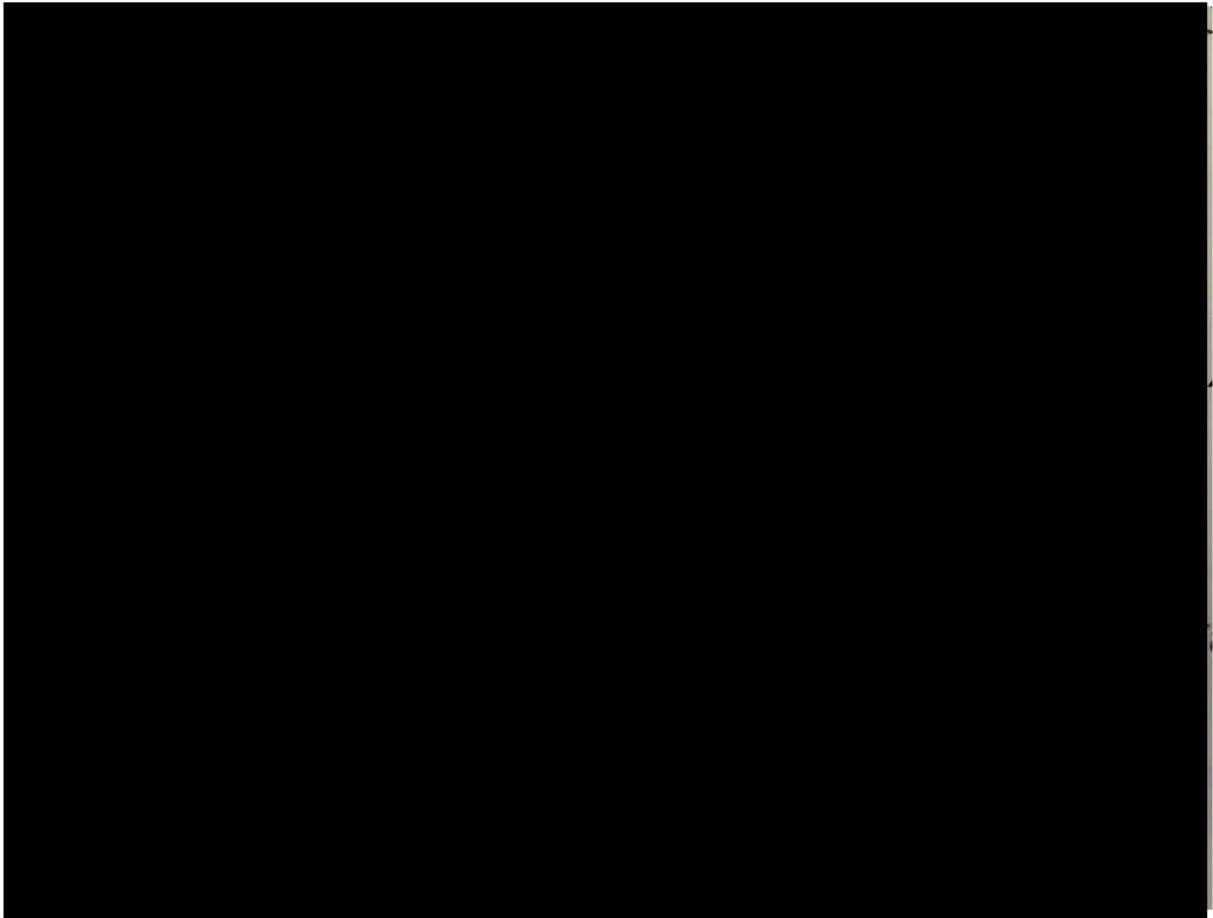


Figure 2: Silicone Sample sent by Braley to Conway, 1961

Braley sought out Conway's feedback to help further shape the sample's future materiality. 'I am enclosing one of our early tries for you to examine. Our feeling is that this is too firm, and we are attempting to make it less so.'⁷⁵ He continues, 'from the chemical nature of this material, we'd expect it to be as implantable as our other medical grade silicones. It is fluid when injected and sets up to a non-fluid after implanting.' This new type of silicone had the potential to be a Dow Corning game-changer. Inserted via injection rather than invasive surgery, once inside the body it transformed from viscous material to device: an agentic liquid that could set rapidly to become semi-solid prosthetic object. This slippery visceral material, both fluid and object, was opening up novel approaches to

⁷⁵ Ibid.

shaping the ideal gendered body. Celebrated as a ‘miracle material’ that could pad out the body as desired, inevitable legislative quandaries lay ahead. I felt the forgotten sample at the archive. Today the material encased in the see-through plastic pocket feels like a forgotten gummi bear; soft but tough, slightly tacky and speckled with tiny black flecks. It sticks in a sweaty embrace to the plastic skin that protects it. So carefully preserved – I wonder what Conway did with this small initial sample that still appears intact? Did he also engage with its materiality by kneading it between his fingers before returning it to its original casing? Or is this all that remains from a larger sample?

Conway was ‘thrilled’ with the material. He enthused: ‘it looks to me as though it is just about the same as the material which I saw in Japan.’⁷⁶ Wanting to know more, he wrote:

‘[W]ill you be good enough to give us data regarding its chemical content, name, technique, etc. We should have a fairly large amount, as I would plan to insert about one thousand grams in each two breasts, provided that I can find a suitable patient who will give written permission in advance for experimental use of this material for breast augmentation.’⁷⁷

Conway makes clear that his immediate interest in this material is for breast augmentation. There is no mention of other medical uses, such as hemifacial atrophy. This is significant, because the latter was often listed as a smokescreen, as if to validate and distract from the less savoury field of cosmetic breast enhancement.⁷⁸ I noticed that in his early correspondence with Dow Corning before he went to Japan, Conway lists non-mammary uses first, and breast augmentation is briefly mentioned at the end, as if it were an afterthought. Conway lists ‘facial cavitis’ (as McGregor rightly points out – not a medical term!) as if attempting to veil his real primary agenda. At a loss for the correct medical term, he then later attempts to describe what he means: ‘my term “facial cavitis” was not correct. What I meant to refer to is a variation in the surface contour of the face so that a surface

⁷⁶ Conway, letter to Braley, January 13, 1961, HCP, Box 7: Series I, Correspondence.

⁷⁷ Ibid.

⁷⁸ Charles Vinnik, a vocal opposer to silicone shots, also noted that Dow Corning distanced themselves from breast augmentation shots by stressing its other applications. See Vinnik, ‘The Hazards of Silicone Injections’ *JAMA*, 236.8 (Aug 23 1976), 959, and Vinnik, cited April 21 1975 Public health service, FDA, Agenda, Special Drugs Advisory Committee Minutes, p. 2, JMP, Box 1, Folder 33.

concavity is present on one side and convexity [...] on the other.’⁷⁹ Again, Conway is still unable to articulate the correct medical term – hemifacial atrophy and / or hemifacial convexity – and is ironically corrected by McGregor, who had no medical qualifications but had been running the DCCAMR, giving him access to many letters with medical terms. Far from an afterthought, most papers in Conway’s files on silicone hold information on breast augmentation rather than research for other uses, such as congenital physical disorders including facial dystrophy, exposing a second layer to the story that has been largely omitted from Dow Corning’s public-facing history, and therefore histories that do not employ extensive archival methods.

As soon as the material became available, Conway indicated his keenness to test it and implant it within the female body to augment the bust artificially. Braley’s cautionary comments that the silicone material was still too firm, and they would like to produce something softer, were ignored. There was a sense of excitement and urgency: Conway and Goulian wanted to start using this material immediately. As with all the other materials that preceded it (paraffin, plastic foams, silk, etc.), as soon as silicone became available there was a desire to experiment with it as a bust-enhancing, implantable material. This is particularly noteworthy as my research into Dow Corning’s public-facing statements indicates that between 1959 and 1976 they repeatedly distanced themselves from silicone injections into the breast.⁸⁰ For example, Braley accused Symmers, Chair of Pathology at Charing Cross Hospital, of bias for naming Dow Corning as the silicone supplier in his 1968 *BMJ* article ‘Silicone Mastitis in “Topless” Waitresses and Some Other Varieties of Foreign-body Mastitis’.⁸¹ Braley wrote to Symmers on 1 August 1968 that ‘we at Dow Corning have never felt that [silicone injections for breast augmentation] was a proper use of the material and have consistently done all that we can to prevent it.’⁸² He continued, ‘although we have

⁷⁹ Conway, letter to McGregor, November 6 1959, HCP, Box 7: Series I, Correspondence.

⁸⁰ My assertion here is not original; however, the provision of evidence is. In *Informed Consent*, 1996, John Byrne claims Dow Corning would later publicly deny having any knowledge of breast injections prior to 1963, when Harvey D. Kagan, an osteopath by training, shared his research findings at the week-long meeting of the American Otorhinological Society for Plastic Surgery Inc. (p.43). Byrne does not provide a specific reference for his claim, but it does correlate with my findings. It should also be noted Byrne is frequently cited in the established scholarship on breast augmentation; see, for example Zimmermann, 1996; Webb, 1997; Jacobson, 2000; Miller, 2006. The US popular press heralded Kagan as ‘the first real American apostle of breast enlargement through injection’ (Byrne, *Informed Consent*, 1996, p. 43). I have noticed osteopath Kagan was later known as an MD. Based in Beverly Hills, California, it is likely he converted his DO into an MD in 1962 under Proposition 22, a state-wide ballot initiative in California that eliminated the practice of osteopathic medicine in the state. All doctors of osteopathy (DO) were offered to convert their degrees into MDs for a minimal fee and attending a short seminar.

⁸¹ Symmers, 1968, p. 21.

⁸² Braley, Letter to Symmers, August 1 1968, JMP, Box 1, Folder 33.

done nothing in the area of mammary augmentation, we have done considerable work, under FDA protocol, in studying soft tissue augmentation other than in the breast'. This contrasts starkly with what is revealed in Conway's correspondence and in publications such as Conway and Goulian's 1963 article which clearly states that 'The material under investigation is Silastic RTV S5392 which is manufactured by the Dow Corning Corporation', thus naming Dow Corning's support for his research in this area.⁸³ Braley also wrote to Symmers that 'clandestine injectors' used silicone fluid adulterated with additives, and it was this that could cause reactions – not the [Dow Corning] silicone itself – 'we have come to the almost inescapable conclusion that the reactions reported in patients are due to the unspecified additives and not to the silicone itself'.⁸⁴ Braley continued, 'we have never condoned [the use of Dow Corning 360 Medical fluid for breast injections] and have endeavoured in every way possible to keep our material out of the hands of those doing breast injections'.⁸⁵ Dow Corning may not have publicly condoned Dow Corning 360 Medical fluid for breast injections, but as this chapter shows, there was a culture of silicone samples in various viscosities (for example Silastic RTV) and other material states readily being sent out.⁸⁶ Braley enclosed a bibliography of silicone fluids in soft tissues for Symmers – research on breast augmentation injections is not mentioned or included in this.⁸⁷ Indeed, Dow Corning's public-facing research, newsletters and annual reports at the time largely omit research conducted on breast enlargement.⁸⁸

Contrary to Byrne's (1996) much-cited claim that Dow Corning had no knowledge of breast injections before 1963, Conway's papers reveal that Dow Corning was corresponding with him on silicone injections for bust augmentation as early as 1959.⁸⁹ Conway's letters show that DCCAMR's McGregor and Braley were already aware of silicone injections for bust augmentation, and interested in them even before he wrote to them. McGregor, then

⁸³ Herbert Conway and Dicran Goulian, 'Experience with an Injectable Silastic RTV as a Subcutaneous Prosthetic Material' *Plastic & Reconstructive Surgery* (September 1963), 295 – 304; p. 294.

⁸⁴ Braley, letter to Symmers, August 1 1968, JMP, Box 1, Folder 33.

⁸⁵ Ibid.

⁸⁶ As openly documented in Conway and Goulian, 1963.

⁸⁷ Braley, letter to Symmers, August 1 1968, JMP, Box 1, Folder 33.

⁸⁸ See, for example, First annual report 'Dow Corning Center for the Aid to Medical Research', August 15 1960, HCP, and Dow Corning reports held in Edgerton, Murray and Spohn papers. Of the bulletins I have accessed there is one exception to this – Fourth Annual Report of the DCCAMR August 15 1963, which lists developments in 'prostheses and materials for mammary augmentation' (HCP) but does not explicitly mention silicone injections into the breasts for augmentation.

