

Spatial Reckonings

Mapping the *Raumproblem* in Modern Mathematics
and German Modernism, 1890-1933



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Declaration

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Thomas Hedley

Summary

By placing the transformative era of the late 19th century to the early 20th century under the microscope — a period in which both mathematics and the arts underwent significant change — this thesis aims to show that the label “modernism” can envelop the two disciplines by exposing commonalities on two distinct levels: philosophical influence and the question of expression and representation. As a more specific pathway into this comparative analysis, a two-fold *Raumproblem* is used as a conceptual and methodological lens through which to probe these commonalities: (i) the study of space becomes an examination of invariant properties within transformation, which (ii) actions and is then incorporated within a wider separation of mathematical language from empirical or transcendental objects exemplified by the formalist school of mathematical thought.

Beginning at the “end” of German-language modernism with the rise of Nazism in 1933, the introduction briefly correlates the ideological incursion against modern art and literature in the 1930s with the lesser-known attempt to establish a paradigm of *Deutsche Mathematik*. While the movement failed, the contemporaneity of the two attempts to erase expressions of “modernism” raises a question that has been taken up by various scholars in recent decades, namely: how “modernist” is modern mathematics? By taking stock of both the pitfalls and the benefits of existing work in the history of mathematics (e.g. Mehrrens 1990; Gray 2008; Corry 2013) and in literary criticism (e.g. Albrecht 2008; Engelhardt 2018), a flexible approach is constructed, which works thematically (i.e. with respect to spatiality) as opposed to an adherence to overarching, inherently flawed definitions of modernism. In seeking to ascertain moments of shared philosophical influence across disciplines, in turn, a less restrictive focus on representations of mathematics by trained mathematicians (e.g. Robert Musil and Hermann Broch) is made possible.

A lengthy Chapter 1 is an exercise in the history and the philosophy of mathematics, with an initial sketch from Euclid’s *Elements* to the transformative moment of the late 19th and early 20th centuries both bolstering a conception of space proposed in the introduction and setting up the subsequent focus on the topologist Felix Hausdorff as a case study of cross-cultural practices and influences. Foregrounding initially Hausdorff’s inaugural lecture of “Das Raumproblem” in Leipzig in 1903, the majority of this chapter is dedicated to underscoring the influence of the decidedly non-mathematical philosophies of Friedrich Nietzsche on his mathematical thinking. Specifically, Hausdorff’s conception of space by way of a *Transformationsprinzip* within a broader “Spielraum des Denkens” will be traced back through his essayistic and philosophical writings, focusing on his engagement with Nietzsche’s *ewige Wiederkehr des Gleichen* and his critique of language and knowledge in particular. As such, this section fuses the impactful philosophy of Nietzsche to key developments in modern mathematics, and it thus “excavates” a small, local but nonetheless important moment of cross-disciplinary influence.

Having isolated an instance of shared philosophical influence in Nietzsche, the subsequent chapters successively probe the question of parity of spatial expression between modern mathematics and aesthetic modernism. Firstly, in Chapter 2 the topological maxim of “invariance through change” is used to assess a potential “topological turn” in German modernism, taking F.W. Murnau’s landmark film *Der letzte Mann* as a case study. Cast by critical consensus as a showcase for unrelenting change and transformation (e.g. Kracauer 1947, Eisner 1980), the film is re-assessed from a more mathematically cognisant perspective. It will be argued that, upon more careful analysis, the many processes of change in *Der letzte Mann*, both in plot and cinematography, serve to reveal subtle and concealed continuities therein. To further

ground these findings, certain elements of the prose texts by Franz Kafka, the “ultimate topological author” (Fletcher 2016), will be brought into conversation with the film.

Building on this nuanced dynamic between metamorphosis and invariance, Chapter 3 turns towards the literary scene of 1920s Vienna and the recently re-discovered Mela Hartwig with a view to observing not only a continuation of this topological concern for invariance but also its entanglement within a broader renunciation of content and objects. Contextualising Hartwig’s two novels *Das Weib ist ein Nichts* (1929) and *Bin ich ein überflüssiger Mensch?* (1931) within a misleading cultural paradigm shift of “die neue Frau” and a misogynistic societal discourse on gender dominated by Otto Weininger’s pseudomathematical *Geschlecht und Charakter* (1903), it will be argued that Hartwig both satirises and subverts her contemporaries in a way that is curiously mathematical in nature. Reimagining Weininger’s conception of the woman as a *Nichts* — infinitely malleable material sculpted at the hands of invariant men — into something more topologically nuanced, it is argued that Hartwig’s protagonists find in this nuance an often-destructive agency that is contingent upon their titular *Nichtigkeit* and *Überflüssigkeit*. In short, in this chapter the two tenets of space and spatiality identified above begin to synchronise.

Then, Chapter 4 turns to the wider question of language, ontology and objects in their own right. In search of like-minded companions in the artistic realm, this chapter indirectly sets up a secondary comparison between two modernist movements that grapple with these issues very differently: Bauhaus and Dadaism. At first glance, Bauhaus, with its overt use of geometrical terms and ideas alongside the guiding philosophies of constructivism and formalism, is better placed for a comparison with the logical language of mathematics. However, this chapter will upset ostensibly plausible alignment of mathematical modernism and Bauhaus and present Dadaism as an unlikely ally to the guiding principles of mathematical formalism. Considering the works of Wassily Kandinsky and Walter Gropius, Bauhaus, it is argued, is beholden to two philosophies that mathematical modernism either outgrew or directly opposes: a Kantian view of geometry (which is tethered to the empirical space of the world via the transcendental aesthetic) and a Platonist/realist view of mathematical objects. Conversely, by reflecting upon Ernst Cassirer’s *Substanzbegriff und Funktionsbegriff* (1910), in which modernist shifts in mathematics are linked to a break away from traditional Aristotelian logic, it will be shown that the ostensible “anti-logic” of Dada can be feasibly reimagined as the *alternative* form that undergirds the non-ontological, axiomatic and conceptual workings of mathematical formalism. Here, focus will be drawn to Tristan Tzara’s manifestos and the much-debated name “Dada,” before working outwards to suggest possible re-conceptualisations of readymades, photomontages and assemblages.

Finally, a conclusion will summarise the findings of these successive chapters and bring them to bear upon the overarching question of integrating modern mathematics into the wider modernist fold. Furthermore, as well as gesturing towards further meaningful comparisons across these two discourses that exceed the scope of this thesis, this conclusion will also take stock of other potential approaches that could further the ongoing project of interweaving mathematics and cultural expression.

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Despite a great fondness for it, I have never been someone for whom mathematics comes most naturally. Unlike the gifted few, I would often toil at it for months, regularly fail, and develop a knack for suddenly understanding things long after the exams had passed. The self-doubt this can trigger is well known to mathematics educators, and my decision to push through is largely indebted to some patient and non-judgemental members of TCD's School of Mathematics. Some of them are no longer with us. I would like to thank: Professor Donal O'Donovan (1946-2019), always covered in chalk dust and carrying a can of coke ("*never* diet!"), for his approachability and warmth; the dry-humoured Professor Richard Timoney (1953-2019); the kindly Dr Paschalis "Pete" Karageorgis; and Elizabeth Oldham, whose inspiring seminar on Mathematics Education taught me to think about mathematics in entirely new ways.

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O

An Introduction, or: Lines in the Sand

“But mathematics is the sister, as well as the servant, of the arts and is touched with the same madness and genius.”¹

— Marston Morse

“Ein erfolgloser Künstler machte [...] der erfolgreichen Kunst der Moderne den Prozess,”² writes Thomas Anz in the sobering foreword to his far-reaching 2002 survey of German *Expressionismus*. Here, Anz is of course referring to the complicated relationship between Hitler’s fascism, the cultural scene of the Weimar Republic from which it emerged, and indeed aesthetics as a whole. While Walter Benjamin contends that “Faschismus läuft folgerecht auf eine Ästhetisierung des politischen Lebens hinaus,”³ the ideology of Nazism with regards to art and cultural production is perhaps more concretely evidenced by the treatment of art and artists in the Nazi regime. Indeed, the latter’s *Kulturpolitik*, led by propaganda minister Josef Goebbels, saw a large-scale attempt to “purify” the cultural scene of the proclaimed 1000 Year Reich. Bookending the antecedent Weimar Republic and the “efflorescence of modern art, literature, film and music”⁴ that it witnessed, in Stephanie Barron’s words, the first manifestation of this “Prozess” at the hands of a mediocre artist took the form the notorious book burnings of May 1933. Alongside Marxist, communist or pacifistic literature and any writings of Jewish authorship, tens of thousands of literary works, many “aus dem Umkreis des Expressionismus,” as Anz indicates, were, to use the ominous phrasing associated with the burnings, “den Flammen übergeben.”⁵ This *Kulturkampf* is perhaps best encapsulated, however, by the infamous

¹ Marston Morse, “Mathematics and the Arts,” *Bulletin of the Atomic Scientists* 15, no. 2 (1959): 55.

² Thomas Anz, *Literatur des Expressionismus*, 2nd ed. (Stuttgart and Weimar: J. B. Metzler Verlag, 2010), 1.

³ Walter Benjamin, *Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit* (Frankfurt am Main: Suhrkamp, 2003), 42. This “Ästhetisierung der Politik” takes many forms, from stylised military parades “im Kult eines Führers” to propagandised cultural production, and while it is to communism that Benjamin ascribes “die Politisierung der Kunst,” the role of art in the fascist regime that secured power in Benjamin’s time and home nation, German Nazism, is surely no less political. *Ibid.*, 42f.

⁴ Stephanie Barron, ed., *Degenerate Art: The Fate of the Avant-Garde in Nazi Germany* (New York: Harry N. Abrams Inc., 1991), 11.

⁵ Neil H. Donahue attributes the stunted development of German modernism, particularly expressionism, to the book burnings: “To a large extent, the writers of German Expressionism and their works, literally the copies of their books, along with the audience for those texts, were destroyed by the Nazis. The book burnings [...] prevented or forestalled for decades further reception and critical, scholarly scrutiny of these works, and thus still

4-month long exhibition in Munich in 1937, namely *Entartete Kunst*. A collection of the modern art that had been deemed un-German, unnatural and responsible for a perceived cultural disintegration, the exhibition showcased works across most major strands of modernism, from Expressionism and Dadaism to Neue Sachlichkeit, Surrealism and Cubism, foregrounding artists such as Ernst Ludwig Kirchner, Otto Dix, Paul Klee and Käthe Kollwitz.⁶ Aside from the cruel fates of many modern artists in Germany of the 1930s and 1940s, which Anz records in his foreword,⁷ the exhibition therefore marked, as Neil Donahue writes, “the apogee of the impulse in Germany toward virulent anti-modernism,”⁸ and was tantamount to the attempted murder of German modernism.

This ideological incursion against *die ästhetische Moderne* by the National Socialist regime is indeed well documented, and it forms the basis of much scholarship surrounding the relationship between Nazism and art. A parallel can be drawn, however, with another, much lesser-known manifestation of censorship and propaganda during the Third Reich: that pertaining to mathematicians and, more curiously, mathematics as a discipline. While the cruel fates of many (often Jewish) mathematicians who were active in German universities are painstakingly documented by Sanford L. Segal in *Mathematicians under the Nazis*,⁹ the intersection of Nazi ideology and mathematics — an unlikely conceptual pairing to most — is most tangibly observed in the attempt to establish a paradigm of “Deutsche Mathematik.” Led by Berlin-based mathematician Ludwig Bieberbach, a member of the *Sturmabteilung* (SA) who became a full party member of the NSDAP in 1937,¹⁰ the movement began to communicate its philosophy through a bi-monthly scientific journal entitled *Deutsche Mathematik* from February 1936. With Bieberbach as chief editor, the journal was officially published by his influence Theodore Vahlen, a Viennese mathematician and Gauleiter of Pomerania, who, like Bieberbach,

determined in large part the reception of that work.” Neil H. Donahue, ed., *A Companion to the Literature of German Expressionism* (New York: Camden House, 2005), 26f.

⁶ Barron, *Degenerate Art*, 9. Barron’s volume carefully curates and analyses the works of these artists and reconstructs the exhibition itself, alongside facsimiles of the brochures and tickets for the event in Munich. Despite the racial connotations of the term *entartet*, Barron notes that only 6 of the 112 artists defamed at the exhibition were Jewish: The supposed degeneration hinged much more upon artistic output and aesthetics. Indeed, in an Orwellian twist, the very framework used by the *Reichsministerium für Volksaufklärung und Propaganda* to identify deviant artists was based upon none other than Carl Einstein’s periodical of modern art *Die Kunst des 20. Jahrhunderts*, rendering those represented, as Barron points out, “easy targets” for vilification. *Ibid.*, 9f.

⁷ Anz, *Literatur des Expressionismus*, 2.

⁸ Donahue, ed., *Literature of German Expressionism*, 26.

⁹ Sanford L. Segal, *Mathematicians under the Nazis* (Princeton and Oxford: Princeton University Press, 2003). Segal collates the harrowing stories of censorship, blacklisting and often imprisonment of Jewish mathematicians working in German academia from 1933 until 1945, such as Erich Hecke, Ernst Zermelo and Felix Hausdorff. The latter’s works in mathematics, philosophy and the arts will form a central pillar of the following analysis.

¹⁰ *Ibid.*, 356f. Segal frames Bieberbach’s turn to the Nazi party as an opportunistic move by an undoubtedly gifted mathematician who had, in his eyes, been denied the career advancement he believed he deserved. This opportunism is reiterated by Mark Walker, *Nazi Science: Myth, Truth and the German Atomic Bomb* (New York: Springer US, 1995), 85f.

joined the *SA* in 1933, but defected to its successor, the *Schutzstaffel* (SS) in 1936.¹¹ Divided into two sections, “Forschung” and “Arbeit,” as Philipp Kranz notes, the journal initially showcased in the latter section racialised contributions, largely pertaining to the discipline’s pedagogy, but these more directly ideological articles were not included beyond the second volume.¹² Nevertheless, the journal by no means became a mainstream scientific journal like *Mathematische Annalen*, for example, a longstanding hub of mathematical research in German-speaking institutions.¹³

Mathematics, as with most developed disciplines, has many inter-related but distinct sub-disciplines (such as algebra, geometry, calculus, analysis, statistics, and mechanics), and Kranz indicates that the fields of “geometry and statistics were disproportionately highly represented” in *Deutsche Mathematik*, when compared to other journals of the era.¹⁴ The manifest over-representation of two particular categories of mathematical research is neither without reason nor consequence; as Kranz claims: “These were the disciplines that could most easily become connected with ideology.”¹⁵ This association of certain types of mathematics with ideology needs to be unpacked somewhat. The two aforementioned fields — geometry and statistics — by their very nature touch upon central philosophical and practical issues within the discipline of mathematics. Historically speaking, geometry and arithmetic (and statistics is based upon the latter) form what are often called the ancient, “central pillars” of (European)¹⁶ mathematics, as both find their origins in around 2000BC in Ancient Egypt and Mesopotamia. Both areas were developed into well-defined concepts, however, in Ancient Greece (by Euclid of Alexandria for geometry and Archimedes for arithmetic), which prompts the common characterisation of the Hellenic civilisations as the birthplace of mathematics as it is known today. Here, one cannot overlook the well-documented enthusiasm for Ancient Greece (and its successor, the Roman empire) within the Nazi leadership, particularly with regards to architecture and art, and it could be posited that this enthusiasm informed any attempts to connect mathematics and ideology. In more practical terms, geometry and statistics substantiate the sub-discipline known as applied mathematics, as opposed to what is referred to as “pure” mathematics; this is particularly clear

¹¹ Walker, *Nazi Science*, 85ff.

¹² Philipp Kranz, “The Journal ‘Deutsche Mathematik’ (1936-1942/44),” *History of Mathematics in Germany, 1920–1960* 3 (2010): 133.

¹³ Ibid.

¹⁴ Ibid.

¹⁵ Ibid.

¹⁶ Here it is necessary to emphasise the Eurocentric nature of this discussion of mathematics. As Irish-Nigerian scholar Emma Dabiri explains, “When it comes to maths, the African, Arab and Chinese mathematical systems are largely ignored, and the origins are located with the Greeks.” The scholarly challenges to this Greek paradigm will return in the conclusion to this thesis. Emma Dabiri *Don’t Touch My Hair* (New York and London: Penguin Random House, 2019), 221..

for statistics, which applies arithmetical methods to analyse given data sets. Relatedly, Euclidean geometry forms the theoretical foundations for classical mechanics, most commonly associated with Isaac Newton, and which overlaps substantially with the empirical science of physics. Unsurprisingly, as paradigmatic examples of mathematical *Anwendung*, these fields have often found use in an area of great concern to the modern, militarised nation (Nazi Germany is no exception), namely industry and technological warfare.¹⁷

Yet there is another, much more complicated and consequential issue that is unearthed by the privileging of geometry in particular by the “Deutsche Mathematik” movement. The term “geometry,” from the Greek *geo* (earth) and *metron* (measure) is understood primarily as referring to the study and measurement of space, more specifically the empirical space of the natural world, facilitating the aforementioned disciplinary proximity to physics. Arising (by most historical accounts) from attempts to resolve disputes over land measurements, geometry has historically been regarded, in short, as “die Vermessung der Welt,” to borrow the title of contemporary Austrian-German novelist Daniel Kehlmann’s unexpected bestseller of 2005. This earthly essence of geometry has of course been integral to its cultural image since antiquity. As Benjamin Wardhaugh notes, many depictions of Ancient Greek geometers at work show them scoring lines and shapes into the dry sand beneath them, “raking in the ‘learned dust’, as the Roman orator Cicero put it.”¹⁸ The most common account of Archimedes’ death during the capture of Syracuse by the Roman Empire is somewhat iconic in this regard. Interrupting the mathematician as he pondered over his geometrical figures he had etched in the sand, a Roman soldier killed Archimedes on the outskirts of the city when he disobeyed a summon to see Marcellus. Archimedes had ostensibly insisted that he had to finish working through the geometrical conundrum first. He perished, therefore, both literally and figuratively over his lines in the sand (depicted below in Fig. 0.1):

¹⁷ Herbert Mehrtens, “The Social System of Mathematics and National Socialism: A Survey,” *Sociological Inquiry* 57, no. 2 (1987): 163.

¹⁸ Benjamin Wardhaugh, *Encounters with Euclid: How an Ancient Greek Geometry Text Shaped the World* (Princeton, NJ: Princeton University Press, 2021), 11.