⁸⁹ See Conway Dow Corning Correspondence, cited throughout. Particularly; letter from RR McGregor to Conway, October 29 1959, Braley, letter to Conway, November 10, 1960, Braley, letter to Conway, January 4 1961, HCP, Box 7: Series I, Correspondence. See also footnote 10.

director of DCCAMR, responded on 29 October 1959 to Conway's request for injectable silicone materials for breast augmentation, received by him on 18 September 1959: 'we would be very glad to supply you with experimental samples of such silicones [fluid when injected, solid after injection] as you might consider to be helpful', demonstrating Dow Corning's readiness to supply injectable silastic silicones for breast augmentation R&D.⁹⁰ McGregor advised Conway that DCCAMR had also supplied silicone materials for experimentation in soft tissue augmentation to a Dr. Marzoni of Alabama and a Dr. Ohlwiler, working with Dr. Brown in St. Louis (he does not specifically mention what parts of the body they are working on).⁹¹ This again complicates Dow Corning's claims of not being involved in/having no knowledge of silicone breast injections prior to 1963 and the scholarship that uncritically repeats this. Unfortunately, Dow Corning has no public archive or records of DCCAMR correspondence, so it is not possible to fully trace and map out the international medical actors with whom they were corresponding and supplying samples to.⁹²

In October 1962, Conway and Goulian presented a report on their 'Experience with an Injectable Silastic RTV as a Subcutaneous Prosthetic Material' at the Annual Meeting of the American Society of Plastic and Reconstructive Surgery, published in *PRS*, 1963.⁹³ In this article, Conway and Goulian make some of their research public. They outline the purpose of the research as sharing their findings on Dow Corning's Silastic RTV, an inert liquid silicone which can be transformed using a catalyst into a 'jellylike solid with properties which offer distinct advantages over the implants of synthetic sponge.'⁹⁴ As with previous materials, Silastic RTV is presented as a novel material improvement to its predecessor, plastic foams. As Symmers notes, silicones were the latest in a series of materials to be promoted as a safe option for artificially augmenting the body. Its materiality differed greatly from that of plastic foams, adding to its 'novel' appeal.⁹⁵ Conway and Goulian's research timeline complicates Dow Corning's claim they had no knowledge of silicone being used to augment the bust

⁹⁰ RR McGregor, letter to Conway, October 29 1959, HCP, Box 7: Series I, Correspondence.

⁹¹ Ibid.

⁹² Dow Corning has previously been accused of altering records and paperwork: see, for example, 'a review of the Dow Corning Corporation's silicone gel breast implant business found that some documents about the manufacturing of the implants in the 1980s were altered, the company said today' in 'Dow Corning Says Records on Implants Were Altered' *New York Times*, November 3 1992, p. 3. Haiken, 1997, further notes 'Dow Corning has conceded that it should have made more of an effort to ensure that its product was not being used in humans'; see *San Francisco Chronicle*, January 20, 1971, 4, (p. 343).

⁹³ Conway and Goulian, 1963. It is worth noting this article is not referenced by cosmetic surgery scholars including Haiken. It does, however, get a brief mention in Zimmermann, 1996, pp 24-25.

⁹⁴ Conway and Goulian, 1963.

⁹⁵ Symmers, 1968, pp. 19 -22.

before Kagan's paper was published in 1963, a challenge that has not been pointed out by established scholars on cosmetic surgery, further highlighting the criticism of unexplained gaps in US-centric cosmetic surgery history of this period, about which Laura Miller and I agree.

This 1963 article stands out in that it cites and acknowledges the medical research being carried out in Japan, and draws comparisons with it.⁹⁶ Conway and Goulian note that at an early stage of their investigation they realised that a syringe of far greater mechanical advantage than those conventionally available on the US market was needed. They sought the aid of medical technology company Becton Dickinson (a Dow Corning business partner that DCCAMR recommended for creating prototypes) to develop an instrument 'not unlike the devices which have been described by the Japanese for use with similar silicone derivatives'.⁹⁷ US surgeons thus openly looked to Japanese medical research to design a new surgical instrument. Figure 3.1 shows the original image of the syringe in the article. Specially designed to administer large volumes of Silastic RTV S5392 of up to 600ml, the stainless-steel syringe, of enormous, seemingly industrial proportions, penetrates the page diagonally at an acute angle, held by what appear to be male rubber-gloved hands. One hand holds the syringe's barrel up at a slant, the other grips the plunger. The design looks like a weapon – more specifically, like a rocket launcher. However, the 600ml capacity cannula is likely to have been designed in this way so that it would only need to be filled once, thereby reducing risk of infection.

⁹⁶ Citing Junichi Uchida, Director Marubiru Plastic Surgery Clinic, 'Clinical applications of cross-linked dimethylpolysiloxane; restoration of breast, cheeks, atrophy of infantile paralysis, funnel shaped chest etc.' *Japanese Journal of Plastic and Reconstructive Surgery* 4, (1961), 303

⁹⁷ Conway and Goulian, 1963, p. 295.



FIG. 1. *Bottom.* Assembled view of the high pressure, 600 ml., stainless steel syringe designed with Cardiovascular and Special Instrument Division of Becton, Dickinson and Company, and built by them for injecting large volumes of Silastic RTV S5392. *Top.* Break-down view of this instrument showing individual parts.

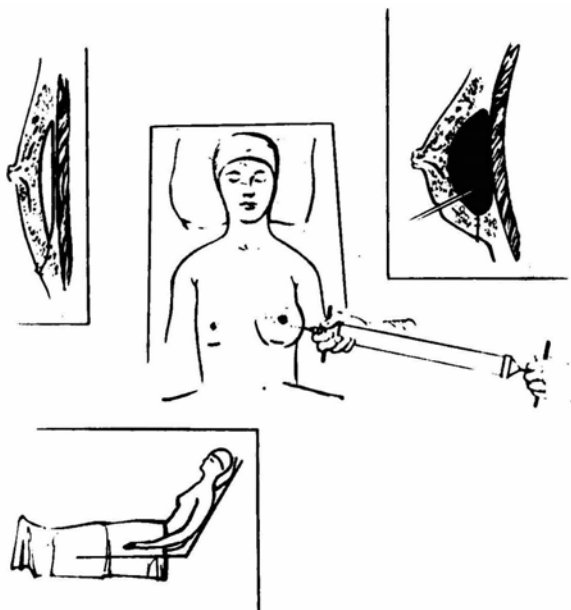


FIG. 5. Sketches depicting the method found most satisfactory for mammary augmentation using Silastic RTV S5392. After dissection of the retromammary cavity, the needle (stylette in place) is inserted through the breast into the cavity. The wound is then closed in three layers and the injection accomplished. Care should be taken to prevent the deposit of Silastic in the tract of the needle. Extrusion of the material to the outside is prevented by use of a suture to close the cutaneous perforation of the needle.

Figure 3.1: Conway and Goulian, 'Experience with an Injectable Silastic RTV as a Subcutaneous Prosthetic Material' syringe designed with Becton Dickinson 1963

Figure 3.2: Conway and Goulian, 'Experience with an Injectable Silastic RTV as a Subcutaneous Prosthetic Material', 1963 method sketches

It is worth noting that the article omits Conway's visit to Japan, where he was most likely to have seen such an instrument in the procedures he observed. Instead of mentioning Conway's first-hand witnessing of procedures, it instead refers to 'devices which have been described by the Japanese'.⁹⁸ On the other hand, the article mentions that 'Dr. Takeya Shirakabe of Kyoto, Japan [...] kindly supplied a sample of the silicones which he has injected for augmentation of soft tissues'.⁹⁹ This sample, and the accompanying correspondence, appear to be missing from Conway's papers. Perhaps Dow Corning and Conway finally paid the fee for the sample, as requested by Shirakabe. The investigators were, however, keen to assert Silastic RTV's superiority over the Japanese product:

'The Dow Corning Research laboratories have found [Shirakabe's] samples to be substantially different from Silastic RTV. Whereas Silastic RTV sets into a semisolid mass upon mixing with the catalyst, the silicones injected by the Japanese (available in variable forms ranging from a thick fluid to a puttylike mass) retain their original physical nature in situ. That material has been injected directly into the tissues, frequently in multiple stages, to accomplish the desired volumetric increment and surface contour.'¹⁰⁰

The Silastic of Conway and Goulian's investigation was unique in that it was liquid when injected and would soon afterwards form into a semi-solid shape: an injectable prosthetic of sorts. Once delivered via the high-gauge needle, Silastic would set in the body and it was hoped that its semi-solid consistency would prevent migration and the physical complications this could cause. Here silicone's materiality shifted in the process of its application to the body: material became object, entering the body as a liquid and setting within it. Endowed with agentic properties by surgeons and DCCAMR executives, silicone's synthetic materiality ruled over flesh, auto-designing and pushing the body's contours outwards to become a self-contained object within it.

Figure 3.2 shows the original sketches from the article. Four rectangular frames detail the procedure. The upper left-hand corner shows a diagram of the silhouette of a small breast, with an unshaded or 'blank' cavity between the nipple, the breast's surface tissue

⁹⁸ Ibid.

⁹⁹ Ibid.

¹⁰⁰ Ibid.

and the chest wall. This, we can assume, is the 'before' image. The upper right-hand corner shows the silhouette diagram of a larger breast, where the cavity is shaded in black and is comparatively larger, pushing the nipple and breast tissue out further. What appears to be a needle pierces through the skin's surface and into the dark rounded space, transferring silicone and representing the 'after' image. These two diagrams flank the central image: a female figure in a surgical cap, resting on a pillow, eyes closed; with the top half of her body exposed and arms partially missing she somewhat looks like the Venus de Milo, whose beauty is appreciated, as disability studies scholar Matt Frank notes, 'not despite, but in part because of her missing arms'.¹⁰¹ Here again we see a reference to classical sculpture: the white female patient's body, laid out on the operating table, has become material to be designed and sculpted by the male surgeon. Her right breast looks relatively flat; the special syringe, operated by a pair of phantom hands from a 'safe' distance, is injecting her left breast, which appears larger. A detail below shows the patient arranged in an upright position, as recommended in the article. Conway and Goulian noted:

'when augmenting the breasts, we have found it unnecessary to use molds if injection into the pocket is carried out in the sitting position. The soft tissues of the breast will contour the deposited material in the form of the normal breast.'¹⁰²

In this diagram, the dissected retromammary cavity serves as corporeal fleshy void to be filled by Silicone RTV. Injected into what is essentially a hollowed-out pocket behind the breast, via a specially engineered syringe, the material turns from liquid to prosthetic. The body's organic matter is shown as shaping the plastic by providing an empty void and restricting the flow of the viscous oozing material as it spreads. The plastic in turn shapes the body by pushing the breast further out from the chest wall into the fuller shape desired. Reciprocally the female body serves as a mould for plastic, a biological shell to be filled with a new man-made plastic material. Medical actors such as Conway elevated plastic as

¹⁰¹ Matt Franks, 'Mental Inversion, Modernist Aesthetics, and Disability Exceptionalism in Olive Moore's Spleen', *Journal of Modern Literature*, 38.1 (January 2015), 106 – 127 (p.107). The armless Venus de Milo, a cultural icon representing a feminine beauty ideal, is the subject of a range of disability studies scholarship. See for example Ann Millett-Gallant, 'Sculpting Body Ideals: Alison Lapper Pregnant and the Public Display of Disability', in Lennard Davis, *The Disability Studies Reader* (New York: Routledge, 2013) (fourth edition), pp. 398 – 410; Lennard Davis, *Enforcing Normalcy: Disability, Deafness, and the Body* (New York: Verso Books, 1995).

¹⁰² Conway and Goulian, 1963, p. 295.

superior to women's flesh, and invested it with the power to shape the female body; however, as this chapter will later discuss, the body also had agency, and reacted to injected silicones.

Dow Corning Medical Products Division

From its establishment in 1959, DCCAMR was inundated with requests for silicone. By 1962 Dow Corning claimed it was proving increasingly challenging to locate manufacturers equipped to efficiently supply medical-grade silicone items 'properly', so they set up the Medical Products Division to meet the demand. In 1963, they expanded production and opened a Medical Products Plant.¹⁰³ Braley claimed that between 1959 and 1973 Dow Corning corresponded with around 35,000 physicians and medical researchers in the US and internationally, each of whom was hoping that silicones could provide the solution to a medical problem.¹⁰⁴

'If the solution was satisfactory and if the device seemed to satisfy a need, it was turned over to the marketing people for evaluation. If the economics of the device permitted, it was produced for the physician to use.'¹⁰⁵

It is unclear here what need Braley thinks might be satisfied with a device. Does he mean patients, prospective patients, doctors themselves and their research interests, or Dow Corning and their commercial interests? Here it also becomes clear that there were few formal testing rules in place before the Medical Device Regulation Act of 1976, and that the FDA had limited jurisdiction. Viscous liquid silicone could be regulated by the FDA, as it was classified as a drug, not a prosthetic. Since the inception of the Dow Corning Medical Products Division in 1962, the company claimed that they had grown to become 'the world's largest manufacturer of implantable soft tissue substitutes'.¹⁰⁶

The official story of access to silicone is that after 1964 the eight members of the Silicone Committee were the only physicians to have had access; this was strictly monitored, and every pint of fluid needed to be traceable and accounted for. This is the victor narrative

¹⁰³ Warrick, 1990, p. 232.

¹⁰⁴ Braley, 1973, p. 284.

¹⁰⁵ Ibid.

¹⁰⁶ Ibid.

that Dow Corning wants people to remember,¹⁰⁷ and it is a story that is perpetuated and largely unchallenged in histories of cosmetic surgery.¹⁰⁸

Doctors who requested the fluid were required to sign an affidavit, legally agreeing that silicone would not be injected into humans and detailing their proposed application of the fluid. In reality, however, there were many loopholes that were exploited; medical-grade silicone was slippery and challenging to keep track of, for multiple reasons. Samples often went 'missing'; Conway and Goulian, for instance, repeatedly requested additional samples after some had gone missing or been 'undelivered'.¹⁰⁹

Dow Corning appears to have had difficulty collating data and monitoring and recording samples. This also applies to their record-keeping for experiments with silicone injections, which the FDA ruled was shoddy, as well as their documenting of who was given access to silicone in the first place.¹¹⁰ Non-Silicone Committee doctors circumnavigated access restrictions by claiming to carry out research on non-human subjects, such as race horses, to ensure their continued access to silicones for illegal human use.¹¹¹ In 1964, after silicone had been classified as a new drug, supplies of the product were seized en route to osteopath Harry Kagan and other doctors.¹¹² This resulted in a federal grand jury indictment in 1967 against Dow Corning for shipping an unapproved drug via interstate commerce. The indictment named Shailer Bass, Dow Corning President, 'Dusty' Rhodes, former manager of the company's medical products division and Gordon McIntyre, sales manager of the medical products division. The company claimed it was unaware that doctors planned to use

¹⁰⁷ Eight members on a Committee is certainly in great contrast to the 35,000 surgeons DCCAMR claim to have corresponded with.

¹⁰⁸ Haiken, 1997; Byrne *Informed Consent*, 1996; Jacobson, 2000; see also footnote 16.

¹⁰⁹ See HCP, for example Braley, letter to Goulian, April 24 1963, where ten pounds had 'unexplainably' gone missing and needed to be resent.

¹¹⁰ Murray's papers, for example, reveal incomplete sets of records on experiments with silicone injections for facial atrophy.

¹¹¹ Las Vegas-based MD and silicone injection critic Charles Vinnik, cited April 21 1975 Public health service, FDA, Agenda, Special Drugs Advisory Committee Minutes p. 14, JMP, Box 1, Folder 33. 'I must tell you that there were two physicians that injected virtually everybody in our community. One was an osteopath [Kagan?], and one was an MD [Franklyn?], both of whom had access, that we know of, to Medical Grade Silicone. In the case of the osteopath, he had protocol for the evaluation of the injection of liquid silicone into the long tendons of race horses. In the case of the physician, there was a large burn unit which was using large quantities of liquid silicone at Southern Nevada Memorial Hospital. The man was a member of staff and the material was being used by the gallon.'

¹¹² 'Dow Corning 3 Officers indicted on silicone fluid', *Wall Street Journal*, August 17 1967, Conway papers. Regulating interstate commerce was one of the forms of jurisdiction the FDA held prior to the 1976 Medical Device Regulation Act.

the fluid for breast injections.¹¹³ Finally, in 1971, Dow Corning pleaded no contest to the charges and paid a \$5,000 fine.¹¹⁴

Beauty Salon Culture and Class

Silicone injection advertisements in classified sections of newspapers and Yellow Pages listings, as well as long features in publications such as *Vogue*, *Harper's Bazaar* and *Esquire*, show how silicone shots were offered as a quick beauty salon service.¹¹⁵ Such treatments were not only reserved for 'quacks' serving sex workers on the West Coast.

Norman Orentreich MD, who ran a cosmetic clinic in an affluent area of New York City, had a very different clientele: a Clinical Associate Professor of Dermatology at New York University Medical Center, a member of the Silicone Committee and famed for his pioneering work in hair transplants, he claimed to have first encountered silicone in 1954.¹¹⁶ A vocal supporter of silicone, Orentreich considered that it was 'immediately needed' for cosmetic applications.¹¹⁷ Orentreich claimed that prior to his work with Dow Corning, he had ordered industrial-grade silicone from General Electric, transforming it into purified, sterilised medical-grade fluid in his own laboratory.¹¹⁸ Having experimented with its variety of viscosity and vulcanisation, Orentreich's relationship with silicone was referred to by Morini as that of 'an old friend'.¹¹⁹ Once again, silicone was anthropomorphised – here as an 'old friend' whom one could visit in Orentreich's chic clinic on the Upper East Side, and who could help one achieve the great skin with which his practice and consultancy work for Clinique were associated. On the surface, this presents the opposite of an underground illegal silicone ring: its clientele allegedly consisted of white celebrities and socialites, including Nancy Reagan.¹²⁰ Orentreich, who used silicone for over 35 years and claimed to have treated over 100,000 patients, maintained his belief that silicone was harmless if

¹¹³ As we have already seen, it is questionable whether Dow Corning were unaware as they had already engaged in research into silicone breast injections.

¹¹⁴ The equivalent of roughly \$31,848 in 2020 (www.in2013dollars.com)

¹¹⁵ See also Al Reinert, 'Dr Jack Makes His Rounds', *Esquire*, May 1975 pp. 114 – 116.

¹¹⁶ Morini, 1971, p. 115.

¹¹⁷ *Ibid.*

¹¹⁸ *Ibid.*

¹¹⁹ *Ibid.*

¹²⁰ It has been suggested Dr. Orentreich's prosecution may have been affected by an FDA memo in 1984 noting that Nancy Reagan was one of his silicone injection patients. See FDA memorandum from George Gerstenberg to Marvin Shumate, quoted in Hearings before the Human Resources and Intergovernmental Relations Subcommittee of the Committee on Government Operations, June 11, 1991 p. 192. This history is detailed in H.R. Rep. 102-1064, p. 5. cited in Webb, 1997. See also 'Report flays FDA on vanity product hazard' *Washington Post*, Monday 23 November 1992.

injected correctly in his recommended micro-doses of less than 1/50mg using his own specially designed syringes.¹²¹

He believed that any issues with silicone related to the use of ‘impure silicone’ – an attack on Japanese silicone formulas such as Sakurai, that apparently contained additional substances believed to prevent silicone migration in the body.¹²² Orentreich also felt that silicone, if injected in micro-doses and in sterile conditions by skilled medical practitioners, posed no danger. Internal Silicone Committee communications reveal there was a concern around Orentreich’s outspoken enthusiasm for silicone shots and his lack of transparency about the number of clients he was treating.¹²³ The only dermatologist on the committee, his work was more directly linked to the commercial and cosmetic realm. He came under FDA investigation in the late 1970s when he refused to limit his use of injectable silicone to the congenital facial deformities the amended protocol specified.¹²⁴

In 1976, the Dow Corning New Drug Application (NDA) review stated that he had treated several hundred patients with liquid silicone for cosmetic purposes, but had omitted these from the research records submitted to the FDA.¹²⁵ Orentreich was eventually dropped from the investigation in 1978, but his clinic continued to be successful, catering to a largely white American upper-middle-class and celebrity clientele. Silicone administered in a dermatological exclusive setting such as that of Orentreich’s clinic bestowed the material with luxurious cosmetic properties, similar to those seen in Re-Nutriv.

In Japan and Hollywood, Rin Sakurai offered silicone shots to counteract signs of ageing and as a bust enhancer. He launched his own range of ‘Dr. Sakurai’-branded skin products in 1970; these are still sold in Japan today.¹²⁶ Contrary to scholarship that perpetuates the tale of stolen vats of silicone being pumped into Japanese sex workers’ breasts, Sakurai offered an exclusive and expensive service in a beauty salon-like setting. Likewise, Robert Alan Franklyn, self-professed ‘Beauty Surgeon’, enthused:

¹²¹ Morini, 1971, p. 115.

¹²² Morini 1971; Anne Louise Bardach, ‘The Dark Side of Plastics’, *New York Times*, 17 April 1988.

¹²³ See, for example, Edgerton, letter to to Kelman Cohen, dated June 24 1975, JMP, Box 1, Folder 33.

¹²⁴ FDA inspection records reveal that Orentreich continued to order industrial-grade silicone and process it in his clinic for subcutaneous injection until 1991. In November 1991 Norman Orentreich and his son David who runs the clinic today signed a consent decree of permanent injunction to agree to stop manufacturing, distributing, promoting, and administering liquid injectable silicone in surgical procedures in humans to this order. See FDA papers, HHS News Release Feb 28 1992 and FDA Quarterly Reports, Jan to March 1992, pp. 32 – 33.

¹²⁵ Orentreich was not the only Silicone Committee member to have kept poor research records. As noted in the chapter, Murray’s papers show that a lot of his papers and documents are also missing from the FDA NDA.

¹²⁶ *Dr. Linn Sakurai*. Available at: <https://www.linn-store.com/ext/about.html> (accessed Feb 5 2019)

‘Injection Therapy: Instant beauty

The most spectacular new development in the world of beauty surgery is not surgery at all. No incision is made, no skin is clipped away, no stitches are taken, no bandages are used, and there is no operating room or hospitalization.’¹²⁷

Silicone shots offered an instant walk-in youth- and gender-booster.

West Coast US Strip Culture and the ‘Topless Craze’

Such associations of silicone as a glamorous and exclusive material administered by charismatic doctors described by *Vogue* were absent from US reports of exotic dancers on the West Coast. In *Mondo Topless* (1966) director Russ Meyer, inspired by Carol Doda’s notoriety, presents a midnight movie snapshot of San Francisco, considered the home of the topless phenomenon, its go-go dancing night club culture and the dancers themselves.¹²⁸ Actor John Furlong narrates, over a montage of neon signs of San Francisco nightlife:

‘exploring from dusk to dawn with the way-out craze of the topless, nurtured by stayed and stolid San Francisco and cut loose to rage the USA and even Europe. National publications such as *Life*, *Playboy* and *Esquire* have documented the topless – the phrase and craze that is changing the mood and the mores of people everywhere. *Mondo Topless* captures the basic quintessence of the movement with movement: way-out, wild movement! There, go-go girls in and out of their environment will be revealed to you in scenes that can only be summarised as a swinging tribute to unrestrained female anatomy.’¹²⁹

Furlong’s text conveys the excitement of the ‘topless craze’. Peggy Moffitt scandalously modelled California-based designer Rudi Gernreich’s monokini on the June 4 1964 cover of *Women’s Wear Daily*. On 22 June 1964 in San Francisco, exotic dancer Carol Doda, credited with being the first known woman in the US to perform in his design, further challenged national and local US censorship laws. Doda’s legendary monokini performance, her

¹²⁷ Franklyn, *The Art of Staying Young*, 1964, p. 116.

¹²⁸ For more on Russ Meyer see Kristen Hatch, ‘The Sweeter the Kitten, the Sharper the Claws: Russ Meyer’s Bad Girls’ in Murray Pomerance (ed.) *BAD: Infamy, Darkness, Evil And Slime on Screen* (New York: State University of New York Press, 2004), pp. 143-155.

¹²⁹ Russ Meyer, *Mondo Topless* (1966).

subsequent prosecution and acquittal and the press coverage this generated, had a domino effect on other striptease venues in San Francisco, and later across the country, in what was termed the 'topless craze'. In the summer of 1964 female dancers began performing topless throughout their routines, doing 'swim-inspired' movements such as the Watusi. No longer restricted by the fans, nipple tassels or bras the striptease required, these new dances conveyed a freedom of movement that coincided with changes in uplifting bust augmentation surgery. Topless restaurants, resorts, country clubs, cocktail bars, shoeshine parlours, ice cream stands and girl bands (see for example The Ladybirds, launched in 1966) followed soon afterwards.¹³⁰ Earl Wilson, gossip columnist and journalist for local newspaper the *San Francisco Examiner*, remarked, 'are we ready for girls in topless gowns? Heck, we may not even notice them.'¹³¹

Despite her initial acquittal, Doda and dancers like her were frequently arrested in police raids on nightclubs for indecent exposure. Doda even became a cause célèbre.¹³² On 22 April 1965, a group of over 100 protesters were reported outside a San Francisco police station demanding Doda's release and that of Mario Savio, a free speech student activist already in prison.¹³³ In the 1960s, topless dancing and free speech were associated: Doda attended student protests, and was known to have openly commented on the liberating feeling of not wearing a bra on stage.¹³⁴ In *Mondo Topless* a dancer commented on the freedom of not wearing anything on top: 'you don't need to bother with pasties anymore, sometimes they slip and then the glue shows, sometimes they fall off and that's terrible [giggles]'.¹³⁵

Unlike actresses or models, Doda spoke openly about the work she had done to 'improve' her body. 'I get letters from all over the world asking me where to get the treatments because [women are] depressed over the size of their bustlines, but now a girl can be as large as her dreams'.¹³⁶ Dancers such as Doda thus shared their knowledge of silicone shot treatment and openly recommended it to female members of the audience and readers who wished to also participate in their culture of self-improvement. As open as she

¹³⁰ See Rachel Shteir, *Striptease: the Untold History of the Girlie Show* (Oxford: Oxford University Press, 2004), p. 321.

¹³¹ Earl Wilson, 'The Almost Topless Gown' *San Francisco Examiner*, June 29 1964, p.16.

¹³² Doda also travelled to Vietnam to boost morale amongst US troops in 1967 (Shteir, 2004).

¹³³ Shteir, 2004, p.321.

¹³⁴ Ibid.

¹³⁵ *Mondo Topless* (1966) 19:43.

¹³⁶ Doda, 'Escalation', 1965.

was about her procedure, Doda never publicly shared the name of her doctor. In October 1965, *Newsweek* reported that Doda's doctor had a six-month waiting list, and that a treatment of 20 shots ranged between \$750 and \$1,000.¹³⁷ Big Al, a topless entertainment venue and The Condor's competing neighbour, however, boasted an in-house doctor who administered weekly one-and-a-half-ounce liquid silicone shots to the breast.¹³⁸ Doda commented: 'I don't believe topless is a fad. It's something that's going to stay – like burlesque.'¹³⁹ She was subsequently proved right, as appearing on stage topless became the norm in Western strip culture.