Figure 0.1: The doomed Archimedes and his sand figures¹⁹

This conception of geometry and indeed of *space* in mathematics endured (albeit with fluctuating philosophical underpinnings) for millennia, positioning mathematics in close proximity to the natural sciences and their concern for the empirical space of the world around us. By the latter half of the 19th century, however, this consensus had collapsed, with the scandalous discovery of non-Euclidean geometries serving as a catalyst for a transformation into what would become known as “modern mathematics”: a period of profound change from the late 19th century to the early 20th century that saw a total realignment of the discipline’s understanding of itself and its subject matter. In his 1987 analysis of Bieberbach’s movement in particular, the late historian of mathematics Herbert Mehrtens summarises the transition to modern mathematics with respect to ontology and autonomy:

Mathematics gained cognitive autonomy during the 19th century through de-ontologization, self-justification, and productive self-reference. De-ontologization meant giving up the basic assumption that mathematics is concerned with real space and with magnitudes as applied in the real world. The legitimacy lost through giving up ontological ties to the real world was compensated through self-justification by method. Instead of the inquiry into the ‘nature of the object’ it was the methodologically and logically controlled conceptualization of relations and operations which became the object and justification of mathematical knowledge. With this mathematics became, in its ‘pure’ core of knowledge production, self-referential.²⁰

¹⁹ Etching after painting by Gustave Courtois (1852-1923), digitally archived by the Courant Institute of Mathematics at New York University. “Death of Archimedes Illustrations,” Math at NYU, Last modified October 12, 2022, <https://math.nyu.edu/~corres/Archimedes/Death/DeathIllus.html>.

²⁰ Mehrtens, “Mathematics and National Socialism,” 164.

Characterised here by a central “de-ontologization” with regards to space, the rise of modern mathematics can be seen to mark a shift in focus from the empirically minded geometry, which is to say an *outward* looking conception of space, to a more *inward* looking, formal and self-reflexive production of knowledge. While it will be discussed in more detail later, for now it suffices to note that to speak of geometry as it had been understood since the origins of mathematics, as an inherently *worldly* field of inquiry emerging from lines in the sand, draws attention to another line in the sand: one in the history of mathematics. Returning to *Deutsche Mathematik*, the journal’s choice to prioritise geometry, in the wake of this turning point in the discipline, is thus necessarily “fachpolitisch”: the epochal line in the sand extends into an ideological one.

As reactionary as the regime from which it emerged, the *Deutsche Mathematik* journal and its eponymous movement were thus also driven by a forceful anti-modernism within the discourse of mathematics.²¹ Unlike *Entartete Kunst*, however, which toured Germany and Austria and eventually reached an estimated audience of 3 million viewers, earning it the notoriety which it has been accorded in scholarship to this day, the story of “Deutsche Mathematik” and its associated publication is one of failure. The publication timeline of journal issues became increasingly irregular,²² and, as Mehrtens notes, a compromise between the professional autonomy of mathematicians and an anti-intellectual state apparatus, which was ultimately more interested in the instrumentalisation of the sciences, rendered Bieberbach and his movement largely unsuccessful in their aims.²³ In short, the censorship of modern art in the Reich was state-led, whereas the radically anti-modern *Ideologisierung* of mathematics centred around a few intellectuals who were sympathetic to the regime. This divergence in scale likely accounts for the relatively scant attention paid to *Deutsche Mathematik* in existing scholarship, in stark contrast to the prolific Munich exhibition. Nevertheless, this historical line of enquiry has unearthed a curious intersection: alongside the ideological assault on *die ästhetische Moderne* by the Nazi leadership, there was a decisive attempt by German mathematicians aligned with the party’s ideology to bolster premodern conceptions of mathematics and smother revolutionary developments that ushered in a mathematical *Moderne*. One could thus posit a counterpart to “entartete Kunst” in “entartete Wissenschaft,” where the proximity to that which is notionally “modern” signals the *Entartung*. Though for all the wrong reasons and sinister motivations, it is

²¹ Mehrtens characterises the movement as an extremist form of the “Gegenmoderne” school of thought that emerged in the wake of non-Euclidean geometries and the changes described in his definition. *Ibid.*, 166.

²² Kranz, “The Journal ‘Deutsche Mathematik,’” 134.

²³ In his article, Mehrtens charts the downfall of Bieberbach within the mathematical community, attributing this to his failure to convince the leadership of the NSDAP to provide the necessary resources to enable his domination of the *Deutsche Mathematiker-Vereinigung*. Mehrtens, “The Social System of Mathematics,” 168f.

indeed logical to observe in the above stories of cross-disciplinary censorship and propaganda that modern mathematics and aesthetic modernism have more in common than their mere co-existence at the beginning of the 20th century and the nebulous adjective “modern.” Can the decades leading up to 1933, therefore, be perceived as a point at which these two disciplines began to harmonise in some way?

Despite the often-celebrated ascent of “interdisciplinarity” within academia in recent decades, despite the wealth of research on European modernism, and indeed despite the historically aware use of the term “modern” within the mathematical community, such questions have been afforded too little attention. Mathematics and the arts continue to be viewed as unrelated disciplines, forming what novelist C. P. Snow branded the “two cultures” in 1959: separate academic spheres that — to their mutual detriment — are treated as having very dissimilar origins, influences, methods and aims.²⁴ In spite of Snow’s timely warning, this cultural divide has ultimately been realised: the humanities and mathematics, the latter frequently grouped with the empirical sciences by way of the increasingly partisan acronym STEM, occupy very different spaces on the traditional university campus. In a disciplinary sense, therefore, yet another deeply embedded line in the sand persists. It is precisely this enduring consensus that this dissertation seeks to undermine. By bringing modern mathematics into a conversation with the relatively simultaneous developments in literature, film and visual art, this thesis aims to uncover not only the potential overlap in philosophical influences and debates that undergird both realms, but it also intends to demonstrate that the modes of expression and representation that arise from these debates are by no means as divergent as they are often taken to be. As such, by burrowing underneath this disciplinary line in the sand, I endeavour to show that it is in fact a more superficial one than it initially seems to be. In turn, by beckoning modern mathematics into the wider modernist fold, it is hoped that a more mathematically aware, inclusive and simply more *useful* understanding of modernism in its broadest sense will begin to take shape.

With this overarching aim in mind, a more precise and feasible pathway to achieving it is now needed. At this point it is necessary to look backwards before looking forwards, i.e. to existing research that interrelates aesthetic and mathematical modernisms and indeed mathematics and the arts more broadly. The relatively niche nature of these pursuits attests to how deeply entrenched these disciplinary divides are; there have to date been comparatively few scholarly attempts to establish a meaningful conversation between mathematics and the arts. However, by casting a net wide enough to account for the intellectual labour in several fields, some

²⁴ C.P. Snow, *The Two Cultures* (Cambridge: Cambridge University Press, 1998).

fundamental first steps come into view. In lieu of a formal literature review, the following paragraphs will survey existing approaches to answering the questions above from several (inter)disciplinary standpoints, principally emerging from the small but vibrant field of the history of mathematics and from mathematically engaged literary criticism. This appraisal serves to identify common pitfalls in the pursuit of positioning modern mathematics alongside cultural modernism and helps to distil a more refined, rigorous and robust pathway forwards. While historical studies into the period known as modern mathematics are plentiful, the specific question of a possible “modernism” in mathematics has been discussed in most detail by the late Herbert Mehrtens (1946-2021) in a far-reaching 1990 survey *Moderne-Sprache-Mathematik*, British historian Jeremy Gray’s *Plato’s Ghost: The Modernist Transformation of Mathematics* (2008), and more succinctly (but no less directly) Leo Corry’s 2013 article “How Useful is the Term ‘Modernism’ for Understanding the History of Early Twentieth-Century Mathematics” in *Modernism and the Sciences, ca. 1900-1940*. When working largely chronologically through these three interventions but accounting for critiques that arise in the subsequent analyses, a multiplicity of possible approaches becomes apparent. Each of these is delineated by varying degrees of geographical spread, the question of overarching characterisations of modernism and reliance on differing modes of historical analysis. These divergent routes, as will become clear, then come to both inform and work in tandem with later discussions of mathematics and modernism in literary criticism — a disciplinary strand still very much in its infancy. To focus on an analysis of German-language literature, attention will be drawn to the work of two contemporary scholars: Andrea Albrecht, whose 2011 monograph *Die Mathematik im ‘Diesseits der Kultur’* covers a wider basis than just the era of modernism, which she more directly addresses in shorter texts; and Nina Engelhardt, who published *Modernism, Fiction and Mathematics* in 2019. Given how most of the scholars mentioned here will re-emerge at several points throughout this thesis, the following discussion will offer only brief overviews of their approaches, prioritising the aspects that pertain to the question of modernism in particular.

Returning to the conception of mathematical modernism raised in his 1987 article on Nazi Germany, as its title suggests, Mehrtens’ account of the modernist epoch in mathematics is one of a conflict between the differing schools of thought that emerged in the wake of discoveries such as non-Euclidean geometries and paradoxes in the foundations of set theory. These conflicting reactions hinge upon whether these changes are to be perceived as an emancipatory opportunity or a loss to be mourned. On the one hand, in the more successful “Moderne,” which encapsulates the formalist position led by David Hilbert and propelled by figures like Ernst Zermelo, Abraham Fraenkel, Felix Hausdorff and Emmy Noether, “Wahrheit und Sinn

in der Texte bestimmen sich in der Arbeit an ihnen, nicht in der Repräsentation der gegebenen physischen Welt, auch nicht im Bezug auf eine transzendente Ordnung.”²⁵ On the other, the ultimately more limited “Gegenmoderne,” represented by L.E.J. Brouwer’s intuitionist camp, sought to salvage and repurpose aspects of the then tainted Kantian position on mathematical knowledge in order to establish some sense of an “Ur-Grund.”²⁶ Crucially, these two camps are to be considered a “genuine dialectic,” as Gray notes, for each is needed for the other to achieve “full expression.”²⁷ It is necessary to stress that Mehrtens does *not* cast the latter group as being in some way “antimodern,” and its association with the racialised and reactionary emergence of *Deutsche Mathematik* is by no means an integral or inevitable one.²⁸ The “Gegenmoderne” does not seek to return to the familiar comforts of a pre-modern mathematical understanding. Rather, it tries to re-establish in a way that is *still* novel some sense of “Einheit” and mitigate against a radical arbitrariness it sees in its formalist counterpart. As with the case of Bieberbach, this position only slips into an “Antimoderne” when its reaction to the aforementioned losses becomes a dogmatic attempt to rewind the story. This is then rendered more perverse when the modes of thought that ground the “Gegenmoderne” are explicitly racialised.²⁹

Importantly, Mehrtens neglects to begin his discussion with a pre-ordained definition or binding characterisation of modernism beyond the presence of the features mentioned above. The relationship between the two posited groupings is best elucidated, according to Mehrtens, by the introduction of Foucault’s discourse analysis into the analytical fold. As a guiding thread, Mehrtens distinguishes between “die Sprache Mathematik” and “das Sprechen der Mathematiker” throughout the text, remarking on their different responses to questions like “Was bedeutet das?,” “Worüber reden wir?,” “Was soll das?” and “Wozu das?.” The first question is perhaps the thorniest. Citing Cantor’s naïve “Definition” of sets, which ascribes to them a certain meaning and inadvertently prompts Russell’s devastating paradox, Mehrtens

²⁵ Herbert Mehrtens, *Moderne-Sprache-Mathematik* (Frankfurt am Main: Suhrkamp, 1990), 9.

²⁶ Ibid.

²⁷ Jeremy Gray, *Plato’s Ghost: The Modernist Transformation of Mathematics* (Princeton, NJ: Princeton University Press, 2008), 10.

²⁸ It should be noted, however, that the heavyweight Mehrtens casts as the initiator of the “Gegenmoderne,” Felix Klein, while by no accounts a vocal antisemite, expressed in his 1911 Evanston lectures some unfortunate views that typecast certain mathematical approaches as “Jewish” or “Germanic.” There he suggests that the Jewish lack of territorial “Heimat” manifests as a propensity for abstract mathematics with no recourse to empirical space, unlike the more practically minded mathematics he characterises as intrinsically German and/or European. See Felix Klein, *The Evanston Colloquium: Lectures on Mathematics* (New York: American Mathematical Society, 1911), 46f. This claim has of course been both factually debunked and morally problematised, and given his status, Klein bears some responsibility for normalising this line of thinking. See, for example, David Rowe, “‘Jewish Mathematics’ at Göttingen in the Era of Felix Klein,” *Isis* 77, no. 3 (1986): pp. 422-449 and Birgit Bergmann, Moritz Epple, and Ruti Ungar, eds, *Transcending Tradition: Jewish Mathematicians in German-Speaking Academic Culture* (Berlin and Heidelberg: Springer, 2012).

²⁹ As Gray puts it, “the losers made a fetish of intuition, turned it into a racial category, and some, led by Ludwig Bieberbach and Oswald Teichmüller, became Nazis.” Gray, *Plato’s Ghost’s*, 10.

explains how the modernists “mußte[n] auf das Bedeuten verzichten, um den logischen Widerspruch auszuschließen.”³⁰ As such, there are immediate ramifications for the language of mathematics:

Die Sprache Mathematik, so wie sie die Moderne erarbeitet hat, bedeutet sich selbst. Ihre Zeichen, die sich an den Marken auf Papier realisieren, weisen auf den Regelkomplex ihres eigenen Gebrauchs. Es geht in ihr nur um Möglichkeiten des Setzens von Zeichen nach strengen Regeln, die sich ohne Widersprüchlichkeiten ineinander fügen. [...] Sie ist eine Sprache der puren Möglichkeit, und darum bedeutet sie nichts.³¹

Determined to retain “einen Rest Bedeutung” and secure a certainty for mathematics “im menschlichen Intellekt und nicht ‘auf dem Papier,’” the “Protest der Gegenmoderne” manifests more in the “Sprechen” of certain mathematicians,³² which Mehrtens sees as inseparable from broader disciplinary and geopolitical concerns. By the end of *Moderne-Sprache-Mathematik*, he is thus able to speculate whether the so-called “Krise” of the early 1900s in mathematics is in fact to be seen as an interwoven crisis of masculinity and patriotism.³³ As if to take the inner-mathematical unease with Cantor’s opening definitions of a set as a methodological impulse, Mehrtens works thematically and biographically without recourse to some fixed delineation of mathematical modernism. Beginning with a helpful “Vorgeschichte” of mathematical modernism, he sets up three thematic focal points in “Zahl,” “Raum” and “Funktion,” which he then threads through chapters on the “Moderne” and “Gegenmoderne” camps, as well as a history of disciplinary modernisation in German institutions.

While opening up various thematic channels that could lead into substantial comparisons with simultaneous shifts in modernist art and culture, Mehrtens stops short of any explicit attempt of his own. Indeed he is cognisant of this self-imposed restriction in scope: acknowledging that “eine Harmonie zwischen der künstlerischen und mathematischen Moderne” is not explicitly forthcoming, a short speculative chapter towards the end of the book attempts “höchstens [...] eine zu konstruieren.”³⁴ In fact, a significant portion of this sketch is negational in nature. Considering Linda Dalrymple Henderson’s 1983 study *The Fourth Dimension and Non-Euclidean Geometries in Modern Art*, he suggests that, for all its merit, such work in fact serves to better elucidate the relationship between modern art and modern breakthroughs in theoretical physics, as opposed to the autonomously imagined modern mathematics.³⁵ Indeed, with the

³⁰ Ibid., 12.

³¹ Ibid.

³² Ibid. The case of Felix Klein, as will be shown later, is a solid example of this division of “Sprache” and “Sprechen.”

³³ Ibid., 561ff.

³⁴ Ibid., 559.

³⁵ Ibid., 550ff.

popularisation of the cosmological mysteries in Einstein's theories of relativity via science fiction writing, the analysis of cross-disciplinary overlap between avant-garde literature and physics is a more developed field of research.³⁶ Modern mathematics, however, "war kein öffentliches Thema," and as such, it is more difficult to meaningfully discuss parities between modern mathematics and the avant-garde beyond specifically trained "Mathematikkenner" — who are "offensichtlich seltener als 'Kunstkenner'" — such as Robert Musil, to whom Mehrrens turns to on occasion in momentary comparisons.³⁷ However briefly (and only really in response to Henderson's work), Mehrrens stays in the realm of visual art and draws attention to certain avant-gardists who *could* be brought into a discussion with modern mathematics as opposed to physics, such as Marcel Duchamp and his propensity to work "ohne eine Ontologie."³⁸ As will be seen, these deliberations will become particularly relevant in Chapter 4.

Envisaged as an attempt to build on the foundations laid by Mehrrens, the next substantial work to deal with the question of modernism and mathematics is Jeremy Gray's *Plato's Ghost* of 2008. While praising the "fresh insights" of Mehrrens' research, citing in particular his genuinely new discussion of the hitherto marginal Felix Hausdorff, Gray is quick to identify some perceived shortcomings of his predecessor's work, which range from overreliance on certain methodological devices to geopolitical limitations. Firstly, Gray takes issue with some implications of Mehrrens' strongly Foucauldian discourse analysis, which is mandated by the latter because of his view that "modernism in mathematics is inseparable from the arrival of modernity, the social condition of the modern world."³⁹ Gray stresses that this relationship is far from self-evident, especially from a more contemporary perspective by which time "postmodernist certainties have swelled, older Marxist certainties have diminished, and now too postmodern approaches seem to be losing what charm they had."⁴⁰ This methodological quibble is also linked to Gray's complaint about the restrictive geographical remit of Mehrrens' work: "For all these reasons, the book's tight focus on Germany is unfortunate,"⁴¹ for *Moderne-Sprache-Mathematik* fails to account for important developments in modern mathematics abroad, primarily in France, Italy, Britain and the USA. As a course correction, Gray therefore positions his work very much as one that "investigate[s] how broadly an account of mathematical modernism could be drawn, going beyond its heartland in Germany."⁴² Methodologically

³⁶ Ibid., 560.

³⁷ Ibid.

³⁸ Ibid., 556.

³⁹ Gray, *Plato's Ghost*, 9.

⁴⁰ Ibid., 12.

⁴¹ Ibid.

⁴² Ibid.

speaking, the aim to cover more ground in a geographical sense becomes a more achievable one, in Gray's mind, by way of an initial definition that can be used to characterise a broader array of modernist manifestations. He proposes:

In this book I argue that the period from 1890 to 1930 saw mathematics go through a modernist transformation. Here, modernism is defined as an autonomous body of ideas, having little or no outward reference, placing considerable emphasis on formal aspects of the work and maintaining a complicated — indeed, anxious — rather than a naïve relationship with the day-to-day world, which is the de facto view of a coherent group of people, such as a professional or discipline-based group that has a high sense of the seriousness and value of what it is trying to achieve.⁴³

As Andrew Arana puts it in his review, “there is much to wonder at this definition.”⁴⁴ Of course, many of these aspects chime with Mehrtens' treatise, e.g. emphasis on formal aspects, absence of outer reference and the role of professionalisation, and they form perfectly valid prisms through which to raise questions about modern art and literature. When Gray fuses these various notions together to form this somewhat unwieldy definition, however, one might begin to foresee certain methodological limitations.⁴⁵ Ultimately, these bear out to a certain extent in Gray's analysis. While *Plato's Ghost* diligently maps out the history of modern mathematics beyond the German “heartland,” a coherent “vision of modernism”⁴⁶ that can be used to initiate a cross-disciplinary discussion never really takes shape. Instead, a throwaway remark about his “list of modernists”⁴⁷ is unwittingly prophetic in terms of how the book unfolds: it becomes a very extensive, encyclopaedic study that tends to list outlines of various mathematical concepts and philosophical debates, which is interspersed with biographies of his many key protagonists. Although it is an unprecedentedly far-reaching survey of the international mathematical landscape from 1890 onwards, Gray's suggested method thus runs into difficulties long before the question of reaching across disciplinary lines is even raised, for it is questionable to what extent this opening definition comes to elicit a working characterisation of modern mathematics in its own right.