Silicone shots appeared to offer a 'quick change' to the literal construction of the self. This appealed to Doda's celebrity consumerist belief in self-improvement, which resonates with the transformative ideology of military-industrial synthetics. Silicone enabled Doda to realise her full potential; 'It's part of me,' she said, referring to the silicone which had given her added dimensions. 'It's me. It becomes a part of yourself.'¹⁴⁰ Doda distanced herself from her pre-silicone body: 'when I see old pictures [of myself] I tear them up'.¹⁴¹ Silicone gave Doda the agency to shape her body as she wanted: she claimed never to have suffered any complications from silicone shots, and asked: 'science has invented all these new wonderful things, why shouldn't we use them?'.¹⁴²

In theory, silicone meant female dancers could now design the size of their curves, and no longer needed a bra to support their busts. In practice, this was often not the case and many women suffered disfiguration, health problems and, in some cases, death from silicone shots. Symmers' 1968 *BMJ* article 'Silicone Mastitis in "Topless" Waitresses and Some Other Varieties of Foreign-body Mastitis', presents a study of a number of female patients who had had silicone breast injections and had experienced complications.¹⁴³ He describes their medical conditions and complications from the procedure, but also their line of work. His patients 'worked in "topless restaurants" [in the US] and had been obliged to seek artificial means to maintain the excessively large bust that was necessary in that

¹³⁷ Ibid.

¹³⁸ Haiken, 1997, p. 249.

¹³⁹ *San Francisco Chronicle*, January 1967. This widely replaced the tradition of performing a tease with covered breasts, as demanded by censorship legislation at the time of traditional burlesque dancing. For more on this see Shteir, 2004.

¹⁴⁰ Carol Doda, cited in Hudson, 1968, p.84.

¹⁴¹ Ibid.

¹⁴² Ibid.

¹⁴³ Symmers, 1968.

environment'.¹⁴⁴ This included top-up injections, even when the breasts were already disfigured with granulomas. He also describes the case of a teenage student who worked as a 'get-together girl' in a topless country club in the US. She had undertaken a two-year course of silicone injections, expanding her bust from 34" to 37" (her waist and hip measurements were respectively 23" and 34"). Her first series of injections was spread across three weeks and entailed about 400ml of DC 360 Medical, 'an ethical proprietary brand of pure silicone fluid'.¹⁴⁵

As with foam, women who opted to undertake this procedure were responding and contributing to socio-economic changes and pressures. However, silicone's fluid materiality perhaps appeared less invasive and more instant. A journalist reasoned that women were likely to take the risk, 'because compared to breast implants, silicone is fast. A girl can be pumped up in the afternoon to become a perfect 36 and maybe get a job the next day'.¹⁴⁶ Ruth Ponce, a white recently divorced Las Vegas dancer with a young child, said she was not told she *had* to get injections but she saw it as an economic investment. 'I had to eat,' she said. 'I could get a job as a secretary for \$90 a week, only you can't live in Vegas on \$90 a week. You can live on \$240 a week, and that's what I was promised for chorus work at the Sahara.'¹⁴⁷ Silicone shots were an illusory promise: at first they offered social mobility, financial independence and an instant solution, but this demanded upkeep and was hazardous to health, and in some cases proved fatal. More shots were required to keep up the desired volume, as silicone tended to migrate and scar tissue would shrink. Side effects included the formation of granulomas, hardening of breasts, infections, gangrene requiring amputation and in some cases death from silicone poisoning, where silicone entered the bloodstream or lungs.¹⁴⁸

The white men who made important decisions about women's bodies and the materials that were implanted within them participated in a homosocial heteropatriarchal culture of constructing and consuming women's bodies. In keeping with masculine heteronormative work norms at the time, male actors, such as surgeons and chemists, who

¹⁴⁴ Ibid, p.19.

¹⁴⁵ Ibid.

¹⁴⁶ Harry Nelson, 'Silicone Injections Health Hazard, Study Indicates' *LA Times*, 2 November 2 1975.

¹⁴⁷ Ruth Ponce interviewed in Linda Witt, 'What is a Woman without Breasts?' *Today's Health*, April 1974, pp.30 – 36, 65-66. p. 35.

¹⁴⁸ Witt, 1974.

operated in these networks of power associated with plastics, engaged with and participated in strip culture, not just in the US but internationally. Writing to another plastic surgeon due to visit Tokyo in 1962, Conway recommended visiting the Queen Bee night club and the Papagayo Club, which:

[H]as some nicely undressed shows, and these seem to be the rage in Japan at the present time since their appetite for entertainment is thirty or forty years later in development than that of the Western World. A friend took me there to scrutinize the breasts of the performers for needle marks of injection of their fluid polythene for augmentation mammoplasty. There is a special show at the Papagayo Club for men only at 5pm daily.¹⁴⁹

Besides being orientalist, Conway's comment on nude shows being 'the rage in Japan', which is behind 'the Western World', is inaccurate given that nude shows remained a popular form of entertainment across Western Europe and the US West Coast. Conway's research was not simply confined to hospital visits in Japan; he also enjoyed and recommended visits to nude shows, allegedly to scrutinise women's breasts for needle marks.

As this menu for a dinner honouring Milton Edgerton, a member of the Silicone Committee (Figure 4) and Conway's trips to men's clubs show, key actors within the postwar US network of silicone's application, such as respected US surgeons, engaged in homosociality, objectifying women's bodies as sites of entertainment and sexual pleasure. Edgerton and his white male guests were served 'Augmented Breast of Chicken with Smithfield ham' at Baltimore's Elkridge Country Club.¹⁵⁰ Edgerton is shown in front of a line of busts of white men considered to be founding fathers of plastic surgery.

¹⁴⁹ Conway, letter to K. L. Pickrell MD, January 22 1962, HCP, Box 7: Series I, Correspondence.

¹⁵⁰ Elkridge Country Club has a long history of an exclusively white male membership. African-Americans and Jews were only admitted from 2005. Stephanie Desmon, 'A Long History of "Us" Keeping "Them" Out', *The Baltimore Sun*, 10 July 2005.

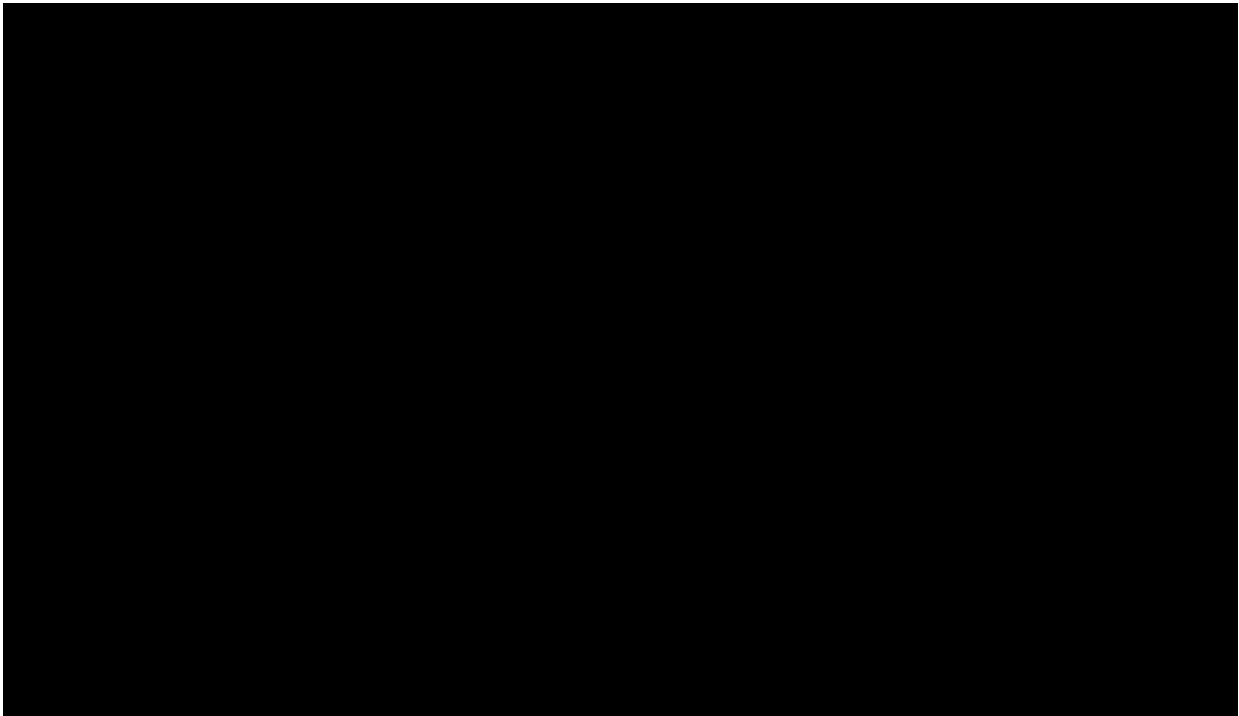


Figure 4: Menu for Dinner in Honour of Edgerton, 1970

Edgerton, dressed in scrubs, is next. Behind him are a series of illustrations of plastic surgery procedures, hung like works of art, each with its own spotlight. The central image shows breast augmentation with an implant. A white woman is shown, her face cropped, her arms raised. This is the only image on the wall to depict a hand engaging with the body in a medical procedure. Oddly, the hand is ungloved (other earlier images show gloved hands) and is inserting the implant (likely to be polyurethane foam, as it appears to be porous and rolled up). This image is placed centrally and, unlike the others, it shows [male] hands engaging directly with a female patient's body. Similarly, it is only the female patient and augmentation mammoplasty that is joked about in the menu selection, further demonstrating the inequality of gendered power structures within the US network of medical actors.

Other professionals in the silicone network also engaged in a culture of sexualising women's bodies and sometimes belittling them. The *Chemical Peddler* (1920s–1980s), for example, published by and distributed amongst members of the Salesmen's Association of the American Chemical Industry Inc. as a novelty gift, featured misogynist imagery of semi-clad, often entirely nude women, in chemical company advertisements. This imagery was meant for American Chemical Industry salesmen and embodied an ideology of flawless female corporeality, often crafted by chemists themselves. The imagery presents women's

bodies as a site for improvement and consumption, shaped by developments in the chemical industry. A 1955 Monsanto advertisement that appeared in the *Chemical Peddler* depicts the transformative qualities of Monsanto's 'Rejuvenation X 516' (see Figure 5). The comical clothed 'abject' white female (ageing, sagging breasts, short hair, stout figure, long-nosed, thin-lipped) is sent through a Monsanto Rejuvenation showering device. The women appear to be 'masculinised', they are disproportionate, misshapen, grotesque: they have 'pot bellies', bad posture, thick ankles, unruly hair that seems to sprout from the sides of their heads, and a general lack of corporeal self-control. US Gender Studies scholar Linda Mizejewski writes on the 'abject' female comic body and its often racialised aspects: that which is seen as abject, undesirable, unkempt, unruly and unclean in women is 'othered' and racialised and through this becomes comical.¹⁵¹ In this carnivalesque, inside-out and upside-down reordering of the world, that which breaks with the physical and social norms of white idealised Westernised well-proportioned femininity is comical.¹⁵² In summary, the women's bodies in Figure 5 are mocked for not complying with conventional heteronormative cultural codes of white female beauty and the hourglass body ideal.

¹⁵¹ See Linda Mizejewski, *Pretty / Funny: Women Comedians and Body Politics* (Austin, TX: University of Texas Press, 2014).

¹⁵² Mizejewski, 2014, explores the abject comic female body using Mikhail Bakhtin's theory of the carnivalesque.

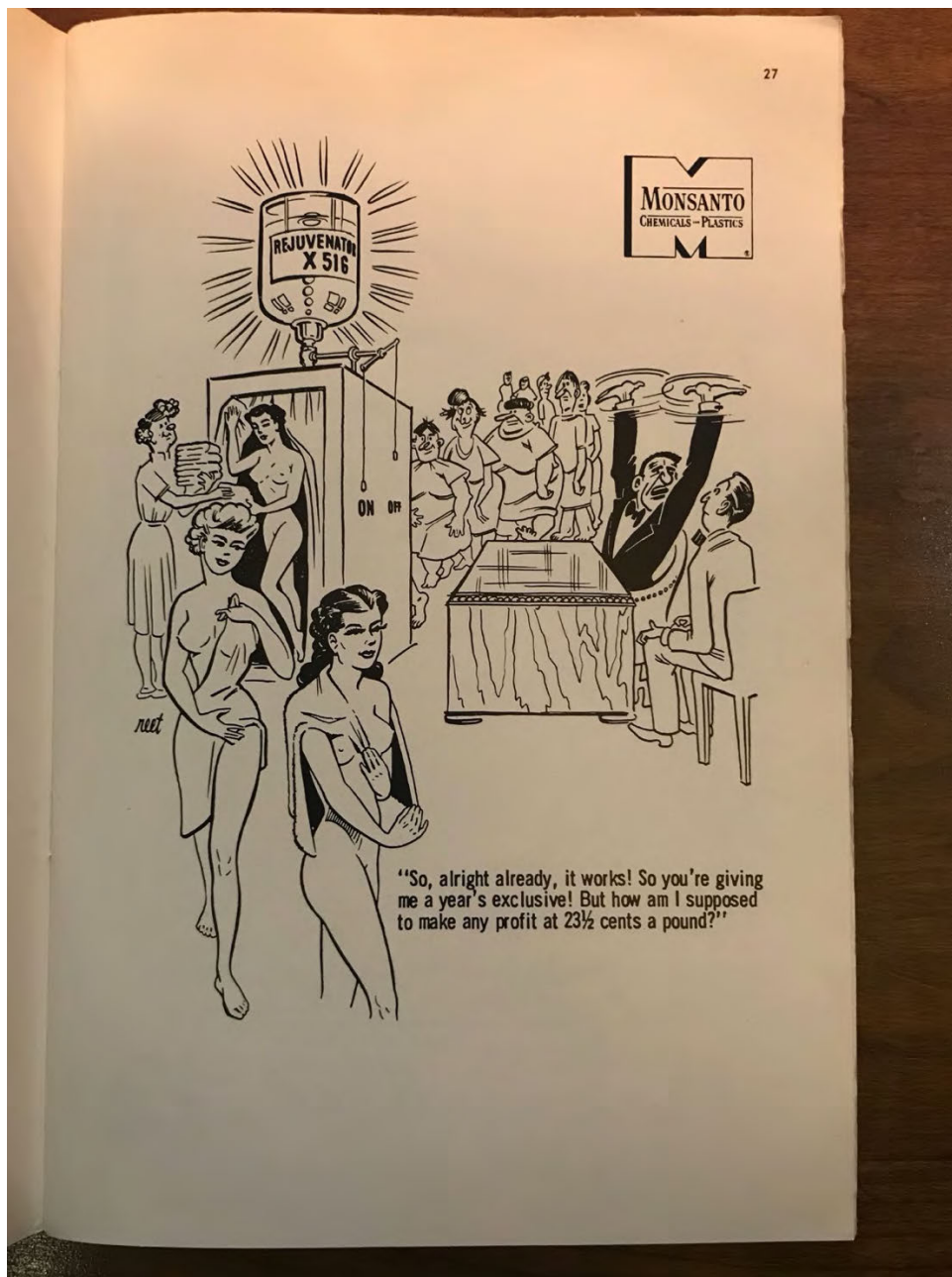


Figure 5: *Chemical Peddler Monsanto's Rejuvenation X 516* (1955)

The suggested solution is to undergo a procedure of some kind. In the case of the women in Figure 5, an instant treatment with Monsanto's 'X516' fluid can quickly fix their predicament. Once they have passed through the Monsanto-fuelled contraption and out from behind its curtains, these women emerge nude, youthful and svelte, their bodies smooth and free of any hair other than that which is perfectly coiffed on their heads, their made-up faces boasting a flutter of long lashes and fuller painted lips. In Figure 5, the

desirable, rejuvenated body is the 'civilised' white body that is seen to reference the white smoothness of classical sculpture, with lifted breasts exposed.¹⁵³

The Monsanto ad seems to maintain a dream of rejuvenation that was increasingly popular in Los Angeles, particularly for bust enhancement. In 1965, the FDA, which publicly opposed silicone shots, estimated that 75 doctors offered this service in the area.¹⁵⁴ One surgeon claimed to be treating 25 patients a week at a charge of \$1,000 per course.¹⁵⁵ In Beverley Hills the treatment was known as 'Cleopatra's Needle', a term Franklyn claims to have introduced.¹⁵⁶ Not all of the patients were showgirls: the majority of women treated by one Anaheim doctor were housewives and college girls; some anxious parents even brought teenage children in, and in Las Vegas one doctor estimated he had given some 16,000 silicone injections to 200 women, about half of whom were, he claimed, housewives rather than showgirls.¹⁵⁷ It was common practice for patients to be required to sign a statement acknowledging that the treatment was experimental, to avoid any liability.¹⁵⁸ 'What kind of woman goes to a plastic surgeon hoping to have the shape of her breasts changed? The answer is that she isn't of any particular category.'¹⁵⁹ Patients included adolescents who felt inadequate, women with flat chests and women whose breasts had started sagging after childbirth. It should be noted, however, that at an average of \$200 per silicone shot appointment the cost of treatment was considerable, making it unattainable for many, especially those seeking out treatment from a reputable surgeon.¹⁶⁰

The cost of cosmetic surgery and bust augmentation in the US made it unattainable to most American people of colour in this period, when compared to numbers of white Americans seeking out treatment.¹⁶¹ Furthermore, Michele Burgen, writing for *Ebony*, argued; 'among many blacks (and to an extent, among Orientals), there is the feeling that

¹⁵³ For more on the influence of classical white sculpture of the creation of whiteness see Nell Irvin Painter, *The History of Whiteness* (New York: W.W. Norton & Co., 2011); Richard Dyer, *White: Essays on Race and Culture* (London: Routledge, 1997).

¹⁵⁴ Hudson, 1968.

¹⁵⁵ Ibid.

¹⁵⁶ Franklyn, *The Art of Staying Young*, 1964.

¹⁵⁷ 'Escalation', 1965. Teenagers are also mentioned in the AMA correspondence files; Symmers, 1968; Webb, 1997.

¹⁵⁸ Figures taken from 'Escalation', *Newsweek*, October 25 1965.

¹⁵⁹ Ibid.

¹⁶⁰ As we know, after the Silicone Committee was established in 1964, these were officially the only surgeons with access to Dow Corning medical-grade silicone; however, cosmetic surgeons could claim to resort to sterilising industrial-grade silicone from Dow Corning or other manufacturers themselves. It was impossible to control silicone's entry into the body via subcutaneous injection.

¹⁶¹ Michele Burgen, 'Plastic Surgery: a Lift for the Face, Figure and Spirit' *Ebony*, January 1977, pp. 40 – 50.

altering the nose, lips or other facial features is a betrayal of one's racial heritage.'¹⁶²

Moreover, as Burgen noted, there were not many black plastic surgeons working at the time. Burgen, however, welcomed a new age, enthusing:

[Cosmetic surgery] just gives you a new way to look. It's nothing to be ashamed of. It's no different than losing weight, deciding you want to change the kinds of clothes you wear, changing your walk, or taking a new career. It's just shaping the house you live in - and the house you live in is your body.'¹⁶³

Burgen's comments echo Doda's beliefs about the importance of self-improvement. As Burgen attests, technologies that were once unattainable for people of colour in the US, and therefore received little coverage during the 1950s and '60s in publications targeted at a black readership, such as *Jet* or *Ebony*, were becoming comparatively more accessible by the late 1970s.

Silicone and Transgender Communities

There is another group of women who were excluded from articles on cosmetic surgery such as those in *Ebony*, *Harper's Bazaar* and *Vogue* and who remain largely sidelined to footnotes or as an afterthought in the scholarship, if mentioned at all: silicone shots were also administered to transgender women in this period. Edgerton, based at Johns Hopkins Hospital, Baltimore, at the time, specialised in the relationship between plastic surgery and psychology.¹⁶⁴ Edgerton was also one of the founding members of the Gender Identity Clinic (GIC) set up by controversial sexologist John Money, a major figure in the field.¹⁶⁵ Money established this as part of Johns Hopkins Hospital in 1966. Edgerton was involved at an early stage in performing surgery and decided it was important to carry out research in this area. The GIC programme is revolutionary in US trans history as it sought to offer comprehensive treatment to all its patients in one central clinic, with in-house specialists including

¹⁶² Ibid., p. 40.

¹⁶³ Ibid., p. 42.

¹⁶⁴ See, for example, M.T. Edgerton MD and A.R. McClary MD, 'Augmentation Mammoplasty: Psychiatric Implications and Surgical Indications with special reference to use of the polyvinyl alcohol sponge (Ivalon)', *PRS* 21. 4 (April 1958), 279 – 305. M.T. Edgerton MD, E. Meyer MD, and W.E. Jacobson MD, 'Augmentation Mammoplasty II: Further Surgical and Psychiatric Evaluation' *PRS*, 27. 3 (March 1961), 279 – 301.

¹⁶⁵ For scholarship on John Money and the Gender Identity Clinic at Johns Hopkins see Bernice Hausman *Changing Sex: Transsexualism, Technology, and the Idea of Gender* (Durham, NC: Duke University Press, 1995); Joanne Meyerowitz *How Sex Changed* (Cambridge, MA: Harvard University Press, 2004); David Getsy *Abstract Bodies: Sixties Sculpture in the Expanded Field of Gender* (New Haven, CT: Yale University Press, 2015).

psychiatrists, plastic surgeons, paediatricians and urologists. This meant that the psychological and surgical aspects of treatment would be overseen by one umbrella institution specialising in trans patients, avoiding the need for countless referrals. The GIC claims to have performed the first male to female gender confirmation surgery in the US.¹⁶⁶ According to historian Joanne Meyerowitz, the first patient the GIC performed gender confirmation surgery on was a black transwoman; Avon Wilson in 1966.¹⁶⁷ *Jet* magazine reported Wilson, a former New York City dancer later married her partner musician Warren Combs.¹⁶⁸ Though little is known of Wilson, Meyerowitz writes that her case gained traction in the media and the GIC was joined by 15-20 major gender identity clinic centres at work by the end of the '70s.¹⁶⁹

In a press release from 1966, John Hoopes, GIC spokesman, commented: 'the surgeon represents the last link in a quite long chain as far as the management of these [transgender] patients is concerned.'¹⁷⁰ Edgerton may have been the last link in the chain, and yet he was the one who could materialise desires and gender identities into the corporeal. The press release continued: 'this program, including the surgery, is investigational. The transsexual has never previously been given adequate medical attention'.¹⁷¹ As technologies became available, new corporealities became possible.

Changes in medical (anaesthetisation, sterilisation, antibiotics) and materials (plastics could be sterilised) technologies enabled trans people to have what would previously have been external gendered drag props, such as falsies, butt pads and packing devices, permanently embedded within the body without fear of their immediate expulsion. Just as cis women sought out the aid of cosmetic surgeons to make permanent their own gendered drag accessorising through falsies to pass under heteronormative legitimised and

¹⁶⁶ Many early patients were referred from The Harry Benjamin Foundation of New York - the founder of this organisation, after who it is named, a physician, worked with transgender patients, most famously Christine Jorgensen, for many years and authored *The Transsexual Phenomenon* (1966). The Benjamin Foundation was endowed by transgender activist Reed Erickson's Erickson Educational Foundation, which also became the sole initial sponsor of GIC.

¹⁶⁷ Joanne Meyerowitz *How Sex Changed: a History of Transsexuality in the United States* (Boston, MA: Harvard University Press, 2002) 219. See also Monica Roberts 'Musing About Avon Wilson's Blended Life' *Transgriot* April 5 2009, <https://transgriot.blogspot.com/2009/04/musing-about-avon-wilsons-blended-life.html?showComment=1239041400000>; Monica Roberts 'Who Was the First African-American Transwoman?' May 26 2009 <https://transgriot.blogspot.com/2009/05/who-was-first-african-american.html> (both accessed 15 February 2020)

¹⁶⁸ 'Male Dancer Sex Changed, Marries Musician' *Jet* July 13 1967 p. 58

¹⁶⁹ Meyerowitz, 2002, 222.

¹⁷⁰ 'GIC Press release', 1966, John Money Papers, Medical Archives of the Johns Hopkins Medical Institutions.

¹⁷¹ *Ibid.*

pathologised ideals of hyper-femininity, trans women and men also sought to pass in their gender identities.

In addition to social acceptance, passing could also prevent arrest for cross-dressing, or potentially being targeted for violent physical, verbal or sexual abuse or discrimination. Hoopes claimed that an overwhelming majority of the clinic's patients were trans women, reflecting what he observed were the figures in the country. He added, 'all races are affected'.¹⁷² There was a high incidence of self-mutilation and suicide, and Hoopes encouraged the treatment that was increasingly being developed. Hoopes concluded, 'if the mind cannot be changed to fit the body then perhaps we should consider changing the body to fit the mind'.¹⁷³ This in itself was not necessarily a new line of thought, as international research on transgender surgery had been ongoing with famous early recipients of gender confirmation surgery such as Lili Elbe in 1930 and the work of institutes such as Magnus Hirschfeld's Institut für Sexualwissenschaft. What was comparatively new, however, was the range of plastic materials that could now be sterilised and implanted. Technologies that had been developed in pursuit of autarky and redeveloped by cis white men for cis white females (breast injections and implants) and cis white males (penile implants), were now being queered and reapplied in the shaping of trans bodies. Silicone penile implants, originally developed by white cis men for impotent white cis men, were now being used in gender confirmation surgery for trans men.¹⁷⁴ This conversion destabilised gender norms and challenged the gendered power hierarchies that designed them in the first place. The same can be said of trans women enacting agency upon their bodies by choosing to have feminisation procedures such as silicone shots to the breasts, buttocks or hips. Silicone affirmed queer gender identities, making these more than skin-deep, often serving to protect trans people from further persecution, violence and arrest.

Most GIC patients had already been living in their chosen gender identities and went to the GIC having already undertaken cosmetic procedures such as breast augmentation. This was also reflected in the admission forms that prospective patients were asked to complete.¹⁷⁵ In a section titled 'Cross-Gender Activities', female trans patients were asked:

¹⁷² *ibid*

¹⁷³ *Ibid.*

¹⁷⁴ See 'John Charles Rock Papers', Harvard Medical Archive: Box 13, Folder 37; Silastic Penile Implant, Robert Pearman, Theodore Jones 1966-68; Robert O. Pearman, 'Treatment of Organic Impotence by Implantation of a Penile Prosthesis', *The Journal of Urology*, 97 (April 1967).

¹⁷⁵ See Money Papers.

‘Have you had any operations or procedures to help change your appearance?’

Y / N Date

Breast surgery

Nose surgery

‘Adam’s apple’ surgery

Silicone injections - place of injection

Are you presently receiving hormone pills or injections?