With some serendipity, in the very same year as Gray's *Plato's Ghost*, the German-language community of literary scholars was also forced to reckon with the inherent instability of definitions relating to modernism. In an article drawing upon Luhmann's *Systemtheorie*, Anke-Marie Lohmeier calls for a “Revision literaturwissenschaftlicher Modernebegriff[e]” and

⁴³ Ibid., 1.

⁴⁴ Andrew Arana, “Review of Jeremy Gray's *Plato's Ghost*,” *Philosophia Mathematica* 20, no. 2 (2012): 252.

⁴⁵ Cf. Arkady Plotnitsky, “Adventures of the Diagonal: Non-Euclidean Geometries and Narrative,” in *Circles Disturbed: The Interplay of Mathematics and Narrative*, ed. Apostolos Doxiadis and Barry Mazur (Princeton, NJ: Princeton University Press, 2012), 442.

⁴⁶ Ibid.

⁴⁷ Gray, *Plato's Ghost*, 12.

misguidedly attempts to define “die literarische Moderne” as a particularly pessimistic and backward-looking — “antimodern” — moment in what ought to be understood as a 200-year-long epoch in line with societal modernity.⁴⁸ Proposing therefore a close proximity between German-language modernism and fascism, the article provoked not only a scathing response from Thomas Anz (to whom Lohmeier had mistakenly attributed a similar stance)⁴⁹ but also an entire special issue of the journal dedicated *solely* to defining the “Modernebegriff” from several vantage points.⁵⁰ Such exhaustive disputes, however, have only rendered the notion of “ästhetische Moderne” yet more nebulous. If binding definitions of modernism in both of the so-called “two cultures” prove to be cumbersome — which certainly seems to be the case — then they would surely be an equally unwise starting point when trying to bridge said cultures.

Nevertheless maintaining that his definition of modernism is a feasible way to make this “provocative” connection, Gray, much like Mehrrens, does not aspire to bring his insights to bear upon “the artistic modernisms” by way of a comparative study. Rather, “[r]eaders familiar with the literature on cultural modernisms are invited to bring its various approaches to the history of mathematics, and see which prove fruitful.”⁵¹ Careful to pre-empt the potential methods employed in these future studies, he appeals for researchers “not to collapse into the arms of a generalization so sweeping that Picasso sits on the page with Einstein and Noether.”⁵² This call for rigour and precision is certainly understandable, but the main line of thought Gray seeks to undercut is a different one; he views with scepticism any attempt to infer causal *influence* between modern mathematics and artistic modernism in one particular direction:

There seems to have been little direct influence of the broad cultural shifts into modernism on the practice of mathematics. It is indeed hard to see how a mathematician, drawing whatever inspiration from a cubist painting or James Joyce’s *Ulysses*, could do different mathematics, although Hausdorff seems to have been open to such influences. If anything, the reverse seems to have been the case.⁵³

⁴⁸ Following a patently false characterisation of literary modernism as solely reactionary and as longing for a return to old “Einheiten,” Lohmeier claims that this same impulse rendered modern art and literature as somehow in line with German fascism — a proposition that painfully overlooks the well-known discrimination, imprisonment and in some cases murder of these very artists under the Nazi regime. Anke-Marie Lohmeier, “Was ist eigentlich modern? Vorschläge zur Revision literaturwissenschaftlicher Modernebegriffe,” *Internationales Archiv für Sozialgeschichte der deutschen Literatur* 32, no. 1 (2007): pp. 1-15.

⁴⁹ Thomas Anz, “Über einige Missverständnisse und andere Fragwürdigkeiten in Anke-Marie Lohmeiers Aufsatz ‘Was ist eigentlich modern?’” *Internationales Archiv für Sozialgeschichte der deutschen Literatur* 33, no. 1 (2008): pp. 227-232.

⁵⁰ The follow-up volume, *Internationales Archiv für Sozialgeschichte der deutschen Literatur* 34, no. 2 (2009), includes contributions from Walter Erhardt, Peter Jelavich, Dirk von Petersdorff and Christof Dipper, for example.

⁵¹ Gray, *Plato’s Ghost*, 4.

⁵² *Ibid.*, 7.

⁵³ *Ibid.*

The suggestion that “direct influence” of cultural modernism upon mathematical practice may be limited is, of course, a valid concern. It could be asked, however, if this is the only way that influence can work. Aside from the fact that this passing remark about Felix Hausdorff will prove in Chapter 1 to be more significant than it reads here, the question of “direct” influence surely ought to be turned into one that accounts for *indirectness*. Is it not possible (or indeed plausible) that, while two fields or discourses may not directly affect one another in terms of practice, both can be informed by shared, “third-party” sources of influence? In his own review of Gray’s text, Calvin Jongsma poses this question rather forcefully:

While Gray obviously takes modernism in the arts as encouragement for postulating his thesis for mathematics, he consciously does not connect the two phenomena in any direct sense. He notes similar general trends [...], but he declines to demonstrate a *common source*. This puts his thesis on safer ground, but it will also make it less satisfying for many readers. In the end we are left wondering, why were there similar trends at this time in both fields? [...] Can we dig down below the surface to find any *common motivation, any shared zeitgeist*?⁵⁴

The answer to this question informs the central approach of this dissertation. Not only will Jongsma’s question be answered affirmatively, but the resultant pathways to a cross-disciplinary comparison will deviate from that suggested by Gray’s latter mention of the “reverse” direction, which he supplements with a gesture to the “many mathematical allusions” in the mathematically trained engineer Robert Musil’s work.⁵⁵ Ultimately, a more inclusive understanding of cultural influences would also logically allow for a more meaningful conversation between modern mathematics and modern art and literature than one focused solely on direct references to mathematical ideas by those familiar with them. Taking these various issues together, this dissertation thus will diverge from *Plato’s Ghost* in terms of approach and vision. It must be noted, however, that Gray’s text is an immensely valuable piece of scholarship that commits to paper a detailed and international historical account of mathematical developments around 1900, achieving a rare balance between its depth of focus and breadth of scope. As will become clear, just as with Mehrtens’ text, several aspects of the groundwork carried out in Chapter 1 are indebted to Gray’s rigorous and conscientious historical efforts, both in *Plato’s Ghost* and his contributions to larger multi-author volumes.

Wading into the debate in 2013,⁵⁶ mathematician and historian Leo Corry lets the title of his contribution, an appropriation of Ulrich Weisstein’s 1995 article “How Useful is the Term

⁵⁴ Calvin Jongsma, “Plato’s Ghost: The Modernist Transformation of Mathematics (Book Review),” *Perspectives on Science and Christian Faith* 61, no. 4 (2009), 266.

⁵⁵ Gray, *Plato’s Ghost*, 7.

⁵⁶ Leo Corry, “How Useful Is The Term ‘Modernism’ for Understanding the History of Early Twentieth-Century Mathematics?” in *Modernism in the Sciences, ca. 1900-1940*, ed. Moritz Epple and Falk Mueller (Berlin: Akademie Verlag, forthcoming). It should be noted that the volume, due to the ill-health of one of its editors, has not yet made it to final publication and has been marked as “forthcoming” since 2013. The proofs of the essay have been

‘Modernism’ for the Interdisciplinary Study of Twentieth-Century Art?,” gesture to the not insignificant degree of scepticism he brings with him. Corry’s sober critique has positioned him in the minds of scholars in this field as something of an antagonist, for he suggests that incautiously attributing the term “modernism” to mathematical developments around the turn of the century is perhaps akin to “shooting an arrow and then tracing a bull’s eye around it.”⁵⁷ It would seem that, in Corry’s eyes, the project at hand in this thesis is at risk of committing what English literature’s investigator *par excellence*, Sherlock Holmes, identifies as the “capital mistake” in *A Study in Scarlet*: “to twist facts to suit theories, instead of theories to suit facts.”⁵⁸ He elaborates:

One might easily start by finding a definition that can be made to fit the developments of mathematics in the relevant period just in order to be able to put together all what we have learnt from historical research and thus affirm that, yes, modernism characterizes mathematics as it characterizes other contemporary cultural manifestations. Although this approach has some interest, it does not seem to be in itself very illuminating, and indeed it runs the risk of being misleading since, by its very nature, it may force us to being unnecessarily flexible in our approach to the historical facts so as to make them fit the desired definition.⁵⁹

A closer reading of Corry’s work, however, reveals a much more sympathetic and indeed optimistic point of view, for he welcomes the idea of bringing mathematics into a closer dialogue with the arts; his grievances with the previous works concern not the desired destination but the methodology used to get there. It is curious, therefore, that Corry lauds Gray’s work as “much broader and more nuanced characterization” of modern mathematics than that of Mehrtens, despite its initiation in nothing other than a definition.⁶⁰ Furthermore, though he stresses the “original” and “pioneering” efforts in *Moderne-Sprache-Mathematik*, he repeats historian Moritz Epple’s criticism thereof lamenting the lack of a “clear claim about the internal construction of modern mathematics”⁶¹ as a methodological starting point. This surely edges towards a critique of Mehrtens for *not*, in fact, operating with binding definitions of modernism.

made available online by Corry, and this digital version has been cited by scholars since in lieu of the final volume. The page numbers cited here refer to this digital version and may not reflect its position in the forthcoming collection. For the digital text, see <https://www.tau.ac.il/~corry/publications/articles/Math-Modernism.html>, accessed 3 November 2019.

⁵⁷ Ibid., 3.

⁵⁸ Arthur Conan Doyle, *A Study in Scarlet* (New York: Cosmico, 2011), 17.

⁵⁹ Corry, “How Useful is the Term ‘Modernism,’” 3.

⁶⁰ Corry seems to reconcile his scepticism of definitions and praise for *Plato’s Ghost* by opining that Gray did not intend the opening definition to be a “straight-jacket determined by a strict party line” and more of an “idea of a broad cultural field.” Ibid., 20. This would, however, run against Gray’s own self-reflections when he notes, for example: “I give my grounds for establishing the case on a core definition of modernism, and I believe that mathematical modernism provides a handle with which to grasp otherwise sprawling developments, as well as a store of analogies.” Gray, *Plato’s Ghost*, 4.

⁶¹ Moritz Epple, “Styles of Argumentation in Late 19th-Century Geometry and the Structure of Mathematical Modernity,” in *Analysis and Synthesis in Mathematics: History and Philosophy*, ed. Marco Panza and Michael Otte (Dordrecht: Kluwer, 1997), 191. Cited in Corry, “How Useful is the Term ‘Modernism,’” 18.

In any case, Corry's proposed alternative reads like a direct response to Jongsma's deliberation above:

Beside the critical examination of some existing debates, on the positive side, a main point to be discussed in this article is that a fruitful analysis of the phenomenon of modernism in mathematics must focus not on the *common features* of mathematics and other contemporary cultural trends [...], but rather on the *common historical processes* that led to the dominant approaches in all fields in the period of time we are investigating. [...] If properly pursued, this might amount, in my view, to a significant contribution to the historiography of the discipline. Likewise, and no less interestingly, a clearer understanding of the historical processes that led to a putative modernist mathematics might shed new light on the essence and origins of modernism in general.⁶²

Quite like Gray, Corry thus offers a word of caution against over-generalisation based on similar features, which, he notes, is “typically done in terms of ‘Zeitgeist’ or ‘common cultural values.’”⁶³ It is in this sense that Corry sees the focus on historical processes of modernisation in Mehrrens' work (however fraught and over-reliant on the statements of his chosen case studies) as a valuable starting point upon which to build.⁶⁴ While sympathetic to Corry's more positive call to rigorously look for common ground underfoot, one might wonder to what extent it is possible to untangle “common features” from “common historical processes” in the first place. After all, disciplinary and aesthetic features have historical processes of their own. This is not, of course, to say that investigations into common historical processes ought to be dismissed; rather, there is a balance to be struck that also keeps in sight the distinct features that arise from them. When Corry turns to his two suggested ways to “look for ideas relevant to a possible discussion of modernism in mathematics,”⁶⁵ it would seem that he does in fact strike a balance between common features and their particular historical roots. Firstly, he foregrounds the US-American essayist Clement Greenberg and his deliberations in “Modernist Painting” (1961), suggesting that the “use of characteristic methods of a discipline to criticize the discipline itself,”⁶⁶ which arises from a “Kantian-like self-criticism” that spread across disciplinary lines at the end of the 18th century, could just as easily apply to modern mathematics.⁶⁷ Then, with his second proposal, Corry begins to undermine his (and Gray's) earlier critiques of Mehrrens' reliance on his chosen protagonists and a restrictive geographical range, for he puts forward a case study that is, if anything, a more *local* one again: the city of Vienna in the heyday of Ludwig Wittgenstein, to which he ascribes a historical process in the philosophy of language “leading

⁶² Corry, “How Useful is the Term ‘Modernism,’” 3f.

⁶³ *Ibid.*, 4.

⁶⁴ *Ibid.*, 21.

⁶⁵ Corry, “How Useful is the Term ‘Modernism,’” 29.

⁶⁶ Clement Greenberg, “Modernist Painting,” in *The Collected Essays and Criticism, Volume 4: Modernism with a Vengeance, 1957-1969*, ed. John O'Brian (Chicago: University Of Chicago Press, 1985), 85. Cited in Corry, “How Useful is the Term ‘Modernism,’” 23.

⁶⁷ Corry, “How Useful is the Term ‘Modernism,’” 23.

from Mauthner to Wittgenstein.”⁶⁸ This turn towards critiquing “the limits of language [...] from within,” Corry suggests, gives rise to various local manifestations of self-reflexive practice in architecture, music, painting, philosophy and *potentially* mathematics and physics. As Corry insists, this should give rise “not *Zeitgeist*-like arguments or superficial analogies,” but to a more grounded exploration of the common roots of mathematical and cultural modernism.⁶⁹ Setting aside the minor inconsistencies in the article — Corry propagates that which he criticises in Mehrrens and undermines that which he praises in Gray — the focus on relatively localised expressions is ultimately quite understandable, and it is where Corry’s article is at its most helpful.⁷⁰ If characterising not only modern mathematics but all of modernism internationally necessitates the misguided use of cumbersome definitions, then surely there is nothing *inherently* wrong with a narrower geographical focus, so long as it is recognised as such and insights thereof are not haphazardly stretched beyond their elastic limit. The task becomes a much longer, slower and more patchwork one, but it is also more intellectually honest and reflective of the composite and programmatic make up of modernism as a whole.⁷¹

It is now clear that the discussions of a possible “modernism” in mathematics have given rise to a multiplicity of approaches that could be undertaken in further research. Turning to the contributions of literary scholars, no less than a keen awareness of these pathways and their possible pitfalls is already manifest. Recalling Gray’s earlier invite to humanities researchers to bring their insights to bear upon studies of mathematical modernism, the “many mathematical allusions” in fictional works by writers like Robert Musil was put forward for exploration. Musil’s novels *Die Verwirrungen des Zöglings Törleß* of 1906 and *Der Mann ohne Eigenschaften*, published in volumes between 1930 and 1943, thematise mathematical developments of the era, and a glance at existing work in literary studies would indicate that this approach has become by some distance the dominant one. Common to most is the focus on representations of mathematical concepts *within* literary texts (very often in German-language and English-language modernism). As the title of her *Habilitation* project reveals plainly — *Die Mathematik im ‘Diesseits der Kultur’* — Albrecht’s research in this field focuses on the representation of mathematics and mathematical ideas in mostly German-language literature, spanning from the

⁶⁸ Ibid., 30.

⁶⁹ Ibid., 32.

⁷⁰ Indeed, the case of Vienna will be taken up in Chapter 3, but the conclusions drawn and people in focus will differ from Corry’s suggestion. The work of Fritz Mauthner becomes an important component via Felix Hausdorff in Chapter 1 but more as an inverse image of what the latter achieves, and the focus on Wittgenstein and the Wiener Kreis will arise in Chapter 4, once again as a counterpoint to the characteristics of modernism foregrounded in this thesis.

⁷¹ This serves to vindicate Mehrrens’s *Moderne-Sprache-Mathematik* to a certain degree; for all of its faults, it is Mehrrens who does at least render tangible key thematic and philosophical thrusts of modern mathematics in the context he considers.

Early Modern era through Novalis' romanticism and into modernism with Robert Musil und Hermann Broch.⁷² Indeed, the various studies of Novalis' deployment of contemporary mathematical ideas and Musil's mention of counter-intuitive mathematical conundrums are too numerous to cite here,⁷³ and they are of course part of a wider line of inquiry that is not restricted to the era of European modernism. Indeed an entire section of the recent *Palgrave Handbook of Literature and Mathematics* (2021), edited by Engelhardt alongside Robert Tubbs and Alice Jenkins, is dedicated to examining this phenomenon across time, from Chaucer and the English Renaissance poet Ben Jonson all the way to Charles Dickens and the Soviet avant-garde.⁷⁴

It is Engelhardt's 2019 monograph, however, in which this method is contextualised alongside a reflection on the work of Mehrtens, Gray and Corry, and which grapples with the epoch of modernism specifically. Noting how *Moderne-Sprache-Mathematik* "continues to animate debate,"⁷⁵ Engelhardt also expresses similar concerns to those regarding Gray's "definition of modernism" in *Plato's Ghost*: "as carefully phrased as it may be," she notes, it "is indicative of a challenge: as the concept of modernism is far from clearly defined in any one discipline, how is it possible to identify common modernist characteristics across different fields?"⁷⁶ Then, while also conscious to acknowledge Corry's call to abandon pre-conceived notions of modernism in favour of shared historical processes, Engelhardt similarly expresses doubt about Corry's neat division of "common features" and "common historical processes." She deftly explains: "It is not clear what such a process would look like and how it could be determined except by examining its concrete implications, that is, the very phenomena it is supposed to occasion."⁷⁷ Additionally, the "distinctiveness of German mathematics" and the specificities of key institutions would also, she notes, present stumbling blocks to such a process, thus also alluding to the aforementioned difficulties in moving away from more geographically localised

⁷² Andrea Albrecht, *Die Mathematik im 'Diesseits der Kultur': Literaturwissenschaftliche und wissenschaftsgeschichtliche Studien zur kulturellen Repräsentation des Mathematischen* (Manuscript, Universität Freiburg, 2011).