Pills Y/N

Injections Y/N.¹⁷⁶

This form shows how common it was to find that patients who were already living in their chosen gender identity had undertaken surgery using the latest developments in plastics. ‘Silicone injections – place of injection’ indicates that shots were applied in different areas of the body. There are, however, also some patient records that mention that mammoplasty was to be carried out at Johns Hopkins.¹⁷⁷ If that was the case, it is worth noting that Edgerton, a member of the Silicone Committee, would have had direct access to silicone and Dow Corning products at the time. As the GIC report stated, ‘although transsexualism has been observed since antiquity, hormonal readjustment and particularly sex reassignment surgery, are relatively recent techniques of cross-gender role assumption.’¹⁷⁸ Transgender identities were not new, but changes in technology did enable greater advances in the success of gender confirmation surgery.

Paul. B. Preciado theorises the impact of postwar changes in technology to the gendered, racialised and sexualised body, writing:

‘[T]he somato-political context of the body’s technopolitical production seems dominated by a series of new technologies of the body (biotechnology, surgery, endocrinology, genetic engineering, etc.) and representation (photography, cinema, television, internet, video games, etc.) that infiltrate and penetrate daily life like never before.’¹⁷⁹

¹⁷⁶ ‘Sex reassignment in transsexualism: research justification and protocol’ - follow up questionnaire’, John Money Papers, Gender Identity Clinic 1966- 1967, Box 503600.

¹⁷⁷ Notes from GIC Meeting May 21 1971, John Money Papers, , 1971 – 1973, Box 503600.

¹⁷⁸ ‘Sex reassignment in transsexualism: research justification and protocol’ (1971).

¹⁷⁹ Paul B. Preciado, *Testo Junkie: Sex, Drugs, and Biopolitics in the Pharmacopornographic Era* (New York: Feminist Press, 2013), p. 77.

Unlike foam implants, which closely resembled the external shaping devices designated for the conical and rounded shaping of the body, silicone shots offered a less tangible materiality to the shaping of the body. Gelatinous, transparent, viscous and supposedly inert, a set of actors, including chemical companies, cosmetic and medical professionals, and journalists, promoted silicone as having the capacity to slip into the body and remain there undetected (by both the body's defence mechanisms against 'foreign bodies' and the eye of the beholder). It is important to note that injecting a viscous material into the body to change its shape was nothing new: materials such as paraffin had also served this purpose. However, unlike paraffin, silicone was presented as supposedly inert: a polymeric material, it hailed from the relatively recently developed plastics, thereby offering new properties and possibilities in the construction of the self.

Preciado, who consumed testosterone via silicone gel and transitioned in the process of writing *Testo Junkie* (2013), emphasises the postwar military-industrial 'pharmacopornographic' context of new 'featherweight' technologies such as silicones and synthetic hormones that could be 'injected, inhaled – incorporated'.¹⁸⁰ Preciado argues that these technologies, such as silicones, invite somatic interaction with them and in turn their ingestion creates new realities and subjectivities. As with subversive actors including Doda and Wilson, the creation of new realities and subjectivities is also essential in the practice of auto-design and the presentation of self and sexuality. There is something significantly primordial and abject yet virile and vital in Preciado's description of the viscous and gelatinous that collide through the body. Conversely, there is also something high-tech and instant about silicone shot technology, a fluid, slippery technology that is not contained in an object.

In 'Constructing the Trannie: Transgender People and the Law' (2004), Ohle argues that 'the transgender person is relegated to the bottom of the page, the smaller font, and therefore is often overlooked, ignored, or simply not read.'¹⁸¹ White trans women have been largely omitted from established histories of bust augmentation, and trans women of colour even more so. US media coverage on silicone shots from the mid-1960s focused on

¹⁸⁰ Ibid.

¹⁸¹ John Ohle, 'Constructing the Trannie: Transgender People and the Law', *Journal of Gender, Race and Justice* (Spring 2004), 7.

white cis female dancers such as Doda and many others, often accompanying articles with full body shots that showed off their full bustlines and sold copies. Trans women, particularly trans women of colour, were given minimal or no mention in this context in mainstream US publications.¹⁸² Trans women were also rarely mentioned in medical reports on silicone shots.¹⁸³ However, a 1964 article by Dr Yasuo Muto, at Sapporo Central Orthopaedics, presented a study of 'Akiyama's 327 DMPS' (cross-linked dimethylpolysiloxane, branded as Elicon) cases, eight of whom were trans women, between 1960 and April 1964.¹⁸⁴ Muto presents a rare depiction of a trans female undergoing silicone shot treatment. He argues that in the worst-case scenario, DMPS could be removed, claiming that its advantages as a shaping material outweighed its disadvantages. It is important to note that for trans women the health risks of silicone injections were minimal compared to living in a body that did not correlate with their gender identity. Furthermore, the ease of silicone shot application, compared to implantable objects, defied medical heteropatriarchal structures of surveillance. This can be understood as collapsing traditional Western heteronormative borders of power, gender and the body, also articulated in queer theory on the cyborg.¹⁸⁵

Health risks remained a concern in mainstream discourse: the AMA announced in August 1971 that complications from silicone injections to increase breasts 'had reached such a volume that it was time to sound an alarm'; the FDA in Washington agreed.¹⁸⁶ The FDA evidenced cases where silicone had entered the bloodstream, and had thus reached the brain or lungs. They knew this from four autopsies: one of these deaths was caused by a fraud pretending to be a physician, later charged with murder by malpractice in Houston,

¹⁸² Emily Skidmore writes how the mainstream US press presented whiteness as a defining characteristic of authentic trans womanhood in US culture. In order to gain acceptance in this press, white trans women needed to present as heterosexual married homemakers who denounced homosexuality. In these publications, trans women who made a living as exotic dancers and in other forms of sex work received negative publicity, if any at all. Positive coverage of trans women of colour was almost exclusively found in African American publications including *Sepia*, *Ebony* and *Jet*. See Emily Skidmore "'Constructing the "Good Transsexual": Christine Jorgensen, Whiteness, and Heteronormativity in the Mid-Twentieth-Century Press', *Feminist Studies*. 37.2 (2011), 270–300.

¹⁸³ Exceptions I have come across: Rita Ellenbogen, 'Injectable Fluid Silicone Therapy Human Morbidity and Mortality', *JAMA*, 234 (1975), 308-309; Dr Yasuo Muto, Sapporo Central Orthopaedics, presents a study of 327 Akiyama's DMPS Cases 1960 – 1964. Available at:

https://www.jstage.jst.go.jp/article/ringe1963/26/1/26_1_25/_pdf?fbclid=IwAR3bMbiRd9ZkBlscpVNE-By0oFKL-7ENAI5UktFoY8NjrCR2HF6gVQel81Y. (accessed 16 Feb 2020).

¹⁸⁴ Muto, 1960-1964.

¹⁸⁵ Preciado, 2003; Donna Haraway, *Simians, Cyborgs, and Women: the Reinvention of Nature* (London: Free Association Books, 1991). See also Karan Barad, 'Getting Real: Technoscientific Practices and the Materialisation of Reality', *differences: a journal of feminist cultural studies* 10.2 (1998), 87 – 128.

¹⁸⁶ Witt, 1974, p. 33.

Texas. Writing for the AMA magazine, *Today's Health*, Linda Witt wrote, 'Silicone became a national outlaw'.¹⁸⁷ Responsible physicians needed to explain to inquirers that breast injections were illegal and dangerous. Silicone was unsafe because of its propensity to migrate from the breasts to the chest wall or the abdomen's soft tissues. It also masked tumours, and since it was opaque to X-rays it could obscure their correct identification.

Correspondence from the Silicone Committee in Murray's papers reveals that in the early to mid-1970s Dow Corning was increasingly concerned about the number of deaths linked to silicone.¹⁸⁸ In this period, Dow Corning was starting to regret its position as 'First in Silicones'. In a Silicone Committee meeting, Dow Corning warned that they had 'a special risk which has been generated by the [DCCAMR] publicity'.¹⁸⁹ It was feared that they could be sued, whereas other companies might not be. To counteract the negative publicity generated by the 1971 interstate commerce indictment, deaths and tales of illegal silicone rings, Braley and Bob Emmons, a Dow Corning public relations expert, toured the US to promote the benefits of silicone to reporters and editors around the country. Emmons recalls:

'Si [Braley] was an articulate, clever and witty individual. Si and I came up with a program to get the heat off of us. We went to New York and called on the ladies' magazines with press releases and other materials to get better publicity.'

– a ploy that, from Morini's effusive article in March 1971, certainly seemed to work.¹⁹⁰

Four years later, Dow Corning had to deal with further negative publicity: in 1975, Cook County State's Attorney, Bernard Carey, carried out an investigation into what was reputed to be one of the biggest illegal silicone injection rings in the country.¹⁹¹ The leader of the ring, Hal J. Ellison, operating from Chicago, had been injecting silicone from 1967 to 1975: on 5 December 1974 he 'recklessly' injected Tammy White, a trans woman of colour, who died within an hour of treatment at his apartment.¹⁹² 'An estimated 70 to 80 per cent

¹⁸⁷ Ibid.

¹⁸⁸ See Silicone Committee Correspondence, JMP. For example, Dow Corning Medical Meeting notes New York September 11-13 1975.

¹⁸⁹ Ibid., p.15.

¹⁹⁰ Byrne *Informed Consent*, 1996, 44; Morini, 1971.

¹⁹¹ Ronald Kotulak and George Bliss 'County Office Probes Illegal Silicone Injections', *Chicago Tribune*, Sunday December 7 1975, JMP, Box 1, Folder 34.

¹⁹² Cook County Case Number manslaughter 76CR3340 p. 1., July 26 1975, Cook County Court Archives, Chicago, IL.

of Ellison's customers were show business people or homosexuals. The other 20 or 30 per cent were average men and women from a variety of careers', said Nicholas Lavarone, Assistant State Attorney, who carried out a six-month investigation in the Special Prosecution Unit.¹⁹³ He also mentioned that a number of Ellison's customers were trans women seeking to build their curves. Silicone injection had been completely outlawed by the FDA in 1971. Ellison, who had no formal medical qualifications or experience, had easy access to industrial-grade silicone via his industrial chemicals wholesale business, Silico Chemical Co. Apparently he had the idea after his wife alerted him to the silicone work she had had done, and the potential profitability of such a business attracted him.¹⁹⁴ Potential clients were screened by a beautician working at a North Side salon.

Patricia Gill, admin assistant at Dalcorn Inc., a silicone manufacturer, testified at his trial, stating that the company had sold various quantities of silicone to him from 1970 to 1973. Newspaper reports, however, claimed that Ellison sourced his silicone from Dow Corning. Ellison, like all Dalcorn's purchasers, was required to sign an affidavit that the silicone would not be used for human injection.¹⁹⁵ Carey pushed for the illegal and dangerous practice of unlicensed medicine to have stricter consequences, and for it to be treated as a felony, punishable with penalties such as prison sentences. Carey commented: 'We must protect the uninformed and unsophisticated public. It is tragic that men and women in search of false beauty may instead find liquid death from these dangerous and illegal silicone injections.'¹⁹⁶ Silicone injectors such as Ellison profited from coverage in the popular press that presented silicone as a miraculous material. Silicone and its promise of instant curves could, however, also result in death.¹⁹⁷

According to the investigators, Ellison charged \$200 per shot administered, and averaged eight injections per woman. The material cost Ellison about 10 cents a shot and his profit was allegedly over \$100,000 a year from his silicone injection business.¹⁹⁸ Ellison also injected silicone into other parts of the body, according to his clients' requests. The court records and transcript of the hearing held at Cook County Circuit Court Archives offer a rare and undiscovered resource on the underworld of illegal silicone injections. On the evening

¹⁹³ Kotulak and Bliss, 1975.

¹⁹⁴ Ibid.

¹⁹⁵ Cook County Case Number manslaughter 76CR3340 (1975) p. 4.

¹⁹⁶ Kotulak and Bliss, 1975.

¹⁹⁷ Cook County Case Number manslaughter 76CR3340 (1975).

¹⁹⁸ Kotulak and Bliss, 1975.

of her death, Tammy White met with April Vaugine, a 60-year-old trans woman (ethnicity unclear) from LA who had been working as one of Ellison's go-betweens, arranging silicone injections on his behalf since 1967. Vaugine, who had received gender confirmation surgery in Morocco in 1969, had received around 60 silicone injections from Ellison in total, and described Ellison's usual procedure:

'The person who was to receive the silicone injection would indicate the part of the body where silicone injection was desired. The person would then disrobe, [Ellison] would clean the skin with alcohol, mark off the area with an eyebrow pencil, and inject an anaesthetic with a hypodermic needle.'¹⁹⁹

Cis and trans patients pointed to parts of the body they wanted feminised and Ellison would inject the fluid in, using the same needle. Ellison was known to use the same syringe for anaesthetic and silicone, and on subsequent patients.²⁰⁰

Tammy White had seen a black-market silicone injector in the area before her appointment with Ellison, who had remarked that 'whoever had done the prior silicone injection had done a poor job.'²⁰¹ That night, White had multiple silicone shots to her bust and hips. She immediately felt nauseous and died what was called a 'liquid death' within an hour of being injected. A later coroner's report discovered 'extremely large amounts of silicone in [White's] breast tissue' as well as vacuoles to the lungs caused by silicone particles.²⁰² Ellison was found guilty of manslaughter and sentenced to one to three years in prison. As Ohle argues, trans men and women often had to rely upon the black market for hormones and cosmetic enhancement procedures for their survival, as there were no other options available to them, a situation that remains unchanged for many today.²⁰³

Silicone Implants

Just as the FDA turned its attention to silicone shots in 1964, a new type of silicone technology to permanently shape the female body was emerging. Frustrated by the limitations and issues of foam implants, Frank Gerow and Thomas Cronin of Baylor

¹⁹⁹ Cook County Case Number manslaughter 76CR3340 (1975) p. 3.