⁷³ To name just a few studies into Musil and mathematics, Allen Thiher remarks on Musil's preoccupation with mathematics as several points in his monograph *Understanding Robert Musil* (Columbia, SC: University of South Carolina Press, 2009). See also: Thomas Sebastian, *The Intersection of Science and Literature in Musil's 'The Man Without Qualities'* (Rochester, NY: Camden House, 2005), Tim Mehigan, *Robert Musil and the Question of Science: Ethics, Aesthetics, and the Problem of the Two Cultures* (Rochester, NY: Camden House, 2020). Likewise, Novalis' contemplation of mathematical ideas in his works, ranging from logarithms to combinatorics and geometry, has drawn the attention of several scholars. See, for example, Martin Dyck, *Novalis and Mathematics: A Study of Friedrich von Hardenberg's Fragments on Mathematics and its Relation to Magic, Music, Religion, Philosophy, Language, and Literature* (New York: AMS Press, 1969).

⁷⁴ Robert Tubbs, Nina Engelhardt and Alice Jenkins (eds.), *The Palgrave Handbook of Literature and Mathematics* (Cham: Palgrave Macmillan, 2021). This section (pp. 22-188) alone spans nine diverse contributions from an international range of scholars.

⁷⁵ Engelhardt, *Modernism, Fiction and Mathematics* (Edinburgh: Edinburgh University Press, 2019), 10.

⁷⁶ *Ibid.*, 11.

⁷⁷ *Ibid.*, 12.

perspectives.⁷⁸ In an attempt to get around these methodological hurdles, Engelhardt counters that “broader strokes” have merit after all, for only they can “do justice to [...] the similarities between developments in mathematics and modern culture.”⁷⁹ In order to “show that literary studies also open up rewarding sources of inquiry and contribute a fruitful perspective to research on modern mathematics,”⁸⁰ Engelhardt thus implicitly justifies a focus on Robert Musil, Hermann Broch and Thomas Pynchon as a way to counterbalance the potential haziness that emerges with a return to what Corry might call more “Zeitgeist-like” allusions. Her insightful analysis draws upon a number of philosophical figures that also come into play (albeit to different ends) in this thesis, namely Friedrich Nietzsche and Ernst Cassirer.⁸¹

Therefore, the most significant studies to date on the question of modern mathematics and literary modernism have evidently followed the pattern of the broader examination of mathematics and literature (i.e. have not been restricted by epoch) and largely revolved around the ways in which mathematical ideas are explicitly *thematized* in fictional works. This is no doubt a necessary and illuminating pursuit; both Albrecht and Engelhardt have drawn welcome scholarly attention to this area in a German-language context, and the aforementioned section of the *Palgrave Handbook* is testament to the sheer diversity of forms this can take and wealth of contexts that can be further explored. Nevertheless, is the *presence* of 19th and 20th century mathematics in modernist works is the most robust or indeed the only way of, as Rebecah Pulsifer puns, “adding mathematics to modernist studies”?⁸² The modern era is of course distinctive for the novel professionalisation and institutionalisation of mathematics as a subject — both at school and tertiary levels — and as such, this approach often, but indeed not always, limits the scope to authors who were mathematically trained and had direct awareness of certain mathematical theories, with Musil being the classic case in point. This surely generates, however, an incredibly narrow category of writers and artists who enjoyed access to elite educational institutions — almost always men — within which to examine disciplinary cross-over. Thankfully, although it still dominates contemporary discussions, space has been made for alternatives to this approach, which can be succinctly evidenced by latter sections of the *Palgrave*

⁷⁸ Ibid., 13.

⁷⁹ Ibid., 12.

⁸⁰ Ibid., 13.

⁸¹ In her discussions of Broch and Musil in particular, Engelhardt considers Nietzsche’s brief remarks about mathematics in *Die fröhliche Wissenschaft* and their subsequent (mis)appropriation by Oswald Spengler to ground a focus on “necessary fictions” in response to myriad foundational crises. While by no means countering this approach, this thesis, as will be discussed shortly, opts to foreground aspects of Nietzsche’s philosophies that (ostensibly) have little to do with mathematics but that were more widely influential in modernist circles. Ibid., 14ff.

⁸² Rebecah Pulsifer, “Adding Mathematics to Modernist Studies,” *Journal of Modern Literature* 43, no. 2 (2020): pp. 186-189.

Handbook in which Anna Brubaker, for example, is able to relate various mathematical concerns and ways of thinking to Gertrude Stein's expansive *oeuvre*.⁸³ More broadly, the late Angus Fletcher's 2016 monograph *The Topological Imagination* draws, for example, upon the modern mathematical field of topology in his abstract conception of spheres, edges and islands, which he then uses to probe what might be deemed ecocritical thought in an array of literary examples.⁸⁴ Fletcher's book is distinctive for its clear lack of concern for explicit representation of mathematics in literature, opting instead for an ambitious interrelation of topology with modes of cognition that impact ways in which humans live on and with the Earth.

Having mapped out the key contributions to date from varying disciplinary standpoints, it is now possible to refine the aims, objectives and central method of this thesis. In many ways, the following analysis is a particular synthesis of a number of the approaches outlined above, and it is designed to avoid both the various methodological pitfalls and the unnecessary narrowness of artistic remit identified therein. Firstly, this thesis does not begin with a pre-conceived characterisation or binding definition of modernism. By simply acknowledging the discordance and fragmentation inherent to cultural modernism, I suggest that it is more fruitful to conceive of the epoch *in lieu of a definition* as a simultaneous emergence of programmatic currents that responded to and were influenced by vast societal and philosophical changes. As such, a more conscientious way to bridge modern mathematics and cultural modernism would be to examine shared conceptual concerns, searching for possible instances of common philosophical influences behind them and assessing parity in modes of expression pertaining to them. Accordingly, in a way that resembles the more thematic approach of Mehrtens, I position the admittedly broad concept of space as a serviceable entry point into a cross-disciplinary analysis. In need of some initial characterisation, the *Raumkonzeption* that emerges in modern mathematics, I argue, is two-fold: (i) the measurement-oriented field of geometry gives way to the examination of invariant properties within spatial transformations, which (ii) both occasions and is enveloped by a wider renunciation of external referentiality, either in the material world or in some transcendental apprehension thereof. This focus on the changing understanding of space is, ultimately, a pragmatic one: while not the only concern in mathematical modernism, the landscape around 1900 would be unthinkable without it, and the concept of space is also

⁸³ Anna Brubaker, "Numbers Have Such Pretty Names": Gertrude Stein's Mathematical Poetics," in *The Palgrave Handbook of Literature and Mathematics*, ed. Robert Tubbs, Nina Engelhardt and Alice Jenkins (Cham: Palgrave Macmillan, 2021), pp. 339-360. It should be noted, Brubaker does consider aspects of Stein's direct thematization of mathematical ideas, but the essay shifts focus towards more implicit and structural areas of overlap. Other chapters in these subsequent section probe, for example, the mathematical structures behind non-linearity in creative writing and the poetic meter.

⁸⁴ Angus Fletcher, *The Topological Imagination: Spheres, Edges and Islands* (Cambridge, MA: Harvard University Press, 2016).

inextricably linked to other concerns, like number and finitude, which could also be explored independently. For example, Baylee Brits' insightful book *Literary Infinities: Number and Narrative in Modern Fiction* (2018) explicitly takes up the concept of number and the numerical reappraisal of (in)finity by Georg Cantor as a means to interweave aspects of modern mathematics and a range of literary examples, such as Italo Svevo, Jorge Luis Borges, Samuel Beckett and J.M. Coetzee.⁸⁵ Brits achieves this, crucially, without attempting to preconceive of modernism (mathematical or otherwise) in any fixed way. Furthermore, with aesthetic modernism often linked to a changing understanding of space and spatiality (metaphysically and phenomenologically), the concept presents itself as particularly interoperable when working across disciplinary divides. Having settled upon a *Raumproblem* as the centrepiece of this analysis, the first task is to raise the question of potentially shared philosophical influences behind it, which, in essence, strikes a balance between Corry's unnecessarily separated "features" and "processes." This basis will then serve as a springboard to comparing modes of spatial expression in modern mathematics and aesthetic modernism.

When it comes to the question of case studies, this thesis seeks to build upon the minority of studies to date that do not restrict focus to explicit representations of mathematics, which in turn generates a reliance on cultural actors with mathematical training. In her own contribution to the *Palgrave Handbook*, Alice Jenkins brings to the table a helpful concept that paves the way for a discussion beyond the more restrictive focus on mathematics portrayed in literature. In an essay on "Non-Normative Euclidean," she discusses the preoccupation with the "untaught geometer" in Victorian literature, which is to say, characters who "appear to know geometry without engaging in this disciplining process" and thus "represent a challenge to established educational assumptions, and perhaps even to social order."⁸⁶ While imagined by Jenkins principally in reference to characters in 18th and 19th century British works, this category, which allows for the attribution of mathematical modes of thinking in ways that are indirect and non-explicit, is by its nature flexible enough to probe "historical" figures as well.⁸⁷ As such, the more inclusive category of the "untaught" becomes a way to potentially map the insights attributed to modern mathematics onto authors, filmmakers and artists that were not afforded substantial mathematical education. This thesis will make extensive use of this adaptable (indeed subversive) idea and appropriates it for a modernist context, positing, for example, the existence

⁸⁵ Baylee Brits, *Literary Infinities: Number and Narrative in Modern Fiction* (London: Bloomsbury, 2018).

⁸⁶ Alice Jenkins, "Non-Normative Euclidean: Victorian Literature and the Untaught Geometer," in *The Palgrave Handbook of Literature and Mathematics*, ed. Robert Tubbs, Nina Engelhardt and Alice Jenkins (Cham: Palgrave Macmillan, 2021), 84. The concept, as Jenkins notes, arises from the canonical accounts of the uneducated slave boy in Plato's *Meno*, who was shown to possess innate geometrical knowledge. *Ibid.*, 84f.

⁸⁷ *Ibid.*, 84.

of “untaught topologists” who articulate modern mathematical insights without explicitly recognising them as such.

To outline the path ahead, an opening exercise in the history and philosophy of mathematics that forms the first chapter will then set up three suggested case studies of German-language modernism thereafter. With the substantial task of initiating various overlapping theoretical threads and holding onto each one throughout, a necessarily lengthy Chapter 1 first charts the developing understanding in mathematics of space and spatiality across an expanse of over two millennia, using as a point of departure Theodor Storm’s *Der Schimmelreiter* (1888), in which the young protagonist’s early engagement with Euclid’s *Elements* comes to inform his subsequent revolutionary dike project on the Frisian coastline. Looking back to Euclid’s original method from 300 BCE, the chapter traces its trajectory through the Early Modern era into its incorporation within the Kantian philosophy of space, which itself hinges on cognitive *Anschauung*. Focus then turns to the quake-like advent of non-Euclidean geometries and the deleterious effects of its aftershocks on the Kantian paradigm, paving the way for the competing modern responses to the transcendental doctrine. Chief among them is the formalist programme of Göttingen’s David Hilbert post-1900 and its radical engagement with the so-called “Gegenstands-” and “Grundlagenprobleme” of the early 20th Century.

It is within this context that the aforementioned two-pronged characterisation of *Raum* in mathematics is concretised, i.e. as a shift towards the study of invariant spatial properties within processes of transformation that both occasions and is enveloped by a conception of mathematics itself as a contentless language game of symbols and signs, with no external basis in the material world or *Anschauung*. This proposed way of exploring the understanding and representation of space across disciplines is then used to probe that thorny question of philosophical influence common to both modern mathematics and aesthetic modernism. Here, I opt for a rather localised context, focusing principally on Friedrich Nietzsche’s influence upon one of topology’s key architects, Felix Hausdorff, whose curious position as a mathematician with a pseudonymous alter-ego as the writer Paul Mongré has been the subject of recent and ongoing scholarship.⁸⁸ This task then divides into two subsections. Centralising his inaugural

⁸⁸ It must be noted here that, for the sake of necessary brevity, this thesis “takes as read” Nietzsche’s perhaps unrivalled influence on literary and artistic modernism; it is, of course, well documented and needs little further explanation here. Douglas Kellner and Stephen Eric Bronner, for example, note that the German *Expressionisten* in particular absorbed Nietzsche’s metaphysics “by osmosis” in *Passion and Rebellion: The Expressionist Heritage* (New York: J.F. Bergin, 1983), 11. As Steven Aschheim points out, to name just a few examples, Robert Musil was an avid reader of Nietzsche, Gottfried Benn singled out Nietzsche as the philosophical “Riese” behind not just his work, but the work of his generation, and Nietzsche was even directly portrayed by Otto Dix and Eduard Munch. Steven Aschheim, *The Nietzsche Legacy in Germany, 1890-1990* (Berkeley and London: University of California Press, 1994), 64f.

lecture on “Das Raumproblem” in Leipzig in 1903, the first section underscores the decisive role of Nietzsche’s speculative concept of the eternal recurrence in Mongré’s epistemological critiques in *Sant’Ilario: Gedanken aus der Landschaft Zarathustras* (1897) and *Das Chaos in kosmischer Auslese* (1898) and traces its impact across to the 1903 lecture’s “Transformationsprinzip,” a prototopological deliberation on spatial transformation and invariance (i.e. the first tenet of this dissertation’s proposed *Raumkonzeption*). Then, with respect to the latter, broader aspect of this, the second subsection seeks to “complete” the story of influence by contextualising Hausdorff’s turn to formalism in particular alongside his engagement with Nietzschean critique of language — a topic he took up in an essay entitled “Sprachkritik” in 1903. In short, by bringing the influential but by no means mathematical philosophy of Nietzsche (whose impact in artistic modernism needs little introduction) into a conversation with key developments in modern mathematics, a small and local but nonetheless important moment of cross-disciplinary influence is excavated. In a closing effort to suggest possible pathways outwards that cover more ground, an extended conclusion will draw attention to Emmy Noether’s remarkably productive school of abstract algebra in the 1920s.

Having isolated key spatial aspects of modern mathematics that are not straightjacketed by an attempted definition of “modernism,” and having uncovered with respect to them an instance of philosophical influence that transcends Snow’s “two cultures,” I ask in the subsequent chapters: how can scholars “re-read,” so to speak, modernist literature, art and film in light of this mathematical *Doppelgänger*? Are these shifts in spatial understanding also manifest in aesthetic modernism? On this basis, three distinct but successive analyses aim to demonstrate that modern mathematics and artistic modernism can be heard to speak in a common tongue. These sections are successive in that they move from the dynamic of transformation and invariance, encapsulated by the *Transformationsprinzip* and the rise of mathematical topology, towards the overarching question of language and ontology that facilitates this, thus mirroring the trajectory of the study of common philosophical influence from the preceding chapter.

Building upon what has been termed the “topological turn” by Stephan Günzel (2009), who distances himself from Sigrid Weigel’s representational and anthropologically motivated *topographical* turn (2002), Chapter 2 re-evaluates the well-known modernist concern for metamorphosis from a more topologically cognisant perspective, bringing the leitmotif of “invariance through change” to bear on a paradigmatic example of Weimar Cinema: F.W. Murnau’s *Der letzte Mann* of 1924. The critical consensus formed by canonical scholars of German cinema, e.g. Siegfried Kracauer and Lotte Eisner, casts the film as an exhibition of unrelenting change, transformation and metamorphosis, which manifests not only in the plot

but in the *Kinoästhetik* that articulates it. This characterisation, I suggest, is ultimately too one-dimensional: when the film is reconsidered with more nuanced topological structures in mind, stubborn continuities within processes of apparently all-consuming transformation are exposed. To further ground these findings by way of comparison, two of Franz Kafka's prose texts will serve as springboards to re-evaluating the very aspects of *Der letzte Mann* that are commonly linked to unremitting change: the breakthrough technical feat of the "entfesselte Kamera" and the dominant symbol in the film, namely the revolving door of the cosmopolitan hotel that serves as the film's primary setting.

Then, if Chapter 2 begins the work of re-examining modernist works of metamorphosis in a topological light, Chapter 3 furthers this task with a view to also catching sight of the second tenet of modern mathematics at work in a literary context, namely the disavowal of fixed contents and objects in the service of a "de-ontologized" self-conception. Here, I turn towards the literary scene of the Wiener Moderne, which is often called into focus in studies into modern literature, science and mathematics due to the presence of figures like Robert Musil and Hermann Broch and the legacy of the Wiener Kreis. In an effort to move beyond the dominant but narrow focus on writers who were mathematically trained, this chapter examines two novels by the recently re-discovered Mela Hartwig: *Das Weib ist ein Nichts* (1929) and *Bin ich ein überflüssiger Mensch?*, which despite being completed by Hartwig in 1931 was not published until 2001. Using conceptual insights of Engelhardt's focus on Musil, Hartwig's work is contextualised in a developing discourse on gender and subjectivity that found its most infamous expression in Otto Weininger's influential diatribe *Geschlecht und Charakter* (1903), which (mis)appropriates mathematical language to underpin a dangerously misogynistic line of argumentation. Hartwig's two texts, it is argued, intervene in this discourse in such a way that is more inherently (modern) mathematical than Weininger's vexing pseudomathematics: she brings an inherently topological understanding of transformation to bear upon questions of gender, agency and subjectivity and the contested modern paradigm of the "neue Frau," and she does this within a broader characterisation of the female as empty and "eigenschaftslos." As such, Hartwig's works begin to lay bare the interplay of the two connected facets of space in modern mathematics proposed in this thesis. This chapter therefore becomes an important structural transition between the previous chapter and the one to follow, which each grapple with one of these two facets individually.

Finally, Chapter 4 will take a necessary step backwards and explore questions that pertain to the broader second tenet of mathematical modernism that comes to encompass the first. Here it is asked not what the language of topology *says*, but rather what kind of a language it *is* in the first

place. Accordingly, this chapter foregrounds the anti-ontological nature of mathematical formalism, i.e. as a detached language game of symbols and signs, with a view towards unveiling parallels in contemporary artistic movements. Considering first the overt use geometrical concepts and repeated references to the “formalisms” and “constructions” in the archetypally modernist Bauhaus design school, this chapter seeks to short-circuit the obvious temptation to correlate Bauhaus and modern mathematics by linking the school’s key doctrines to formalism’s philosophical rivals and predecessors: the retention of a Kantian view of geometry and a Platonist/realist view of mathematical objects. Instead, I propose that a surprising degree of overlap in approach with mathematical formalism is to be found in an unlikely place, namely in Dadaism. Drawing on the insights of Cassirer’s differentiation between forms of logic in *Substanzbegriff und Funktionsbegriff* (1910), it will be argued that Dadaism’s incursion against substance-oriented Aristotelian logic comes to establish, conversely, a new function-oriented form of concept creation that operates much like mathematical formalism. Here, focus will lie upon Tristan Tzara’s manifestos and the much-debated name “Dada” in light of the nominalisation processes at large in mathematical formalism, before working outwards to suggest possible re-conceptualisations of Dada “readymades” and photomontages.