²⁰⁰ Ibid.

²⁰¹ Ibid.

²⁰² Ibid., p. 5.

²⁰³ See Jules Chyten-Brennan 'Surgical Transition', in Laura Erickson-Schroth (ed) *Trans Bodies, Trans Selves: a Resource for the Transgender Community* (New York: Oxford University Press, 2014), pp. 265-290.

University, Texas, were collaborating with DCCAMR on the design of what came to be known as the Cronin-Gerow silicone gel mammary implant. Profiting from the controversial coverage silicone shots had been receiving, silicone implants would be publicised by DCCAMR and surgeons alike as wholesome and safe solutions to shape the female body. As Haiken has noted, since silicone implants could be prefabricated and mass produced, they offered greater profits and also greater control.²⁰⁴ In some cases, female patients whose breasts had been amputated following complications from Dow Corning silicone shots had their breasts replaced by Cronin-Gerow implants.²⁰⁵ Implants, however, offered a very different solution to prospective clients. Las Vegas-based dancer Ruth Ponce was originally offered gel implants by a cosmetic surgeon; however, she decided against them, citing economic reasons. 'It would have meant six weeks out of work, along with a hospital bill, a bill from the surgeon and money for baby-sitters.'²⁰⁶ In addition to the costs associated with an in-patient procedure such as implantation of a silicone device, it was also an entirely different procedure in itself.

Ponce may have been presented with a sizing device such as the rare surviving Dow Corning Silastic Mammary Sizer demonstration kit (see Figure 6). The accompanying booklet for surgeons explained: 'a seamless, thinwalled, contoured silicone sizer enveloping a translucent silicone gel which closely resembles the characteristics of the SILASTIC (R) Mammary Prosthesis Seamless Design'.²⁰⁷

²⁰⁴ Haiken, 2002, p. 183.

²⁰⁵ See Fernando Ortiz-Monasterio and Ignacio Trigos (Mexico) 'Management of Patients with Complications from Injections of Foreign Materials Into the Breasts', *PRS*, 1.50 (July 1972), 42 -7.

²⁰⁶ Ruth Ponce, cited in Witt, 1974, p. 35.

²⁰⁷ 'SILASTIC Demonstration Mammary Sizer Implant Seamless Design 350 CC' booklet (1970), SHI.



Figure 6: Dow Corning Silastic Mammary Sizer Seamless Design Demonstration Kit, 1970

The patient, it appears, was then presented not with an actual implant but instead with a sizer device that was designed exclusively as a demonstration piece to ‘assist the surgeon in office patient counselling’.²⁰⁸ Dow Corning’s booklet, aimed at surgeons, gives them the ultimate agency: ‘allows the surgeon to accurately decide in the office the appropriate size for patient requirements’.²⁰⁹ It was also designed for ‘size demonstration or size determination in the operating room’ to ‘provide assurance of correct size selection’, again emphasising the surgeon’s agency in selecting the ‘correct’ design for the female patient’s body. A tangible external object, usually of a sizable nature, it was permanently embedded in the body, requiring anaesthetic and surgical incision. Removed from its Styrofoam plastic case, it feels precious to hold, the silicone suspended within it; a prized

²⁰⁸ Ibid.

²⁰⁹ Ibid.

fluid contained within a fragile object. The sizing device's agentic materiality reacts to touch: it warms with your hand temperature and mimics the softness of flesh, instantly moving and moulding to your body. Holding the sizing device in my hand, I was struck by its weight and physicality. This is the opposite of the 'featherlight' gelatinous technologies Preciado describes.

Devices such as the 1973 Surgitek 'Perras-Papillon Design Mammary Prosthesis (Figure 7) were marketed and photographed to look like bras that could sit neatly against the chest wall. Described as 'a soft seamless outer "skin" of Surgitek medical-grade silicone specifically designed to follow the individual left and right natural anatomic contours of the human female breast with axillary prolongation', these implants promised to 'simulate the natural weight and consistency of normal breast tissue'.²¹⁰ The curved 'organic' teardrop form, shaped by the possibilities of its materiality, differs greatly from the conical shapes of foam, that were compared to 'bullet', 'torpedo', 'rocket' or 'missile' design. They are the antithesis of the illusory instantaneity of a subcutaneous injection and yet they are also semi-transparent and appear weightless, as if suspended in mid-air. These objects do not look dissimilar to the silicone false inserts (also known colloquially as 'chicken fillets') available to purchase as bra inserts today.²¹¹ Ponce recalled in Las Vegas in 1964: 'silicone injections for the breast were almost as common – and considered only as a little more daring by most women – as wearing wigs and false eyelashes'.²¹² Silicone mammary implants were silicone's materiality manifest as object.

²¹⁰ 'Surgitek Inc., Sales Brochure' (1973), Walter Spohn Papers, NMAH, Division of Science and Medicine.

²¹¹ See for example Breast enhancers/Chicken Fillets/Bra Inserts, *Amazon* <https://www.amazon.co.uk/Breast-Enhancers-Chicken-Fillets-inserts/dp/B007FFGY0I> (accessed 21 February 2020).

²¹² Ruth Ponce, cited in Witt, 1974, p. 33.



Figure 7: Surgitek 'Perras-Papillon Design Mammary Prosthesis, 1973

Defined as a device and not a drug, Dow Corning marketers and designers ensured that implants steered clear of FDA regulations in the 12 years preceding the Medical Devices

Act of 1976. Fluid was contained in a manufactured object, the implants required surgery and were, therefore, by comparison with injections, more easily regulated and controlled. Silicone implants appeared to offer a solution for bust augmentation and reconstruction that could not easily be offered by an illegal market. Silicone's viscous materiality was now confined to a sac, competing with the earlier free-flowing injection into the body, and this marked its new containment within established structures (surgical spaces) and the supposed norms associated with this.

On 3 September 1975, Dow Corning distributed a press release stating it had filed a New Drug Application with the FDA, seeking approval to market a 'special sterile fluid to qualified surgeons for injection purposes.'²¹³ Its use would be limited to congenital defects, scars and surgical contour defects. The press release again was keen to distance Dow Corning from silicone fluid breast injections, claiming that this was 'a procedure that has never been approved or recommended by Dow Corning'.²¹⁴ It concluded, 'the medically acceptable means for enlarging the breast is to surgically implant a silicone device. The implanting procedure is a currently available means of therapy and is not affected by this application'.²¹⁵ Silicone shots were now strategically othered as something disapproved of by medical structures, enabling silicone implants to thrive as a 'safe' alternative.

On 7 January 1976, Arthur Rathjen, Senior Clinical Research Specialist, Medical Products Business at Dow Corning, testified to the Assembly Committee on Criminal Justice in Sacramento. California was proposing legislation to specifically outlaw the injection of silicone fluid into the human body, following the precedent of Nevada State Law. In his testimony on behalf of Dow Corning, Rathjen stated: 'for purposes of edification, the injection of liquid silicone originated in Japan and eventually found its way to this country.'²¹⁶ This appears to be an attempt to other silicone injection as a way of legitimising silicone mammary implants. In addition to othering and racialising the practice, again as something Japanese and 'clandestine', he also stated:

'Dow Corning has never sold silicone fluids for such purposes and we have never promoted, recommended, suggested or sponsored such usage. We do not consider it

²¹³ 'Dow Corning seeks approval for silicone fluid injections' press release September 3 1975, JMP, Box 1, Folder 34.

²¹⁴ Ibid.

²¹⁵ Ibid.

²¹⁶ A.H. Rathjen, 'Testimony Presented to the Assembly Committee on Criminal Justice in Sacramento', January 7, 1976. p. 2, Circulated to Silicone Committee members, February 16 1976, JMP, Box 1, Folder 34.

acceptable practice and we are prepared to cooperate in any way which would prohibit and eliminate such a practice.’²¹⁷

Whether or not Dow Corning ‘never promoted, recommended, suggested or sponsored such usage [silicone injections for breast augmentation]’ is questionable. This chapter has shown that Dow Corning provided free silicone samples for research into injectable silicone breast augmentation, for example to Conway and Goulian.

Dow Corning was clearly originally interested in silicone’s cosmetic application to the shaping of the female body. Additionally, its silicone sample materials were exported on an international scale to places including Israel, Poland and Germany, where they were tested on animals and humans for breast augmentation.²¹⁸ Rathjen assured the chairman and members of the Assembly Committee on Criminal Justice that, should Dow Corning’s medical-grade silicone fluid be approved by the FDA, it would be clearly labelled unfit for mammary injection. He then continued, ‘doctors are not opposed to implants — precisely the converse applies — they endorse the use of implants. It is the injection of liquid silicone which they have questioned’.²¹⁹ In this binary logic, silicone implants are ‘good’, silicone injections are ‘bad’. In conclusion, Rathjen, on behalf of Dow Corning, recommended the following:

‘[T]hat the state of California implement a program to inform and educate its citizens so that they will seek treatment with SILASTIC Mammary Prosthesis or other commercially available prostheses, to avoid potential dangers associated with injection of liquid silicone in the mammary area.’²²⁰

Dow Corning breast implants were thus offered as a safe option. As silicone implants were promoted by actors including DCCAMR’s Rathjen and journalists such as Morini, the fashionable breast shape also began to change and bustlines look rounder, in keeping with the smooth organic round shapes offered by silicone-filled sacs.

²¹⁷ *ibid* p. 2.

²¹⁸ See footnote 63.

²¹⁹ Rathjen, 1976, p. 5.

²²⁰ Rathjen, 1976, p. 6.

Following conical bullet bras, whirlpool stitching, falsies for the bust, hips and buttocks, and plastic foam implants, silicone shots were offered as the latest technological advancement for shaping and correcting women's bodies. The practice of free silicone shots exploited its viscous materiality, promising instant reshaping of the body. Challenging to regulate and control, an international material born of autarky, it slipped through established structures, enabling ongoing access to a range of socio-economic groups. Transgender health professional Jules Chyten-Brennan (2014) notes that more work needs to be done to bridge the gap in communication about silicone injections, particularly in dialogues within trans communities and medical providers: raising awareness of the historical practice of silicone shots can contribute to this conversation.²²¹

This chapter has used original archival research to explore the historical complexities of the postwar practice of silicone injections in the shaping of women's bodies. It has considered a diverse set of actors and networks and challenged established US Anglophone narratives of silicone's application to the shaping of women's bodies. It has argued that a practice of 'fluid othering' took place in which the practice of silicone shot treatment was conveniently racialised and 'othered' by a set of US actors, including chemical company and medical professionals, as well as journalists. Silicone was praised by actors such as *Vogue's* Morini as a safe and innovative medical development, as long as it was applied to treat and shape the bodies of married white US middle-class cis women on the East Coast in exclusive clinics such as Orentreich's, or by Edgerton in the cases he studied. Again, when Dow Corning began offering silicone breast implants, actors such as Silas Braley were able to distance the company from the practice of silicone shots and create a halo effect for the perceived safety of their implants. Silicone's othering also took place when silicone shot treatment resulted in complications or was associated with groups such as Japanese women, sex workers, trans women and particularly trans women of colour, who were less socially accepted in the postwar US. The chapter's central arguments demonstrate how highly gendered and racialised homosocial power structures, upheld and reflected in US military-industrial networks of plastics and medicine, changed the meaning of silicones and impacted on the shaping of women's bodies through silicone shots. This chapter has also argued that, in the postwar US, silicone's viscous materiality was able to slip through

²²¹ Jules Chyten-Brennan, 2014, pp. 269 – 271.

legislative cracks in US structures such as the FDA and AMA. Unlike implants, silicone shots could be administered outside the controlled traditional heteropatriarchal medical structures of the clinic and hospital. This saw the proliferation of an underground silicone network of new subversive subjectivities who were able to challenge and threaten heteropatriarchal structures such as the FDA and AMA, who ultimately made decisions about women's bodies. Despite the adverse effects silicone can have on the body, it can be argued that its trans-corporeality gave some women, like Carol Doda and Tammy White, who did not neatly fit into conventional ideas of heteronormativity, agency in auto-designing their own bodies.

Conclusion

Restatement of Aims

This thesis set out to explore a number of research questions relating to synthetic materials developed in the interwar, World War II and postwar periods in the US and their relationship to the shaping of women's bodies. Archival research in the US was designed to determine the impact the materiality of nylon, plastic foams (particularly polyurethane foam) and silicone had on decisions to use them on and with women's bodies in the US from 1939 to 1976. The purpose of the study was to discuss and explore how and why key actors, particularly chemical companies and cosmetic surgeons, chose to associate synthetic materials developed for industry and the military with women's bodies. More specifically, the thesis was undertaken to explore how and why key actors in synthetic materials research, development and use promoted military-industrial materials for use on and in women's bodies. It aimed to evaluate how the gender of actors in plastic materials development, design and production impacted on physical outcomes and the consequential effect this had on their corporeal applications. A second aim of the research was to employ a materials-based approach to historical research and to use this to provoke critical thinking about our use of plastic materials in relation to bodies and gender today. The thesis was designed with the aim of giving the materials agency and letting them also guide the research.