Finally, a conclusion will summarise these findings and bring them to bear upon the overarching question of integrating modern mathematics into the wider modernist fold. Furthermore, as well as gesturing towards further meaningful comparisons across these two discourses that exceed the scope of this thesis, I will also take stock of other potential approaches that could further the ongoing project of interweaving mathematics and cultural expression.

1

Digging in the “Landschaft Zarathustras”

Felix Hausdorff, the *Transformationsprinzip* and the Modernist Language of Mathematics

“I attain a different kind of beauty, achieve a symmetry by means of infinite discords, showing all the traces of the mind’s passage through the world, achieve in the end some kind of whole made of shivering fragments.”¹

— Virginia Woolf, *A Passionate Apprentice*

“Das wird ihn vom Euklid curieren,”² thinks the elder Frisian *Landvermesser* to himself regarding his son, Hauke, in Theodor Storm’s *Der Schimmelreiter* of 1888. Storm’s final literary work tells the story of Hauke Haien’s rise from the son of a modest landowner to the chiefly role of *Deichgraf* on the Frisian coastline in the 18th century and his inspired project of constructing a new and improved dike to withstand the forceful waves of the North Sea. Uninterested as a child in his “Fibel oder Bibel,” Hauke is intrigued by his father’s land measurements, prompting the elder to direct his son towards a familiar geometrical tome: “[...] Willst du mehr wissen, so suche morgen aus der Kiste, die auf unserm Boden steht, ein Buch, einer, der Euklid hieß, hat’s geschrieben; das wird’s Dir sagen!”³ Then, when Haien the younger spends so much time deciphering ancient geometrical propositions that he neglects his work on the fens, the father sends him to help carry soil at the dikes to rid him of his Euclidean distraction. This attempt turns out to be in vain, much to the eventual benefit of the coastal community, when the less angular Hauke-Haien-Deich, constructed according to the childhood plans of the protagonist, stands the test of time and holds firm despite a tremendous storm over a century later.

Let us linger for a moment on the childhood engagement with Euclidean geometry in *Der Schimmelreiter*. Dispatched to the nearby dikes, with “Euklid [...] allzeit in der Tasche,”⁴ Hauke

¹ Virginia Woolf, *A Passionate Apprentice: The Early Journals, 1897-1909*, ed. Mitchell A. Leaska (San Diego: Harcourt Brace Jovanovich, 1991), 393.

² Theodor Storm, *Der Schimmelreiter* (Munich: Deutscher Taschenbuch Verlag, 52004), 17.

³ *Ibid.*, 16.

⁴ *Ibid.*, 17.

would often hang back once the other labourers had gone home, and there, his Euclidean musings provoke reflections on how to improve the existing floodbanks:

Er [...] blieb, die Hände über die Knie gefaltet, an der abfallenden Seeseite des Deiches sitzen und sah stundenlang zu, wie die trüben Nordseewellen immer höher an die Grasnarbe des Deiches hinaufschlugen; erst wenn ihm die Füße überspült waren und der Schaum ihm ins Gesicht spritzte, rückte er ein paar Fuß höher und blieb dann wieder sitzen. Er hörte weder das Klatschen des Wassers noch das Geschrei der Möwen und Standvögel, die um oder über ihm flogen und ihn fast mit ihren Flügeln streiften, mit den schwarzen Augen in die seinen blitzend; er sah auch nicht, wie vor ihm über die weite, wilde Wasserwüste sich die Nacht ausbreitete; was er allein hier sah, war der brandende Saum des Wassers, der, als die Flut stand, mit hartem Schläge immer wieder dieselbe Stelle traf und vor seinen Augen die Grasnarbe des steilen Deiches auswusch. Nach langem Hinstarren nickte er wohl langsam mit dem Kopfe oder zeichnete, ohne aufzusehen, mit der Hand eine weiche Linie in die Luft, als ob er dem Deiche damit einen sanfteren Abfall geben wollte.⁵

In this revealing passage it is difficult to overlook the torrent of sense perceptions of the natural world around the young protagonist, from the cool spray of water to the repetitive thuds of the waves on the grassy embankment. While this scene foreshadows the frightful climax of the novella, with its awareness of the devastating potential of the natural world, it is not from these sensations of the empirical space of nature that Hauke's geometrical knowledge arises. Armed with his Euclidean ideas in his fledgling mind, he is prompted to mentally soften the slope of the dike "ohne aufzusehen," letting his hand plot a new trajectory based on a knowledge that comes from within himself, not from the external world. Some degree of distancing of the geometrical knowledge of Euclid from realm of sensory experience is thus apparent, which aligns with the rationalist understanding of mathematical knowledge that can be traced back to Plato but is exemplified in the writings of René Descartes and Gottfried Wilhelm Leibniz. Nevertheless, the omnipresence of the natural world throughout is no mere distraction, because, as story proceeds, a close relationship between this innate knowledge and the protagonist's Frisian surroundings is laid bare. This connection begins to pull on the strings of rationalism's inverse: empiricism.

After his ascent to the position of *Deichgraf* by way of marriage, Haien is soon able to put his youthful imaginings of a new dike to the test, and much of the novella charts the construction of the Hauke-Haien-Deich amidst a backdrop of superstitious locals and manipulative rivals. Struck one day by "[e]in anderer Gedanke, den er halb nur ausgedacht und seit Jahren mit sich umhergetragen hatte,"⁶ Haien re-enacts the scene above from his childhood and identifies a strip of land that could be reclaimed from the seabed with some clever geometry. Much like before, the innate nature of geometrical thinking is made explicit: Haien, locked in intense

⁵ Ibid., 17f.

⁶ Ibid., 78.

“Geistesarbeit” sketches once more “in Gedanken” an invisible line across the short inlet.⁷ This time, however, he looks up. With Haien’s gaze fixed “unablässig” on the features of land and sea he seeks to manipulate, the physical world is now much more in focus, and the line drawn in the mind corresponds to a (potential) material object, namely the new dike:

‘Es muß gehen!’ sprach er bei sich selbst. [...] ‘Das läßt sich dämmen!’ sprach Hauke bei sich selber, nachdem er diesem Spiele eine Zeitlang zugesehen; dann blickte er auf, und von dem Deiche, auf dem er stand, über den Priel hinweg, zog er in Gedanken eine Linie längs dem Rande des abgetrennten Landes, nach Süden herum und ostwärts wiederum zurück über die dortige Fortsetzung des Prieles und an den Deich heran. Die Linie aber, welche er unsichtbar gezogen hatte, war ein neuer Deich, neu auch in der Konstruktion seines Profiles, welches bis jetzt nur noch in seinem Kopf vorhanden war.⁸

Just as Haien seeks to bridge two strips of land with his new construction, so too have the internal mathematical musings been linked to a worldly exterior: the innate Euclidean findings can somehow be applied and *tested* in empirical reality, and it turns out that they work rather well. At the close of the novella, tragedy strikes in the form of an unprecedented storm, and Haien, his wife, child and white horse are all dragged out into the waves to their deaths when one of the older dikes ruptures. The schoolmaster, who relays the catastrophic story a century later to the travelling first-person narrator, reveals the fate of the new dike: “Aber der Hauke-Haien-Deich steht noch jetzt nach hundert Jahren, und wenn Sie morgen nach der Stadt reiten und die halbe Stunde Umweg nicht scheuen wollen, so werden Sie ihn unter den Hufen Ihres Pferdes haben.”⁹ As something of a literalized metaphor, the geometry of Euclid, as the theoretical basis for the dike, is seen to hold water in the real world with an almost biblical certainty: like the Hauke-Haien-Deich itself, Euclidean geometry here is presented as *wasserdicht*. Riding on the wave of the (myth of the) European Enlightenment, it is part and parcel of the often-cited goal of the so-called Age of Reason to not only understand and observe nature, but also, as historian Franz Mauelshagen puts it, to “control nature by means of technology.”¹⁰ With its catastrophic ecological consequences still potent today,¹¹ this zeal is most clear in Storm’s novella, for the geometry of Euclid not only serves well to *measure* land, as the etymology would suggest, but it also serves to do that which makes the Frisian coast with its system of dikes so renowned, namely to *make* arable land by reclaiming it from the seabed. In *Der Schimmelreiter*,

⁷ Ibid., 78.

⁸ Ibid., 79.

⁹ Ibid., 158.

¹⁰ Franz Mauelshagen, “Disaster and Political Culture in Germany Since 1500,” in *Natural Disasters, Cultural Responses: A World History*, ed. Christof Mauch and Christian Pfister (Lanham: Lexington Books, 2009), 58.

¹¹ Indeed Katie Ritson revisits Storm’s novella from an ecocritical perspective, arguing that “Storm’s work is [...] a parable against the dominance of narratives of technical progress and scientific rationality, which always have their blind spots.” Katie Ritson, “Engineering the Anthropocene: Technology, Ambition, and Enlightenment in Theodor Storm’s *Der Schimmelreiter*,” in *Readings in the Anthropocene: The Environmental Humanities, German Studies, and Beyond*, ed. Sabine Wilke and Japhet Johnstone (London and New York: Bloomsbury Academic, 2017), 231.

therefore, Euclid's geometry is a two-sided body of knowledge: on the one hand, it is a system of spatial reasoning that emerges very much from within the mind, without external influence, and on the other, it is knowledge that has a clear and lasting affinity with the empirical space of nature to such an extent that can hardly be dismissed as coincidental — a facet often called the “unreasonable effectiveness” of mathematics.¹² Whereas Ritson notes that Haien “looks both to the formal rules of geometry and mathematics and to nature in order to understand the world around him,”¹³ it is perhaps more the case that the formal rules of geometry are inextricably linked to the world around the protagonist in the first place. They form, in short, a way of *seeing* the world in order to then manipulate it.

Although Euclid in particular is only mentioned by name twice, Storm is evidently embedding his work and its understanding of space, geometry and the mind into a significant European philosophical tradition, which roughly spans the time-period of the Enlightenment and encapsulates mathematical understanding immediately prior to its modernist transformation around 1900. From this cursory engagement with Storm's novella alone, which is a flagship text of late German realism, it is therefore clear that *Der Schimmelreiter* and its portrayal of the world around Hauke Haien cannot be easily separated from a very imposing philosophical framework that predates it and extends across into mathematics and the sciences. In short, that thorny question of influence, which Gray, Corry and Engelhardt variably embrace, skirt around or avoid outright in their assessments of the era that supplants the one discussed above, rears its head. This is *not* to posit a case of “direct influence,”¹⁴ i.e. suggesting that *Der Schimmelreiter* is the product of reading Euclid alone (or in turn that a classical geometer might expect to alter her or his practice on the back of an afternoon reading Storm's novella). Rather, it is to simply recognise that this instance of German realism has been informed by Early Modern and Enlightenment philosophical wranglings that were equally influential to geometers' conceptions of their field of study and their practice. In short, cross-disciplinary influences need not be *direct* pathways between said disciplines, for they are more likely the outcome of considered engagement with a shared philosophical subterrain. Why, then, should modernism be any different?

It is to this question of “third-party” or indirect influence that this thesis will first turn. As something of a balancing act between a rather vast historical backdrop and an attempt to ascertain specific and *feasible* routes towards a cross-disciplinary comparison, this chapter will

¹² The term can be traced back to physicist Eugene Wigner's paper “The Unreasonable Effectiveness of Mathematics in the Natural Sciences,” *Communications on Pure and Applied Mathematics* 13 (1960): pp. 1–14.

¹³ Ritson, “Engineering the Anthropocene,” 226.

¹⁴ Gray, *Plato's Ghost*, 7.

begin with a wide analytical lens before promptly narrowing focus. Firstly, an ambitiously brief history of the spatial dimension of mathematics, from Euclid into the early 20th Century, will chart key turning points that culminate in the onset of mathematical modernism and set up historically the two-fold characterisation of space in modern mathematics that this thesis foregrounds: (i) a changing understanding of the concept of space and spatial transformation, which (ii) is enveloped by a broader loss (or perhaps emancipation from) fixed foundations in either the empirical space of the world or any direct and necessary form of *Anschauung* thereof. The stage is then set for the turn towards Felix Hausdorff’s arrival on the mathematical scene: this survey will converge on his inaugural lecture at the University of Leipzig in 1903, an accessible and intriguing articulation of this new spatial model simply entitled “Das Raumproblem.” Accordingly, something of an archaeological excavation site will be erected around Hausdorff’s renewed evaluation of space in 1903, with the aim of unearthing philosophical influences that tunnel beneath disciplinary lines in the sand. As will become clear from Hausdorff’s tale, it is the explicitly non-mathematical philosophy of Friedrich Nietzsche that bears fruit. Then, in something of an extended conclusion, the use of a wider lens will allow us to briefly chart the immediate mathematical landscape following Hausdorff’s watershed *Grundzüge der Mengenlehre*, i.e. the developments of the 1920s and early 1930s that are exemplified by Emmy Noether’s remarkably productive and creative school of *begriffliche Mathematik* in Göttingen.

A Brief History of Mathematics: From Euclid to the Modern *Spielraum*

Before mapping out the positions that would dominate continental mathematical philosophy from the 17th Century onwards, it is worth dwelling on the text that so enthralled young Haien in order to pin down the kind of mathematical system it came to typify. Despite its foundational status, the history of Euclid’s *Elements* is — as is the case with many ancient works — shrouded in much uncertainty. Apart from a sole fragment of papyrus (Fig. 1.0.1 below), no substantial original text exists, and the familiar version is something of an amalgamation of translations and amendments that have taken place over two millennia.¹⁵ By Euclid’s lifetime (ca. 300 BCE),

¹⁵ The first substantial reproduction was produced by Theon of Alexandria in the 4th Century BCE, and for the earlier half of the Middle Ages it remained unknown to Western Europe. Passed to the Arab world by the Byzantines, it was translated into Arabic in the 8th Century BCE and influenced mathematics in the Middle East most profoundly before it was translated into Latin in the 12th Century by an English monk, triggering its first widespread use in Europe. Until François Peyrard’s discovery of an older manuscript in the Vatican (thought to have been found in a 10th Century Byzantine workshop) in 1808, these translations of Theon’s edition were responsible for the unparalleled reception of Euclid’s geometry across several continents, rendering it a cornerstone of mathematical thought for centuries to come. Peyrard’s discovery then took over when it was translated and incorporated into an annotated edition by Danish philologist Johan Ludvig Heiberg’s from the 1880s into the 1910s, which relied heavily on the analysis of scholia and extensive historical research of Euclid’s contemporaries

many of the mathematical results and relations in *Elements* were known (mostly as oral traditions), such as Pythagorean mathematics, but Euclid was the first to collate them into a rigorous system, and many of the proofs are thought to be his own. Although the critique of Euclid's explorations is a well-trodden path in the history of Western thought and there is little that I could hope to add to the debate here, they are so foundational to the understanding of space in both mathematics and philosophy that an examination of the source material is warranted. Fortunately, of the thirteen books spanning some 465 propositions and their corresponding proofs it is the opening few pages of the first book that are the most relevant, for they have by some distance been subject to the most scrutiny. This is indeed for good reason, because these opening pages contain both the aspects that render Euclid's text a shining example of deductive mathematical reasoning as well as the stubborn glitches that would undo its position as the only consistent geometrical system in the mid-19th century.

The Euclidean Method and its Ambiguities

Principally, Euclid's *Elements* begins with a collection of twenty-three definitions, five postulates and five common notions (sometimes referred to as axioms), which are then used as a baseline conceptual framework for proving the said 465 propositions that span the rest of the work. The definitions most contested pertain to the most foundational ideas of geometry, namely the point, the line and the plane. The first seven definitions are expressed as follows:

1. The point is that which has no part.
2. A line is breadthless length.
3. The extremities of a line are points.
4. The straight line is a line which lies evenly with the points on itself.
5. A surface is that which has length and breadth only.
6. The extremities of a surface are lines.
7. The plane surface is a surface which lies evenly with the straight lines on itself.¹⁶

The sequential nature of Euclid's definitions is clear from the outset: that which is expressed in the first definition enables the third (likewise for the second and the sixth), and the fourth definition, which describes straight lines in terms of points, is a lower order version of the seventh, which in turn describes planar surfaces in terms of straight lines, i.e., using the fourth. Then, in a similar fashion, subsequent definitions then outline concepts such as angles, then

and successors, establishing the basis for the modern version of Euclid's *Elements* familiar to geometers today. Much of the work available in print is due to the Cambridge-based classicist Thomas Heath's translation (and annotation) of Heiberg's manuscripts into English, a project he began in 1908. See Thomas Heath, introduction to *The Thirteen Books of the Elements*, ed. Thomas Heath, transl. Thomas Heath (Cambridge: Cambridge University Press, 1968), pp. 1-143 for an extensive outline of this process.

¹⁶ Euclid, *The Thirteen Books of the Elements*, ed. Thomas Heath, transl. Thomas Heath (Cambridge: Cambridge University Press, 1968), 153.

right angles, parallel and perpendicular, and so on. Following these definitions, Euclid outlines five postulates which must be considered possible steps for further deductions (without being deduced themselves):

Let the following be postulated:

1. To draw a straight line from any point to any point.
2. To produce a finite straight line continuously in a straight line.
3. To describe a circle with any centre and distance.
4. That all right angles are equal to one another.
5. That, if a straight line falling on two straight lines make the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which are the angles less than the two right angles.¹⁷

Finally, the five common notions — ideas that must simply be assumed — complete the introductory pages of *Elements*, and these largely concern the notion of equality:

1. Things which are equal to the same thing are also equal to one another.
2. If equals be added to equals, the wholes are equal.
3. If equals be subtracted from equals, the remainders are equal.
4. Things which coincide with one another are equal to one another.
5. The whole is greater than the part.¹⁸

From this trilogy of baseline ideas, Euclid then constructs his deductive system of several hundred propositions and theorems, all of which either directly cite various combinations of these definitions, postulates and common notions or do so indirectly by citing preceding propositions that have been proved already. The result is a dense, cross-referential and highly methodical web of geometrical results that, as Gray notes, was for thousands of years “held up as a paradigm of perfect rigor, and indeed of human knowledge.”¹⁹ As a self-contained system that begins with elementary concepts and proceeds to successively build more complex results, Euclid’s *Elements* thus forms a pioneering attempt of what would eventually dominate mathematical discourse, namely the axiomatic method.

Yet, Euclid’s initial steps are not without issue. Firstly, there is little clarity as to what precisely distinguishes definitions, postulates and common notions, and when one examines the varying attempts to do so, the problem is rendered even more opaque. Following some Aristotelian wranglings,²⁰ for Heath, when definitions are deployed in geometry, therefore, the *existence* of

¹⁷ Ibid., 154f.

¹⁸ Ibid., 155.

¹⁹ Jeremy Gray, “Geometry,” in *The Princeton Companion to Mathematics*, ed. Timothy Gowers, June Barrow-Green and Imre Leader (Princeton and Oxford: Princeton University Press, 2008), 83.