I allowed both intended contributions to evolve once I had embarked on archival research in the US in order to incorporate both international networks and groups largely neglected in the historiography, such as women of colour and trans women. A greater and more complex diversity of actors than I had originally anticipated emerged, from chemists to admirals, plastic surgeons to beauty salon workers, designers to sex-workers, chemical company sales executives to a First Lady. My original focus on the US widened as I traced the transfer of synthetics between the US and Germany and Japan, as well as to a lesser extent, other countries including Mexico, Israel, Singapore, Poland, the UK, Australia and South Africa. In addition, the racialised nature of the ideal female figure, or 'bombshell', became increasingly evident and reshaped the aims, addressing US racialised politics of the body. Moreover,

trans women developed as an important yet overlooked group of actors in the story, particularly as they have largely been omitted from histories of cosmetic surgery.

Research Findings / Key Contributions to Knowledge

As outlined in the introduction, the contributions of the thesis can be grouped into two central areas: the first is original empirical research findings and the second is methods. This thesis identified and used original archival material to challenge US-centric histories of plastics and cosmetic surgery to reveal complex international networks of technology transfer between countries, as well as from industrial and military contexts, to the gendered body. It provided detailed histories of the military-industrial provenance of polyurethane foam and silicones: unlike the well-rehearsed history of nylon's origins, these were missing from the literature. The focus of the thesis is on gender, as this is what guided the original research questions, however, the racialised dimension of the bombshell cannot be ignored and is highlighted throughout. Informed by an interdisciplinary and intersectional approach, the thesis addressed issues of gender, as well as those of race and ethnicity, within the shaping of the female figure, incorporating discussions of trans women and women of colour, to trouble unmarked norms and assumptions in plastics, design and cosmetic surgery scholarship. It argued that the pathologised 'healthy' and desirable female body was shaped by the fashioned body and vice versa, and that this was shaped by materials as they became available.

This focus on material agency provided the second, methodological, contribution. I not only argued that plastics offered new materialities and ways to shape the fashionable female ideal, and changes in medical technologies such as sterilisation and post-op care meant the body increasingly became a site of permanent auto-design and improvement, but that attention to the materiality of artefacts allows these significant but often silent or silenced historical narratives to emerge. The thesis connected histories of science, technology and medicine with those of design and fashion, gender, bodies, sexuality, race and ethnicity. It employed a material feminist inspired approach in order to present new perspectives on the interconnectedness of these areas and need to address these together. It also demonstrated how and why histories of science, technology, medicine, the body, gender and race and ethnicity are interrelated. Without this understanding, this thesis could not have existed.

Chapter One, on nylon, revisited DuPont's 1939 New York World's Fair and San Francisco Golden Gate Exposition to show how their displays served as laboratories for

testing new ideas about marketing their products and the importance of materiality and women's bodies within this. Each display was vigilantly monitored, and daily reports and weekly summaries were sent to the DuPont Advertising Department (DPAD). Nylon was soon identified as consistently the most requested item, and DPAD's staff and exhibit managers responded to female visitor feedback that demanded greater physical interaction with the material. Nylon's display on a live female model was not a top-down decision, but a complex negotiation between the public and DPAD. The chapter further argued that their 1939 displays functioned as experimental labs for testing new ways of promoting their latest material developments to the public, who wanted to feel it, touch it, see it on a live model and ask her questions about her corporeal experience with the world's first fully synthetic fibre. Archival research for this chapter also identified Katherine Mitton, giving agency to a key actor in the success of DuPont's launch of nylon. The chapter widened the established scholarship to consider 'Miss Test Tube' within wider contemporary discourse on eugenics and racialised bodies. Nationalism was also a central theme: nylon's timely unveiling to the public offered a synthetic alternative to Japanese silk imports. Overall, the chapter argued for the importance of the female body in nylon's successful launch on the commercial market as the world's first fully synthetic fibre.

Chapter Two, on polyurethane foam, identified and located intelligence reports on the German plastics industry, referred to in general but not specifically cited in primary and secondary sources on the subject. By centring arguments around corporeality and materiality, the chapter considered how touch and physical interaction were central in initial encounters with these materials when they were discovered by US plastics experts in Germany in 1945. The chapter traced polyurethane foam's transfer from Germany and launch to the US market, addressed the gendered performativity of polyurethane foam displays and the gendering of polyurethane foam's materiality in the postwar US market by chemical companies who envisioned it as an ideal malleable form for upholstery and furniture design. Chapter Three used this original research on polyurethane foam's provenance and transfer to the US to corroborate cosmetic surgeon Robert Alan Franklyn's claim to have sourced polyurethane foam from a Nazi bomber plane and created breast implants from it. It identified and analysed evidence to show how AMA-approved cosmetic surgeons sourced slabs of polyurethane foam from automobile suppliers for bust augmentation surgery and contextualised this with the comparisons made in popular culture

between the female body and cars and furniture. It argued for the importance of an interdisciplinary approach to the fashioned body, drawing on histories of design, fashion studies, plastics and cosmetic surgery, STS and critical theory, demonstrating how foam's sculptural and fleshy materiality shaped foundationwear, bustline trends and implants. It also argued that the pathologised female bustline in medicine mirrored the fashion trend for a conical bustline, and vice versa. This chapter also addressed the agency of the body, arguing that it, too, had agency and interacted with foam implanted in it. It noted that similarly, polyurethane foam retains its own agency in museum storage in terms of off-gassing effects on textiles and their storage containers, leaving a legacy of orange stains, a visible reminder of how such materials, once implanted, are likely to have behaved within the body.

Chapter Four, on silicone, provided a history of the material's R&D, including its international aspects, and complicated Dow Corning's victor narrative as 'First in Silicones' through chemists' competing oral histories at SHI. It showed how Dow Corning profited from military-industrial ties that led to its expedited founding as a joint venture between Dow Chemicals and Corning Glass Works and its continued profit from these in the postwar era. Chapters Four and Five examined a seemingly disparate set of actors from networks including fashion, chemistry and medicine and traced their role in the changing meanings attached to silicone and its applications in the postwar US, from its original aviation applications to new corporeal markets via 'Pan Glaze' for bakers to an anti-bloating solution for cattle, expensive face creams to medical devices and the practice of silicone injections in luxury Manhattan clinics to the go-go dancing scene of San Francisco and its impact on the shaping of the fashionable ideal. Chapter Five used archival AMA-approved US surgeon papers to trouble the racist myth perpetuated in the historiography of cosmetic surgery that claims 'the Japanese' stole silicone from US occupying forces and 'pumped' it into local sex workers' bodies to enhance their appeal to the *occupationaire*. It widened the historiography by drawing on original evidence including legal documentation to address the role of silicone in shaping trans women, particularly trans women of colour.

In summary, the study has highlighted the connections between medicine, chemistry, industry, plastics, fashion and the military, and the impact of these on the practice of shaping women's bodies. It has shown how a diverse and complex set of actors, including chemical company advertising and sales executives and surgeons, selected the

female body as a site on which to demonstrate, domesticate and apply advancements in plastics materials research and development. This thesis has argued that women's bodies were central to the commercial creation of new markets and material identities for nylon, polyurethane foam and silicone in domesticating them, feminising them as non-threatening and sexualising them as desirable. And it has done so through persistent and extensive archival research, and through insistence on attending to the materiality of the materials involved.

By arguing for the importance of understanding materials as historical artefacts, the thesis has traced the changing meanings associated with these new plastic materials, particularly in relation to their impact on the shaping of the 'ideal' fashioned and pathologized female body and the links between this. The thesis has provided critical contextualisation for the gendered and technological provenance of materials that continue to be used in the shaping of the female body today. It has researched and presented the materials' provenance and later applications, and shown how they became gendered and racialised in the process, arguing that these are emblematic and material manifestations of the prevailing structural power inequalities. Many of these structures are still in place today, and it is important to understand them in order to move forwards and better engage with their disruptive potential for 'queering' the body and their power to create new subjectivities, and thereby to challenge unequal power structures.

Limitations of the current study

Finally, a number of important limitations should be considered. The research was partially limited to the archives accessed and the information held within them. When researching the Silicone Committee, I contacted the home institutions of all eight members to find their archives. However, only a small number of surgeons left papers to archives, which limited this study. I accessed the papers of all the surgeons (Joseph Murray, Milton Edgerton and key related figure Herbert Conway, and the papers of the Gender Identity Clinic where Edgerton worked) who left papers to archives, including those relating to polyurethane foam, silastic, silicone and breast augmentation. These archives are all located on the East Coast (except for the AMA and Cook County Court Archives in Chicago) – and it should be noted here that I contacted medical and chemical company archives in Michigan and Texas, but they had no relevant papers. My research uncovered important connections to chemical

companies and cosmetic surgeons in Germany and Japan. However, I was not able to travel to these places. Although I am fluent in German, I do not read Japanese, and this has also limited my access to Japanese medical journals and texts (although I did receive some help with this). It should also be noted that a number of key actors, such as Franklyn, Frederick's of Hollywood and DCCAMR, left no papers in specific archives. The study thus relied on their papers and artefacts held in other collections. Limitations also relate to access to evidence and the timescale of the project. As stated in the introduction, given the interdisciplinarity and the significance of the themes of the thesis, there are many potential directions for further inquiry which I have had to set aside, due to the scope and the word count of the thesis. This would include detailed examinations of the Hiroshima Maidens and 1959 Miss Universe winner Akiko Kojima and analysis of relevant feature films, as well as further extensive research I carried out on injectable Japanese bust-enlarging fluids and their connection with US surgeons.

Areas for future research

This thesis has demonstrated that if the history of plastics R&D and its impact on the shaping of the female fashioned body is to be moved forward, a more intersectional, inclusive, global and interdisciplinary approach must be developed. The thesis has shown that chemical and medical research and development on plastics and the shaping of women's bodies took place internationally, particularly in Germany and Japan, and an archival study similar to this one could be carried out in these countries to produce further important findings.

Another fruitful area of research would be a deeper analysis and exploration of theory in relation to the empirical findings of the thesis. Such research is timely in that it coincides and engages with current, and increasingly pressing, debates on plastics, the material turn in contemporary critical theory (Bennett, Alaimo, Latour), posthumanism, trans-corporeality and queer discourse on the body (Preciado, Davis, Chen).¹

¹ Jane Bennett, *Vibrant Matter: a Political Ecology of Things* (Durham, NC: Duke University Press, 2009); Stacy Alaimo, *Bodily Natures: Science, Environment and the Material Self* (Bloomington, IN: Indiana University Press, 2010); Bruno Latour, 'Can We Get Our Materialism Back, Please?' *Isis* 98 (2007), 138-142; Paul B. Preciado, *Testo Junkie: Sex, Drugs, and Biopolitics in the Pharmacopornographic Era* (New York: Feminist Press, 2013); Paul B. Preciado *Pornotopia: An Essay on Playboy's Architecture & Biopolitics* (New York: Zone Books, 2014); Heather Davis, 'Toxic Progeny: The Plasticsphere and Other Queer Futures', *philoSOPHIA*, 5.2 (2015), 231-250; Mel Y. Chen, *Animacies: Biopolitics, Racial Mattering, and Queer Affect* (Durham, NC: Duke University Press, 2012).

Further research regarding the role of the queering of technology will make a worthwhile contribution. As this thesis has argued, plastic materials were not only utilised by cis women seeking to enhance their curves and 'pass' for the hyper-feminine postwar bombshell ideal. Trans women also shaped their bodies cosmetically with plastics, both externally and internally. Trans individuals, however, have been historically neglected from histories of fashion, design, technology and plastics.

A greater focus on silicone could produce helpful findings that offer an account with greater emphasis on theoretical explorations of its materiality and role in the shaping and designing of trans-corporeal bodies today. Today the practice of silicone injections for artificially augmenting the body largely affects cis and trans women of colour. Historical research could be combined with current medical research and queer community activism in response to the continued practice of shaping the body with silicone shots today. More information on silicone's historical context and military-industrial provenance can also contribute further to contemporary international debates on the policy around silicone shots. Chyten-Brennan (2014) notes the need for more work to be done to bridge the gap in communication about this issue, particularly in dialogue within trans communities and medical providers; raising awareness of the historical practice of silicone shots can contribute to these conversations.²

Finally, the thesis has demonstrated how an intersectional and interdisciplinary, critical and archival approach to the history of design can contribute to a number of closely interconnected areas. By carrying out extensive research in the US and participating in a number of fellowships I was able to embed myself within research institutions outside of my home discipline, including the history of medicine and STS, while engaging in a transatlantic knowledge exchange around plastics in the US and the fashioned body. I have combined this with archival research and an approach that engages with critical theory of the body. This has enabled me to connect the history of design and the fashioned body with histories of materials to show the importance of better understanding the provenance of plastics, the unequal power structures that shaped them (and that continue to impact on the historiography), their materialities and the ways in which they were gendered and anthropomorphised, and how this influenced their application to the shaping of women's

² Jules Chyten-Brennan, 'Surgical Transition', in Laura Erickson-Schroth (ed.), *Trans Bodies, Trans Selves: a Resource for the Transgender Community* (New York: Oxford University Press, 2014), pp. 265-290 (pp.269-270).

bodies, a practice that continues today. In further research, I intend to continue this approach, further exploring and modelling how interdisciplinary, intersectional work that brings materiality to history, and critical theory to archives, can contribute to rendering power structures visible.

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