²⁰ Heath tries to reconcile the opening of Euclid’s *Elements* with Aristotle’s account of working “from indemonstrable principles” upwards, “otherwise, the steps of demonstration would be endless.” He unpicks Aristotle’s differentiations between these various types of baseline principles and maps them loosely onto Euclid’s own. An axiom is “a principle common to all sciences, which is self-evident, though incapable of proof,” whereas definitions are particular or “peculiar” to each science individually and can be ontologically burdened: “The definition in itself says nothing as to the existence of the thing defined: it only requires to be understood. But in

the objects it defines — points, lines and planes — is necessarily assumed for the construction of higher-order geometrical objects, which is not the case for axioms. While noting that this leaves us “not far from describing what Euclid in fact does,” Heath concedes that these distinctions would entail some degree of swapping around definitions and common notions in *Elements*.²¹ Unfortunately, Heath’s (and Aristotle’s) assessment of postulates in comparison to axioms does little to clear the fog. With the postulate being a statement that must be assumed despite the fact that it is not self-evident, as axioms are, Heath falls back on a rather woolly correlation with the relationship between a teacher and learner.²² Complicating the matter further, Howard Eves then notes that the first and third postulates “refer to existence,”²³ which would, in light of Heath’s arguments, pull postulates towards the structure of definitions. Ultimately, historian of mathematics Reviel Netz opts for a more practical conclusion that renders this endless back-and-forth somewhat futile: “There is no meta-mathematical theory of definition at work here. Before getting down to work, the mathematician describes what he is doing — that’s all. Fuzziness between ‘definition’ and ‘axiom’ is therefore to be expected.”²⁴

Setting this haziness aside, several awkward questions on the nature of axioms remain: to what exactly should an axiom appeal in its formulation if it is “self-evident”? Should axioms like “things that are equal to the same thing are equal to one another” be seen as drawing upon internalised experiences of the real world, of some form of unquestionable intuition in the mind of a mathematician or upon the rules of logic? Or is the question as to what grounds an axiom necessarily wrong-headed because the axiom itself would cease to be a starting point and could be broken down into simpler statements? It may strike the reader that these deliberations are imprecise and speculative, and indeed they are. Yet, it is precisely these philosophical questions, as will be shown in this section, that stalked the development of mathematics from Euclid’s time, through the Early Modern and Modern periods, and into the present day. For all this theoretical ambiguity, the greatest issue, however, lies with one particular statement amongst Euclid’s opening concepts. Considering the set of postulates, it requires little refined

geometry, in addition to the *genus* and the *definitions*, we have to assume the *existence* of a few *primary* things which are defined, viz. points and lines only: the existence of everything else, e.g. the various figures made up of these, as triangles, squares, tangents, and their properties, e.g. incommensurability etc., has to be proved (as it is proved by construction and demonstration).” Heath, introduction to *The Thirteen Books of Euclid’s Elements*, 119ff.

²¹ *Ibid.*, 123f.

²² “Besides the common notions there are a few other things which I must assume without proof, but which differ from the common notions in that they are not self-evident. The learner may or may not be disposed to agree to them; but he must accept them at the outset on the superior authority of his teacher, and must be left to convince himself of their truth in the course of the investigation which follows.” *Ibid.*, 124

²³ Howard Eves, *Foundations and Fundamental Concepts of Mathematics* (New York: Dover, ³1997), 35.

²⁴ Reviel Netz, *The Shaping of Deduction in Greek Mathematics: A Study in Cognitive History* (Cambridge: Cambridge University Press, 2004), 95.

mathematical knowledge to notice that the fifth and final one sits somewhat at odds with the other four: it is expressed in a much more complex manner and reads as if it were a proposition or theorem to be proved. Visualised in Fig. 1.1 below, the postulate represents a familiar result, namely that parallel lines do not meet: given two lines A and B cut by the same line C, if the sum of the two interior angles x and y equates to two right angles (180°), the lines A and B will never meet. Any greater than two right angles, the lines A and B would meet on the left hand-side, and any less they would meet on the right hand-side.

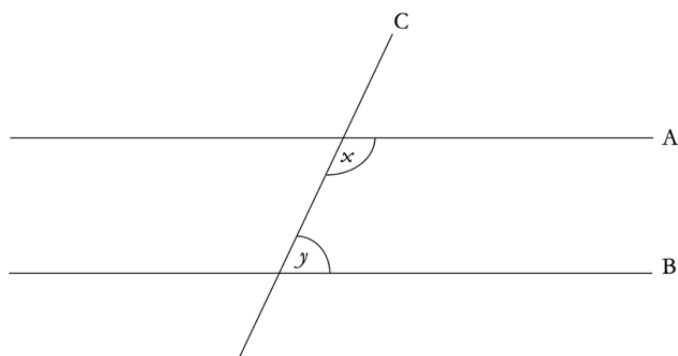


Figure 1.1: Euclid's Fifth Postulate

As Gray explains, “Euclid himself was probably well aware that the postulate was awkward,”²⁵ and it was the Neoplatonic Greek philosopher Proclus who made the first significant attempt follow the above impulse that Euclid’s final postulate exceeds the reasonable remit of assumable steps and rework it as a theorem to be proved with the preceding postulates and common notions.²⁶ This effort, and indeed all subsequent attempts through the Middle Ages and Early Modern period, failed for a variety of reasons, which left mathematicians with an uncomfortable problem in that the loss of the parallel postulate would entail severe collateral damage for the rest of Euclid’s text.²⁷ In fact, any shapes involving parallel lines, such as the simple square, would be placed beyond the capacity of Euclidean geometry to construct if robbed of the fifth postulate. As an aspect so indispensable yet so suspect, Euclid’s parallel postulate became, as John Tabak vividly explains, “the pebble in the shoe of mathematicians everywhere — a constant source of irritation” for two millennia.²⁸ Despite these drawbacks, it is important to stress that they did not detract from the ground-breaking nature of Euclid’s work, which, as

²⁵ Gray, “Geometry,” 85.

²⁶ Ibid.

²⁷ “Unfortunately, not much of the *Elements* would be left if mathematicians dropped the parallel postulate and retreated to the consequences of the remaining definitions: a significant body of knowledge depends on it. Most notably, the parallel postulate is needed to prove that the angles in a triangle add up to two right angles — a crucial result in establishing many other theorems about angles in figures, including the Pythagorean theorem.” Ibid.

²⁸ John Tabak, *Geometry: The Language of Space and Form* (New York: Facts on File, 2004), 30.

Eves notes, is rightly “regarded as the first great landmark in the history of mathematical thought and organization, and its subsequent influence on scientific thinking can hardly be overstated.”²⁹ It is important, however, that they are kept in mind, for these questions would forcefully reawaken in the 1800s in particular.

Early Modern Contests

Leaping ahead to the 19th century bypasses, of course, several crucial steps along the way, but keen to arrive at the immediate context for Hausdorff’s submersion into mathematical modernism, the following intermediate steps (however significant) will be discussed very briefly. While resolutions of these questions surrounding the Euclidean method did not arise in the Enlightenment era, the enduring legacy of Euclid’s rigour served to shape key debates on the nature of rational thought and scientific method from the 1600s onwards, exemplified by the well-known contest between the rationalism championed largely by Descartes and Leibniz and the empiricism most associated with Isaac Newton. In his own summary, historian of mathematics Viktor Blåsjö is careful to note that these two responses to Euclid “generalise the Euclidean method not only to an expanded view of geometry but also to physics and even philosophy in general,”³⁰ and as such, there is more at stake in this debate than the workings of geometry alone. Both approaches, in short, lay claim to the very formation of knowledge itself. Descartes’s maxim *cogito ergo sum*, as Blåsjö notes, exemplifies his view: “one starts in complete ignorance and nothingness and can only build up one’s knowledge from the most immediate and undeniable principles.”³¹ Newton’s view is, in a sense, the inverse of this: “instead of the Cartesian method of ‘composing’ all knowledge from intuitive starting principles, Newton advocates its opposite: analysis, i.e., starting with all the things one wants to understand and then trying to reduce them to simple principles.”³² Put simply, the difference is one of directionality: whereas rationalism understands in Euclid an innate system of knowledge built from first principles and then extrapolated outwards to the world, Newton’s empiricism thus amount to, as Blåsjö’s accessibly puts it, “reading Euclid backwards,”³³ which is to say, beginning with observation in the world, analysing resultant data from sense perception and reasoning

²⁹ Eves, *Foundations and Fundamental Concepts of Mathematics*, 26.

³⁰ Viktor Blåsjö, *Transcendental Curves in the Leibnizian Calculus* (Cambridge, MA: Elsevier, 2017), 205.

³¹ Ibid.

³² Ibid. He continues: “Euclid’s *Elements* and Newton’s *Principia* both start with a few simple axioms and deduce increasingly more complex results from them, but this, according to Newton, is not to be seen as mirroring the process of acquiring knowledge. This ‘method of composition,’ or synthesis, is but a mode of presentation adopted after the fact, for the sake of consolidating and clarifying logically the insights gained through analysis.” Ibid., 205f.

³³ Viktor Blåsjö, “Rationalism 2.0: Kant’s Philosophy of Geometry,” November 18, 2021, in *Intellectual Mathematics*, produced by Viktor Blåsjö, podcast, MP3 audio, 29:59, <https://intellectualmathematics.com/blog/rationalism-2-0-kants-philosophy-of-geometry>.

back to more general laws that encompass these findings. This discordance between rationalism and empiricism would not, in the end, produce a victor; rather the debate would be brought to a (temporary) close by the reconciliatory philosophy of Immanuel Kant in the late 1700s.³⁴

As Kant's position will resurface in some detail later in this chapter, it suffices for now to outline succinctly how Kant, in light of the rationalist/empiricist line in the sand, comes to "contaminate each position with aspects of the other," as Blåsjö helpfully summarises.³⁵ In his landmark *Kritik der reinen Vernunft*, published first in 1781 and revised in a second edition in 1787,³⁶ Kant famously tethers via the system of Transcendental Idealism the realm of sensory experiences in the world and the mind's innate, cognitive forms of intuition, i.e. of *Anschauung*. The conceptual floor of this position revolves principally around the status and validity of Euclidean geometry. With this aforementioned sense of the "unreasonable effectiveness" of mathematics in mind, Kant, as Michael Friedman explains, specifically sought to elucidate "the distinctive relation of [...] geometry to our experience of the world around us — both our ordinary perceptual experience of the world in space and the more refined empirical knowledge of this same world afforded by the new mathematical science of nature."³⁷ To understand how this is achieved, let us consider Kant's own words for a moment. "Alle Erscheinungen enthalten, der Form nach, eine Anschauung im Raum und Zeit, welche ihnen insgesamt *a priori* zum Grunde liegt," claims Kant in his assessment of the "Axiome der Anschauung," with the innate, cognitive comprehensions of space and time serving as the two *a priori* forms of *Anschauung* through which all experiential phenomena are filtered.³⁸ It is in this innate spatial realm, as was seen with young Hauke's "Geistesarbeit," that geometrical knowledge is formed via

³⁴ As Alberto Vanzo explains, an outline such as the above is of course the "standard narrative" of early-modern thought, which is "still widespread in textbooks and entrenched in the curriculum" of most undergraduate philosophy degrees, and it relies upon a number of misconceptions, erasures and over-reliance on the perspectives of key protagonists with specific agendas, like Kant himself.³⁴ As such, this lasting account has been rightly critiqued, but for reasons of scope and the impact of this very narrative on subsequent thinkers relevant to this thesis, here is not the place to continue such pursuits. At this stage, it is adequate enough to take stock of the generally accepted positions of rationalism and empiricism and proceed with (relative) caution on this basis. Alberto Vanzo, "Empiricism and Rationalism in Nineteenth-Century Histories of Philosophy," *Journal of the History of Ideas* 77, no. 2 (2016): 254. Vanzo notes that this general picture has been embedded into the discourse by canonical scholars since the beginning of the 20th century, from Robert Adamson's *The Development of Modern Philosophy* of 1903, through Bertrand Russell's *A History of Western Philosophy* of 1945, all the way to Roger Scruton's *A Short History of Modern Philosophy* of 2002.

³⁵ Blåsjö, "Rationalism 2.0."

³⁶ In the following, citations will be taken from both editions where necessary, for the revisions regarding arithmetic in the second edition are substantial and of relevance to the argument here. Both editions are reproduced side-by-side in the annotated volume published by Jens Timmermann and Heiner Klemme in 1998, which will be used for all citations. Immanuel Kant, *Kritik der reinen Vernunft*, ed. Jens Timmermann and Heiner Klemme (Hamburg: Felix Meiner Verlag, 1998).

³⁷ Michael Friedman, "Kant on Geometry and Experience," in *Mathematizing Space: The Objects of Geometry from Antiquity to the Early Modern Age*, ed. Vincenzo De Risi (Cham: Springer International, 2015), 275.

³⁸ Kant, *Kritik der reinen Vernunft*, 260.

construction, or, in Kant's words: "Wenn ich sage: durch drei Linien, deren zwei zusammengenommen größer sind, als die dritte, läßt sich ein Triangel zeichnen; so habe ich hier die bloße Funktion der produktiven *Einbildungskraft*."³⁹ The human mind is preconditioned, therefore, to perceive the world through a cognitive spatial lens that is *itself* an organising system of geometrical information, which is to say, through a Euclidean lens. In an earlier text, Friedman is careful to stress the significance of this: "So geometrical proofs are themselves spatial objects,"⁴⁰ in that they reside, so to speak, in this innate mental space. In turn, it is due to this Euclidean preconditioning that Kant is able to bridge the inner space of the mind and the outer space of experience and thus also reconcile the discordant positions of rationalism and empiricism. He writes:

Dieser transzendente Grundsatz der Mathematik der Erscheinungen gibt unserer Erkenntnis *a priori* große Erweiterung. Denn er ist es allein, welcher die reine Mathematik in ihrer ganzen Präzision auf Gegenstände der Erfahrung anwendbar macht, welches ohne diesen Grundsatz nicht so von selbst erhellen möchte, ja auch manchen Widerspruch veranlaßt hat. Erscheinungen sind keine Dinge an sich selbst. Die empirische Anschauung ist nur durch die reine (des Raumes und der Zeit) möglich; was also die Geometrie von dieser sagt, gilt auch ohne Widerrede von jener, und die Ausflüchte, als wenn Gegenstände der Sinne nicht den Regeln der Konstruktion im Raume (z.E. der unendlichen Teilbarkeit der Linien oder Winkel) gemäß sein dürfe, muß wegfallen. [...] Die Synthesis der Räume und Zeiten, als der wesentlichen Form aller Anschauung, ist das, was zugleich die Apprehension der Erscheinung, mithin jede äußere Erfahrung, folglich auch alle Erkenntnis der Gegenstände derselben, möglich macht, und was die Mathematik im reinen Gebrauch von jener beweist, das gilt auch notwendig von dieser.⁴¹

With this development, the question of the unreasonable effectiveness of Euclidean geometry is now in fact one of necessity, for the empirical space of the world can only be understood via a form of pure *Anschauung* that is programmed to "think" (or better: "see") in a Euclidean way. As such, the geometrical laws of one realm *must* apply "ohne Widerrede" in the other. In a way that circles back to Hauke Haien's intellectual growth, ascertaining the connection between Euclid's geometry and the real world is, as Asher Moore concisely notes, to simply "look and see."⁴²

In sum, as Kant's central term *Anschauung* conveys, Euclidean geometry is, in essence, the most robust way of *looking* at and *seeing* the world, and this formulation thus amounts, as Friedman notes, to "a conflation of what we now distinguish as mathematical, perceptual, and physical space."⁴³ While some scholars hesitate in concluding that Kant's conception of space as a whole is Euclidean, pointing out that Kant only explicitly deems our human *perception* thereof to be

³⁹ Ibid., 263. Emphasis added.

⁴⁰ Michael Friedman, "Kant's Theory of Geometry," *The Philosophical Review* 94, no. 4 (1985): 459.

⁴¹ Ibid., 263f.

⁴² Asher Moore, "Rationalism, Empiricism and the A Priori," *The Philosophical Quarterly* 9, no. 36 (1959): 251.

⁴³ Friedman, "Kant on Geometry and Experience," 275.

Euclidean,⁴⁴ Friedman rightly observes: “Yet it is essential to Kant’s conception that the three types of space (mathematical, perceptual, and physical) [...] are necessarily identical with one another, for it is in precisely this way, for Kant, that a priori knowledge of the empirical world around us is possible.”⁴⁵ This latter point is of immeasurable importance, because with the characterisation of space (from the innately mathematical to the empirical) as necessarily Euclidean, Kant not only tethers mathematical propositions and proofs to the real world; with *Anschauung* he also provides geometry itself (indeed, mathematics) itself with a foundation,⁴⁶ a *Grundlage*, upon which all new mathematical knowledge is constructed.⁴⁷ Soon becoming the dominant philosophy of mathematics at the close of the Early Modern era, Kant thus further cemented the lasting authority of Euclidean geometry in the discipline. Clearly, a great deal is at stake when questions as to its integrity emerge — and emerge they did.

Rupture: Non-Euclidean Geometries and Modernisation

The tale of non-Euclidean geometries has been written many times over by historians of mathematics, and a renewed endeavour is far from the purpose of this thesis. In an attempt to briefly map out the impact of the novel geometries, it is first necessary to flag a common misconception, in that they are often framed as the “fall from grace”⁴⁸ — to cite Dudley Shapere, for example — or the collapse of faith in Euclid’s work, thus sparking a crisis amongst mathematicians reliant on the Kantian position. Curiously, despite the name’s suggestion that Euclid has somehow been “corrected” and mathematics expunged of his misleading influence, non-Euclidean geometries actually serve to prove that Euclid had been correct all along. In a striking vindication, the parallel postulate, that “pebble in the shoe” of mathematicians for centuries, is *not* a theorem that depends on other assumptions; it *must* be assumed as an independent axiom for the system of Euclidean geometry to hold. It is not only *not* the case, therefore, that Hauke needs to be “curiert” of his Euclid; nor should mathematicians more broadly, for there never really was a conceptual ailment to begin with. The negatory prefix of the new discoveries refers instead to what *alternative* systems can be established with different starting points. For example, if the geometry of Euclid is largely upheld by the parallel postulate,

⁴⁴ Cf. Gray, *Plato’s Ghost*, 25.

⁴⁵ Friedman, “Kant on Geometry and Experience,” 275.

⁴⁶ Kant’s deliberations on the other main subfield of mathematics, arithmetic, follow the same pattern, and pure *Anschauung* becomes its conceptual foundation as well.

⁴⁷ Cf. Jaakko Hintikka, “Kant on the Mathematical Method,” *The Monist* 51, no. 3 (1967): 353.

⁴⁸ Dudley Shapere, *Reason and the Search for Knowledge: Investigations in the Philosophy of Science* (Dordrecht, Boston and Lancaster: D. Reidel Publishing Company, 1984), 210.

which essentially ensures a spatiality of straight lines and planes, then what spaces are formed when the parallel postulate is set aside?

The timing of the answer to this question opens up a contested space of its own. In 1829 and 1831, the Russian mathematician Nikolai Lobachevskii and the Hungarian mathematician János Bolyai separately and independently discovered the possible codification of a geometry in two and three dimensions that diverges from Euclid's in its treatment of parallel lines.⁴⁹ Neither, however, would live to know the full impact of their radical breakthroughs. As Gray explores in some depth, Bolyai's father sent his son's discovery to the esteemed Göttingen mathematician Carl Friedrich Gauß, who was (characteristically) less than helpful in his response. Furnishing "for extra measure" a simpler proof of one of Bolyai's opening statements, he replied to the elder Bolyai that to praise the Hungarian mathematician's work would be to praise his own, for he had apparently discovered something similar some years before — he declined to publish it, anticipating (not incorrectly) a less than pleasant response from the German intelligencia.⁵⁰ Indeed, the reaction in the wider mathematical community was one of outright contempt.⁵¹ After Gauß's death in 1855 and some moderate thawing of this entrenchment, unpublished papers and correspondence that expressed support for the ideas of Bolyai and Lobachevskii were found in his *Nachlass*. This prompted a tentative and all too gradual interest in their works: the latter died in 1856 and the former soon after in 1860, whereas the turning point towards the broader (if reluctant) acceptance of geometric alternatives was, by all accounts, the publication of Gauß's doctoral advisee Bernhard Riemann's paper "Über die Hypothesen, welche der Geometrie zu Grunde liegen" in 1868.⁵² Amounting to "nothing less than a complete reformulation of geometry,"⁵³ Riemann not only amalgamated the work of Gauß, Bolyai and Lobachevskii to form what is now called *hyperbolic geometry*, or the geometry of the saddle surface,

⁴⁹ Gray, "Geometry," 89f. As Gray notes, "Lobachevskii published first, in 1829, but only in an obscure Russian journal, and then in French in 1837, in German in 1840, and again in French in 1855. Bolyai published his account in 1831, in an appendix to a two-volume work on geometry by his father." Ibid.

⁵⁰ As Gray explains, there is no solid evidence of Gauß's claim here, and a "charitable interpretation" would be that he had intuited that "physical space might be described by a non-Euclidean geometry." It remains more plausible, however, that Gauß was not particularly familiar with the idea before reading the works of Bolyai and Lobachevskii. Ibid., 91.

⁵¹ "It was dismissed with scorn, as if it were self-evident that it was wrong: so wrong that it would be a waste of time finding the error it surely contained, so wrong that the right response was to heap ridicule upon its authors or simply to dismiss them without comment. This is a measure of the hold that Euclidean geometry still had on the minds of most people at the time. Even Copernicanism, for example, and the discoveries of Galileo drew a better reception from the experts." Ibid.

⁵² The paper is actually Riemann's *Habilitation* lecture in 1854 (having offered Gauß three different topics that he could work on, his supervisor elected this one), but the publication would only come posthumously in 1868 at the behest of a colleague Richard Dedekind — another mark of hesitation in challenging the Euclidean paradigm in the 1850s. Cf. Arkady Plotnitsky, *Logos and Alogon: Thinkable and the Unthinkable in Mathematics, from the Pythagoreans to the Moderns* (Cham: Springer Nature, 2023), 102. Plotnitsky's third chapter offers a recent, detailed contextualisation of Riemann's paper in the developing theory of geometry and space in mathematics.

⁵³ Gray, "Geometry," 91.

he also established *another* form of geometry that deviates from the Euclidean model, namely *elliptical* or spherical geometry.

To avoid the weighty connotations of the term *Raum*, Riemann posited instead *Mannigfaltigkeiten* — collections of points equipped with a concept of distance, which may look Euclidean on a *local* level but that clearly differ from it at larger scales.⁵⁴ Relying only on properties that are “intrinsic” to manifolds,⁵⁵ i.e. a capacity to determine some distance d between two given points x and y of the manifold, Riemann defines this as the shortest “Kurve” — *not* “Linie” — between the two points that lies completely on that surface.⁵⁶ Notably, this abstraction allows for the consideration of manifolds with curved surfaces. For any two points on a cylindrical surface, for instance, the shortest distance between them *along that surface* is not a straight line but a curved one.⁵⁷ This gives rise to a linchpin of Riemann’s theory, namely the “Krümmungsmaß” of a manifold, which is to say its degree of curvature,⁵⁸ to account for all manifolds more generally (and indeed in n dimensions): if this value is constantly *positive*, then the surface of the manifold in question is spherical or elliptic, and when it is *negative*, this gives rise to the previous geometry of Gauß, Bolyai and Lobachevskii, i.e. hyperbolic geometry. Crucially, the “Krümmungsmaß” can also of course be zero, which describes quite simply the flat surfaces of Euclidean geometry (see Fig. 1.2 below for a visualisation of the three variants). With this final twist, in Gray’s words, “the hegemony of Euclidean geometry was broken once and for all,”⁵⁹ for the Euclidean case is now just one possibility in a theoretically infinite array of alternatives — all accounted for in Riemann’s more general terms. Despite its seismic implications, Riemann expresses himself with little fuss: “Die Mannigfaltigkeiten, deren Krümmungsmaß überall = 0 ist, lassen sich betrachten als *ein besonderer Fall* derjenigen Mannigfaltigkeiten, deren Krümmungsmaß allenthalben constant ist.”⁶⁰

⁵⁴ A sphere is an intuitive example here (and in important one for Riemann): If one zooms in and partitions off a small region on the surface, this appears Euclidean, i.e. virtually flat, even though it is not.

⁵⁵ Gray, “Geometry,” 91.

⁵⁶ Bernhard Riemann, “Über die Hypothesen, welche der Geometrie zu Grunde liegen,” *Abhandlungen der Königlichen Gesellschaft der Wissenschaften* 13 (1868): 135.

⁵⁷ *Ibid.*, 143.

⁵⁸ *Ibid.*

⁵⁹ Gray, “Geometry,” 92.

⁶⁰ Riemann, “Über die Hypothesen,” 144. Emphasis added.

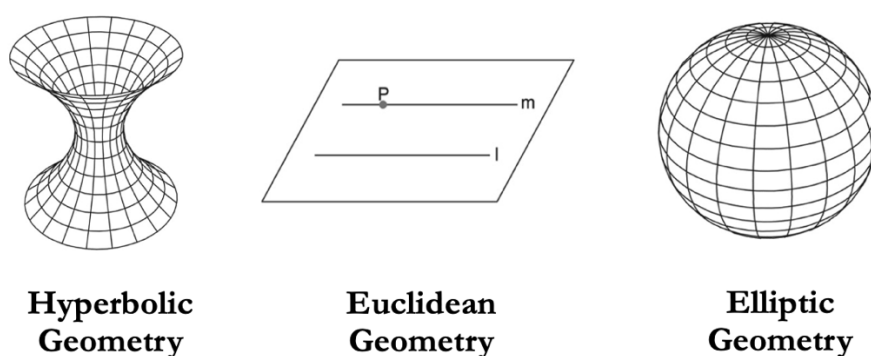


Figure 1.2: Euclidean and Non-Euclidean Geometries⁶¹

While the story of non-Euclidean geometries is not yet over, the ramifications for the disciplinary position of mathematics are obvious. As Mehrtens quite simply puts it: “Der Raum ist nicht Gegenstand der Mathematik, er ist Gegenstand der Anwendung von Mathematik geworden,”⁶² which thus establishes yet another “strikt methodische” line in the sand: “Die Sprache der Mathematik steht gleichsam im Konjunktiv; die Physik hat die Aufgabe, sie auf den Indikativ zu bringen.”⁶³ These sudden question as to the relationship between geometry, space and measurability would amount, then, to a highly vexed “Raumproblem” that would remain “eine umstittene Frage” throughout the coming years and decades,⁶⁴ but perhaps the most decisive intervention in terms of the new geometries would come shortly after Riemann’s paper was published when, in 1872, the 23 year old Felix Klein gave his inaugural lecture as a professor at the University of Erlangen. Now known as the *Erlanger Programm*, Klein’s lecture moved off from Riemann’s already highly abstract concept of the manifold, which is equipped with a distance function, to a territory more abstract again: projective geometry.

With its roots in the Italian Renaissance, projective geometry, as Barrow-Green *et al* explain, “is the study of properties of geometrical figures that are unaltered by a sequence of central projections.”⁶⁵ In his own discussion, Mehrtens stresses the loss of a “Metrik (Maßbestimmung)” in the theory:

⁶¹ As can be seen here, the curved lines in each non-Euclidean geometry (the vertical lines in this case) violate Euclid’s parallel postulate, for in hyperbolic geometry there are infinitely many lines that are parallel to one passing through an arbitrary point, as opposed to one in Euclidean geometry, and in elliptic geometry there are none: all curves (the great circles) intersect at the poles.

⁶² Mehrtens, *Moderne-Sprache-Mathematik*, 55.

⁶³ *Ibid.*, 57f.

⁶⁴ *Ibid.*, 58.

⁶⁵ June Barrow-Green, Jeremy Gray and Robin Wilson, *The History of Mathematics: A Source-Based Approach, Volume 2* (Rhode Island: MAA Press, 2022), 414. They continue: “The idea is to imagine a figure drawn in one plane and projected onto another plane from a point source of light — the centre of the projection. Suppose that the first figure is a conic section (for example, an ellipse). The point source of light causes the figure to cast a conical

Urbild und Abbild Projektion stehen in strengen geometrischen Beziehungen, wobei die Maßverhältnisse verzerrt werden [...] wenn die Leinwand noch schräger steht und aus der Ellipse einer Parabel wird. [...] Ursprünglich als Untersuchungs- und Darstellungsmethode innerhalb eines euklidischen gedachten Raumes entwickelt, wurde die projektive Geometrie zu einer eigenständigen geometrischen Theorie, von der um Mitte des 19. Jahrhunderts klar wurde, dass das Maß, der Abstand zweier Punkte, nicht zu ihren Grundbegriffen gehört.⁶⁶

Klein, fresh from collaborative research visits to Paris-based algebraists, observed in this abstract realm the possibility to unify the existing geometries — Euclidean, hyperbolic and elliptic — under one banner, adopting the algebraic structure known as a *group* to systematise differing types of projections:⁶⁷ “Es ist eine Mannigfaltigkeit und in derselben eine Transformationsgruppe gegeben. Man soll die der Mannigfaltigkeit angehörigen Gebilde hinsichtlich solcher Eigenschaften untersuchen, die durch Transformationen der Gruppe nicht geändert werden.”⁶⁸ By casting each Riemannian *Mannigfaltigkeit* as a group of transformations (in this case projections), each variant of geometry becomes the study of certain geometrical properties that remain invariant throughout the projections. While “Maßverhältnisse werden verzerrt,” as Mehrtens notes, “gewisse Lagebeziehungen, z.B die der Eckpunkte zu einander” can remain unchanged: “So markieren die invarianten Eigenschaften von aufeinander projizierbaren Figuren die Eigenart der projektiven Geometrie und zugleich das Ziel der Theorie.”⁶⁹ Whereas in Riemann’s breakthrough, Euclidean geometry was just one particular instance of zero curvature, now even the geometries of positive or negative curvature (alongside the Euclidean model) are themselves special cases of a unifying projective geometry.

To take stock, there exist now infinitely many geometries that, given Klein’s work, cannot be placed into a hierarchy of any kind: all are equally consistent and as such equally valid in mathematical language. It is thus clear to see that, while Euclid himself emerges from the discovery of non-Euclidean geometries curiously unscathed, Kant’s entire philosophy of space,

shadow, so the image on the second plane is a conic section, but by tilting the second plane appropriately the image can be a circle, an ellipse, a parabola, or a hyperbola — in short, any conic section. This means that any two conic sections are equivalent under central projection. In the same way, any triangle can be projected onto any other, so all triangles are equivalent.” Ibid.

⁶⁶ Mehrtens, *Moderne-Sprache-Mathematik*, 61. This is a notable step beyond Riemann’s metric conception of manifolds.

⁶⁷ See the following definition of the group: “A set of elements is said to form a group with respect to a given operation if (1) the set of elements is closed under the operation, (2) the set contains an identity element with respect to the operation, (3) for every element in the set there is an inverse element with respect to the operation, and (4) the operation is associative. The elements can be numbers (as in arithmetic), points (in geometry), transformations (in algebra or geometry), or anything at all. The operation can be arithmetic (such as addition or multiplication) or geometric (as a rotation about a point or an axis) or any other rule for combining two elements of a set (such as two transformations) to form a third element in the set.” Carl Boyer and Uta Merzbach, *The History of Mathematics* (New Jersey: Wiley, 32011), 499.

⁶⁸ Felix Klein, *Das Erlanger Programm: Vergleichende Betrachtungen über neuere geometrische Forschungen*, ed. Hans Wußing (Leipzig: Akademische Verlagsgesellschaft, 1974), 34. Cited in Mehrtens, *Moderne-Sprache-Mathematik*, 62.

⁶⁹ Mehrtens, *Moderne-Sprache-Mathematik*, 62.

which rests upon the necessity of Euclidean geometry, has been devastated. As Thorsten Botz-Bornstein succinctly puts it:

There is a gap between math and reality, and apparently this gap cannot be bridged. The emergence of non-Euclidean geometry is indirectly linked to these critiques of the reality-math correspondence. If geometry is unable to correctly describe space, then the relationship between math, science and observation needs to be redefined.⁷⁰

Although Riemann and Klein do not even seek to examine which of the now infinite possibility of geometries is the “true” one in the world, the very *possibility* of viable alternatives is, as Arkady Plotnitsky notes, “momentous enough.”⁷¹ Indeed, as Mehrtens is keen to stress, the sudden divergence of subject matter in mathematics and physics also registers on a linguistic level here by the decided departure from (or active avoidance of) the loaded term *Raum*. Instead, Riemann speaks of *Mannigfaltigkeit* and Klein speaks of a *Transformationsgruppe*.⁷² The “Vorgeschichte der mathematischen Moderne,”⁷³ in Mehrtens’ words, is thus bookended by the breakdown of the Kantian conception of mathematics, geometry and space that was encapsulated by Storm’s *Der Schimmelreiter* at the beginning of this chapter: geometry imagined, in simple terms, as a “way of seeing” the world is no longer tenable.

At this juncture, the foundations for the wranglings in the mathematical community around the turn of the 20th century have now been laid. While it is principally in the French context, with Poincaré, that the question of the “true” geometry of the world is investigated, in Wilhelmine Germany, the conflicting positions that unfold are characterised more by opposing responses to this critical loss of a *Gegenstand* (be it empirical or filtered through Kantian *Anschauung*) in mathematics, which then gets enveloped by the broader *Grundlagenkrise* triggered by Bertrand Russell’s discovery of paradoxes in Georg Cantor’s set theory (developed between 1874 and 1884). Recalling the categories posited by Mehrtens that have since been criticised (if a little too forcefully), namely the “Moderne” and the “Gegenmoderne,” it is curiously with Klein, whose *Erlanger Programm* brought about a shift into mathematical modernism, that the inception of the latter lies. Foregrounding a stunning claim that Klein sought to obscure in an endnote that was itself contained in a footnote to the text, namely that “[e]s gibt eine *eigentliche* Geometrie,

⁷⁰ Thorsten Botz-Bornstein, *The Philosophy of Lines: From Art Nouveau to Cyberspace* (Cham: Springer Nature, 2021), 140.

⁷¹ Plotnitsky, *Logos and Alogon*, 104. Of course, it must be noted that Euclidean geometry was the *only* basis available to Kant at the time, and he could thus not have followed an alternative pathway in his transcendental philosophy. Moreover, Friedman is quick to remind us that the later (and still contemporary) conceptions of space and geometry, carried out by later figures like Ernst Mach and Henri Poincaré in the early 1900s, are explicit rejections of Kant’s own, and as such, “we are still very much in his debt.” Friedman, “Kant on Geometry and Experience,” 276.

⁷² Mehrtens, *Moderne-Sprache-Mathematik*, 65.

⁷³ *Ibid.*, 106.

die nicht, wie die im Texte besprochenen Untersuchungen, nur eine veranschaulichte Form abstrakter Untersuchungen sein will.”⁷⁴ This ontological claim, to which Klein would never return in his professional mathematical work, belies, as Mehrrens explains, a reluctance to dispense with a sense of “Bildlichkeit” (via *Anschauung*) in mathematical practice.⁷⁵ In other words, “[a]n Klein wird sichtbar, daß die Moderne ihren Schatten bekommt, sobald die methodische Trennung der Arbeit an reinen Begriffen von gegenstandsbezogener Wissenschaft als Praxis sichtbar und *als Verlust* empfunden wird.”⁷⁶ While forced to abandon the hegemony of Euclidean geometry, this “Gegenmoderne,” exemplified by Dutch mathematician L.E.J. Brouwer’s intuitionist philosophy, would famously attempt to compensate for this *Verlust* by salvaging elements of Kantian *Anschauung*, grounding mathematical practice in the cognitive capacity of the mathematician. Embracing this loss of a common *Gegenstand* with physics with remarkable enthusiasm, however, Klein’s younger Göttingen colleague, David Hilbert, comes to be the “Generaldirektor”⁷⁷ of the modern wave of mathematics in Germany at the turn of the century, often referred to as mathematical *formalism*.

Having identified in Cantor’s embryonic set theory — the “Paradies,” as he would later call it⁷⁸ — the potential for a unifying, purely axiomatic framework for all of mathematics, Hilbert opened what Corry calls “a new chapter in the history of geometry”⁷⁹ that synthesises the various approaches and discoveries, from those of Bolyai and Lobachevskii to Klein’s projective framework, with his *Grundlagen der Geometrie* of 1899. Hilbert’s remarkably short introduction (just two short paragraphs) wastes no time in diagnosing the fundamental problem of his era: “Die Geometrie bedarf [...] zu ihrem folgerichtigen Aufbau nur weniger und einfacher Grundsätze. Diese Grundsätze heißen Axiome der Geometrie.”⁸⁰ Expressed with icy clarity, Hilbert’s stated intent is to ascertain those so-desired foundations of geometry, which is followed immediately by a baptismal act, i.e. he is just as quick to give these foundations a name in “Axiome.” This is to say, the named foundations of geometry are now at most a *pseudofoundation*, for the basis of mathematical language is now just mathematical language itself.

⁷⁴ Klein, *Erlanger Programm*, 74. Emphasis added, and cited in Mehrrens, *Moderne-Sprache-Mathematik*, 66.

⁷⁵ Mehrrens, *Moderne-Sprache-Mathematik*, 67.

⁷⁶ Ibid. Emphasis added. Ironically, it is Riemann, who is in fact equally well known his work in physics, who prefigures the “Moderne” for Mehrrens, for even he gladly crosses the new “Trennung” between mathematics and physics in the wake of his own breakthroughs, he does so with the insistence that there is one. Ibid.

⁷⁷ The term was introduced in jest by Hilbert’s colleague, Hermann Minkowski. Cf. Mehrrens, *Moderne-Sprache-Mathematik*, 108.

⁷⁸ “Aus dem Paradies, das Cantor uns geschaffen, soll uns niemand vertreiben können,” writes Hilbert in “Über das Unendliche,” *Mathematische Annalen* 95, no. 1 (1926): 170. The paper is a transcription of a lecture given in Münster the previous year.

⁷⁹ Leo Corry, “The Development of the Idea of Proof,” in *The Princeton Companion to Mathematics*, ed. Timothy Gowers, June Barrow-Green and Imre Leader (Princeton and Oxford: Princeton University Press, 2008), 138.

⁸⁰ David Hilbert, *Grundlagen der Geometrie* (Leipzig: Teubner Verlag, 21903), 1.

Then, as becomes clear when one turns to the first section, this introductory tendency towards naming things — literally, noting “wie Dinge heißen” — becomes *methodology*, for the analysis opens with the following discussion involving points, lines and planes:

Wir denken drei verschiedene Systeme von Dingen: die Dinge des ersten Systems nennen wir *Punkte* und bezeichnen sie mit A, B, C, \dots ; die Dinge des zweiten Systems nennen wir *Geraden* und bezeichnen sie mit a, b, c, \dots ; die Dinge des dritten Systems nennen wir *Ebenen* und bezeichnen sie mit $\alpha, \beta, \gamma, \dots$; die Punkte heißen auch die *Elemente der linearen Geometrie*, die Punkte und Geraden heißen die *Elemente der ebenen Geometrie* und die Punkte, Geraden und Ebenen heißen die *Elemente der räumlichen Geometrie* oder *des Raumes*.

Wir denken die Punkte, Geraden, Ebenen in gewissen gegenseitigen Beziehungen und bezeichnen diese Beziehungen durch Worte wie ‘liegen’, ‘zwischen’, ‘parallel’, ‘kongruent’, ‘stetig’; die genaue und vollständige Beschreibung dieser Beziehungen erfolgt durch die *Axiome der Geometrie*.⁸¹

Before he even begins to discuss the axioms themselves, Hilbert introduces these parameters of formalist geometry: “Punkte,” “Geraden” and “Ebenen,” and the divergence from Euclid’s inaugural definitions cited above is most apparent. It is noteworthy that he does not seek to *define* them as Euclid did somewhat opaquely in the passages cited above: instead of “a point is that which has no part” and “a line is breadthless length,” Hilbert’s formulation says no more than “let us postulate things that we will call ‘lines’ and ‘planes’ for convenience.” In Hilbert’s work, therefore, naming things does *not* amount to defining them with respect to fixed object, and a clear sense of arbitrariness rests at the base of the system. Hilbert proceeds by collecting his axioms into five groups — “Verknüpfung,” “Anordnung,” “Kongruenz,” “Parallelen” and “Stetigkeit”⁸² — before proving the “Widerspruchsfreiheit” of the axiomatic system and the independence of the axioms themselves, i.e. that they do not necessarily depend on one another. This step then enables him to provide an axiomatic foundation for Euclidean and non-Euclidean geometries, which are constructed upon different sets of the axioms outlined in the beginning.

It is necessary to dwell on this (perhaps) jarring reliance on the arbitrary in Hilbert’s opening argument, for it is something Hilbert was forced to protect in the face of fierce criticism. He was “infuriated,” as Klaas Landsman notes, by correspondence from Jena logician Gottlob Frege,⁸³ who surmised that Hilbert had neglected to define points, lines and planes because their definition was to be taken as familiar to mathematicians — thus an accusation of a lack of rigor or an oversight. Hilbert defends himself in the following way:

⁸¹ Ibid., 2. Emphasis in the original.

⁸² Ibid.

⁸³ Klaas Landsman, *Foundations of Quantum Theory: From Classical Concepts to Operator Algebras* (Cham: Springer International, 2017), 803.

Hier liegt wohl der Cardinalpunkt des Missverständnisses [...]. Ich will hier nichts als bekannt voraussetzen [...]. Wenn ich unter meinen Punkten irgendwelche Systeme von Dingen, z.B. das System: Liebe, Gesetz, Schornsteinfeger ..., denke und dann meine sämtlichen Axiome als Bezeichnungen zwischen diesen Dingen annehme, so gelten meine Sätze, z.B. der Pythagoras, auch von diesen Dingen.⁸⁴

Quite the opposite of Frege's accusation is true, therefore. There is nothing inherently significant about the terms "Punkt," "Gerade" and "Ebene" at all. Instead, they are simple linguistic placeholders for objects that remain undefined because the system is supposed to describe relations between *arbitrary* objects. Arbitrariness, therefore, is not an error but a linchpin in this new geometrical framework. Similarly, albeit in a more casual setting, Hilbert's colleague Otto Blumenthal recalls a conversation in a Berlin train station in 1899, following Hilbert's publication of *Grundlagen*, during which Hilbert asserted that "Man muß jederzeit an Stelle von 'Punkten', 'Geraden' und 'Ebenen', 'Tische', 'Stühle' und 'Bierseidel' sagen können."⁸⁵ This short quip, which has become something of a shibboleth for Hilbert's thinking, is equally revealing: Hilbert is not suggesting the articulation of the geometry of "Bierseidel" in particular; rather, he is underscoring the fact that the terms used *in place* of arbitrary objects are just that — empty metaphors that are agreed upon by mere convention alone. Now, Mehrtens' characterisation of modern mathematics as a "de-ontologized" and entirely "self-referential" language is clearly quite fitting. Mathematics, following Hilbert's intercession, is but an experimental language game.

A cornerstone of the formalist approach, Hilbert's *Grundlagen* then quickly became a blueprint for the "Moderne," announced as something of a rallying cry at the 1900 International Congress of Mathematicians in Paris for his colleagues to rearticulate *all* areas of mathematics by way of the axiomatic method. Framed initially as a set of 23 problems, Hilbert's formalism, as José Ferreirós points out, offered a new framework for "doing" mathematics to the so-called "working mathematicians," i.e. "a self-conscious, autonomous community of research mathematicians," for it "granted them full freedom to choose their topics and to employ modern methods to explore them."⁸⁶ In terms of space, one "working mathematician" of great importance — both to the field and indeed to this thesis — is the "radically modernist" Silesian-

⁸⁴ Hilbert, cited in Landsman, *Foundations of Quantum Theory*, 803.

⁸⁵ Ibid. The origins of this quip have been subject to much speculation, with Peter Simons suggesting Hilbert used the phrase from as early as 1891 in response to some proto-formalists, as opposed to 1899 following his own work. Peter Simons, "Formalism," *The Philosophy of Mathematics*, ed. Andrew D. Irvine (Amsterdam: Elsevier and North Holland, 2009), pp. 291-310, here 297.

⁸⁶ José Ferreirós, "The Crisis in the Foundations of Mathematics," in *The Princeton Companion to Mathematics*, ed. Timothy Gowers, June Barrow-Green and Imre Leader (Princeton and Oxford: Princeton University Press, 2008), 155.

German mathematician Felix Hausdorff,⁸⁷ who in 1914 published *Grundzüge der Mengenlehre*, his magnum opus textbook on set theory and the nascent field of topology. While not an attempt to give set theory a full axiomatic grounding, Hausdorff's text was the first rigorous and systematic study of all aspects of set theory (complete with proofs), which he then uses to formalise highly abstract “topologische Räume” — sets of points accompanied by a structure called, in today's notation, a *topology* τ describing the “Umgebungen” of points around them. In Hausdorff's own words:

Unter einem *topologischen Raum* verstehen wir eine Menge E , worin den Elementen (Punkten) x gewisse Teilmengen U_x zugeordnet sind, die wir Umgebungen von x nennen, und zwar nach Maßgabe der folgenden *Umgebungsaxiome*:

- (A) Jedem Punkt x entspricht mindestens eine Umgebung U_x ; jede Umgebung U_x enthält den Punkt x .
- (B) Sind U_x, V_x zwei Umgebungen desselben Punktes x , so gibt es eine Umgebung W_x , die Teilmenge von beiden ist [...].
- (C) Liegt der Punkt y in U_x , so gibt es eine Umgebung U_y , die Teilmenge von U_x ist [...].
- (D) Für zwei verschiedene Punkte x, y gibt es zwei Umgebungen U_x, U_y ohne gemeinsamen Punkt [...].⁸⁸

To linger on the level of abstraction here, the only meaningful concept left in the absence of distance, proportion and measurability is a notion of “inside” and “outside”: the topological space is characterised solely by points and subsets of points (“Umgebungen”) contained by it. Also operating without any distance metric, the “impeccably modernist”⁸⁹ topology is heavily indebted to and builds upon Klein's study of projective geometry. In essence, topology is the study of properties that remain invariant throughout any continuous transformation (imagined much more broadly than just projections), and because of its sole reliance on neighbourhood relations, it “can be thought of as the geometry that arises when we use a particularly generous notion of equivalence, saying that two shapes are equivalent, or *homeomorphic* [...] if each can be ‘continuously deformed’ into the other.”⁹⁰ As such, a sphere and cube, for example, are deemed “topologically equivalent” because the neighbourhood relations remain intact — structurally invariant — when one is transformed into the other: every point x in a neighbourhood U_x of a topological space A gets mapped onto an image x' with a corresponding neighbourhood $U_{x'}$ in a space A' . A transformation from a sphere into a torus, however, cannot be seen as equivalent; the formation of a hole disrupts the inner-outer structure of subset neighbourhoods.⁹¹

⁸⁷ Leo Corry, “The Development of the Idea of Proof,” 140.

⁸⁸ Felix Hausdorff, *Grundzüge der Mengenlehre* (Leipzig: Veit and Comp, 1914), 213. Note, the final axiom is no longer considered an essential one, and when it applied, this gives rise to what is now called a “Hausdorff space.”

⁸⁹ Gray, *Plato's Ghost*, 129.

⁹⁰ Timothy Gowers, June Barrow-Green and Imre Leader (eds.), “Some Fundamental Mathematical Definitions,” in *The Princeton Companion to Mathematics* (Princeton and Oxford: Princeton University Press, 2008), 40.

⁹¹ Ibid.

Discussed in more detail soon, this brief explication of topology is enough to indicate the scale of the shift in spatial thinking it ushers in. Returning to the bigger picture, by the 1920s, in the face of intuitionist opposition by Brouwer and his followers, this drive to formalise all subfields of mathematics became known as Hilbert's *Programm*, and it is perhaps curious that the most concise (and indeed eloquent) explanation of this new conception of mathematics and its attenuated relationship to the natural sciences was formulated by none other than the modern era's most prolific empirical scientist, Albert Einstein. With a neat turn of phrase, Einstein proposes in his lecture *Geometrie und Erfahrung* of 1921: "Insofern sich die Sätze der Mathematik auf die Wirklichkeit beziehen, sind sie nicht sicher, insofern sie sicher sind, beziehen sie sich nicht auf die Wirklichkeit."⁹² With the *Gegenstand* of mathematics now its own axioms, i.e. itself, Einstein offers a radical answer to the questions surrounding the ambiguities of axiomatic statements that followed from Euclid's *Elements* at the beginning of this section: "Diese Axiome sind *freie Schöpfungen des menschlichen Geistes*, alle anderen geometrischen Sätze sind logische Folgerungen aus den (nur nominalistisch aufzufassenden) Axiomen."⁹³ While also drawing attention to an inherently creative and experimental facet of modern mathematics, Einstein captures in full how the sense of *Verlust* that plagued Klein and his "gegenmodernen" successors can just as easily be imagined as a liberation, and one that secures for mathematics a hitherto impossible sense of autonomy:

Diese von der modernen Axiomatik vertretene Auffassung der Axiome säubert die Mathematik von allen nicht zu ihr gehörigen Elementen und beseitigt so das mystische Dunkel, welches der Grundlage der Mathematik vorher anhaftete. Eine solche gereinigte Darstellung macht es aber auch evident, daß die Mathematik als solche weder über Gegenstände der anschaulichen Vorstellung noch über Gegenstände der Wirklichkeit etwas auszusagen vermag.⁹⁴

Evoking here a process of cleansing, mathematics has been brought out from under the dark shadows cast by an ontological burden and the muddy residue of earthly objects washed away; indeed, *any and all* objects have been expunged. Einstein is thus able to memorably conclude: "Unter 'Punkt', 'Gerade' usw. sind in der axiomatischen Geometrie nur *inhaltsleere Begriffsschemata* zu verstehen. Was ihnen Inhalt gibt, gehört nicht zur Mathematik."⁹⁵

Now, the two-fold characterisation of the *Raumproblem* that I have proposed as a pathway into modern mathematics and into potential comparisons with aesthetic modernism is on firmer footing. Considering the trajectory of mathematical space since antiquity, the arrival of non-Euclidean geometries force a sudden divergence from Kant's transcendental philosophy and a

⁹² Albert Einstein, *Geometrie und Erfahrung* (Berlin: Springer Verlag, 1921), 3f.

⁹³ Ibid., 5. Emphasis added.

⁹⁴ Ibid.

⁹⁵ Ibid.

conception of *Raum* that becomes at first Riemann's manifolds, then Klein's transformation groups and then an abstract study of invariant properties throughout arbitrary transformations in Hausdorff's topology. This constantly shifting understanding of space, then, both provoked and was enveloped by a wholesale liberation of mathematics from its exterior *Gegenstände*, empirical and in *Anschauung*, and broader foundations outside of itself and its own language. In light of these changes, can we begin, even on a local scale, the weighty task of uncovering channels of philosophical influence behind these mathematical changes that *also* bear out as significant influences to instances of aesthetic modernism? By narrowing scope to consider the curious case of Felix Hausdorff in particular, I argue in this chapter that this question can be answered affirmatively.⁹⁶ Let us dwell for a moment on Hausdorff's (at times tragic) biography, for in it a notable turning point becomes most apparent that naturally raises the question of "third party" and necessarily cross-disciplinary influences in his mathematical development.

Felix Hausdorff and Paul Mongré

Born in 1868 in Breslau, then a city in the Kingdom of Prussia but now known as Wrocław in present-day Poland, to secular Jewish parents, the young Felix Hausdorff proved himself as something of a polymath in his school in Leipzig — at the time a well-known hub of humanistic education — and demonstrated a talent for mathematics, a keen literary voice and a very promising musical ability.⁹⁷ While he expressed a wish to study music upon leaving school, his father pressed him into mathematical study at the Universität Leipzig, and he graduated in 1891 with a thesis on light refraction in the atmosphere. In 1895 he completed his Habilitation on a similar theme. Struggling to find gainful employment in the realm of applied mathematics, from 1895 Hausdorff became increasingly involved with a radical group of philosophers and artists in Leipzig, including Franz Wedekind, Max Klinger and Otto Erich Hartleben, among others. Topics ranged from metaphysics to women's emancipation, but they all circled around one particular source of influence: Friedrich Nietzsche.⁹⁸ Writing under a pseudonym Paul Mongré

⁹⁶ Mehrrens repositioning of Hausdorff as much more central figure in the story of modern mathematics than he was hitherto considered is to be credited for the recent surge in scholarly interest in Hausdorff. Beginning in 1994, historians of mathematics Walter Purkert and Moritz Epple have led a curatorial project producing a nine-volume critical edition of Hausdorff's works, encompassing his mathematical texts, correspondence and literary/essayistic writing. The final piece (including the paper central to this thesis, "Das Raumproblem") which was published only in 2021, and this dissertation is greatly indebted to the painstaking labour of the project's dedicated team.

⁹⁷ The following biographical details are borrowed from Walter Purkert, "The Double Life of Felix Hausdorff/Paul Mongré," *The Mathematical Intelligencer* 30, no 4 (2008): pp. 37-50. To avoid excessive footnoting, it can be assumed that Purkert's text is being used as a source unless otherwise stated.

⁹⁸ As Gray explains, Hausdorff's "turn to Nietzsche came about through his involvement in the Akademisch-Philosophischer Verein [...]. The society became a forum for modernist trends in science, literature, music, and the arts, and all manner of cultural and intellectual issues were fiercely discussed in regular evening meetings." Gray, *Plato's Ghost*, 222.

(“Paul to-my-liking”), Hausdorff published in 1897 a vast collection of aphorisms entitled *Sant'Ilario: Gedanken aus der Landschaft Zarathustras*, and in 1898, he published a follow-up treatise *Das Chaos in kosmischer Auslese: Ein erkenntniskritischer Versuch* that builds upon the epistemological section of the previous work.⁹⁹ Hausdorff's final texts written under the pseudonym were published in the first few years of the 1900s — a career breakthrough would bring an end to this side of his written work.

Obtaining at last a professorship at the Universität Leipzig in 1902, Hausdorff delivered his inaugural lecture, entitled “Das Raumproblem,” the following year, but in it there is little trace of the applied mathematician of the previous decade. The lecture bears witness to a remarkably rapid about-face, for Hausdorff arrives on the mathematical stage as a fervent advocate for a (radically)¹⁰⁰ modernist outlook. Concretising a disciplinary transition to Hilbert's *Formalismus*, Hausdorff's modern work as an archetypal “working mathematician” culminated (following a move to Universität Greifswald) in his aforementioned *Grundzüge der Mengenlehre* (1914), in which his topological musings in “Das Raumproblem” would be rendered much more rigorously. As a measure of its impression on colleagues, even by 1921, US-American mathematician Henry Blumberg is able to claim that no “volume in any field of mathematics, even in the unclouded domain of number theory, [...] surpasses the *Grundzüge* in clearness and precision.”¹⁰¹ Moving from Greifswald to Universität Bonn, in the ensuing years Hausdorff continued to teach on his research and was recognised as a leading authority on set theory and its articulation of the concept of *Raum* in mathematics. His related work on dimension theory, published in shorter papers, would become some of the most cited mathematical sources of the 1910s and 1920s, and in 1927, he published a second edition of his magnum opus, entitled *Mengenlehre*.¹⁰² The widespread success of Hausdorff's work on set theory and topology, as will be touched upon soon, would unexpectedly contribute to his tragic fate in 1943, ten years into the Nazi regime.

⁹⁹ On top of this, he published a few collections of poetry and even a moderately successful play *Der Arzt und seine Ebre*, which was published in the *Neue Deutsche Rundschau* in 1904 and staged much later in several cities, mostly during the war years of 1914 and 1918.

¹⁰⁰ As Mehrtens indicates, Hausdorff's position is in fact so radical that it almost surpasses the rest of his colleagues at this early stage of the epoch. Mehrtens, *Moderne-Sprache-Mathematik*, 165.

¹⁰¹ Henry Blumberg, *Bulletin of the American Mathematical Society* 27, no. 3 (1921), 116. Cited in Purkert, “The Double Life of Felix Hausdorff/Paul Mongré,” 37.

¹⁰² As Erhard Scholz notes, the second edition is so heavily revised that it really should be considered a separate work. Erhard Scholz, “Felix Hausdorff,” in *The Princeton Companion to Mathematics*, ed. Timothy Gowers, June Barrow-Green and Imre Leader (Princeton and Oxford: Princeton University Press, 2008), pp792-793, here 793.

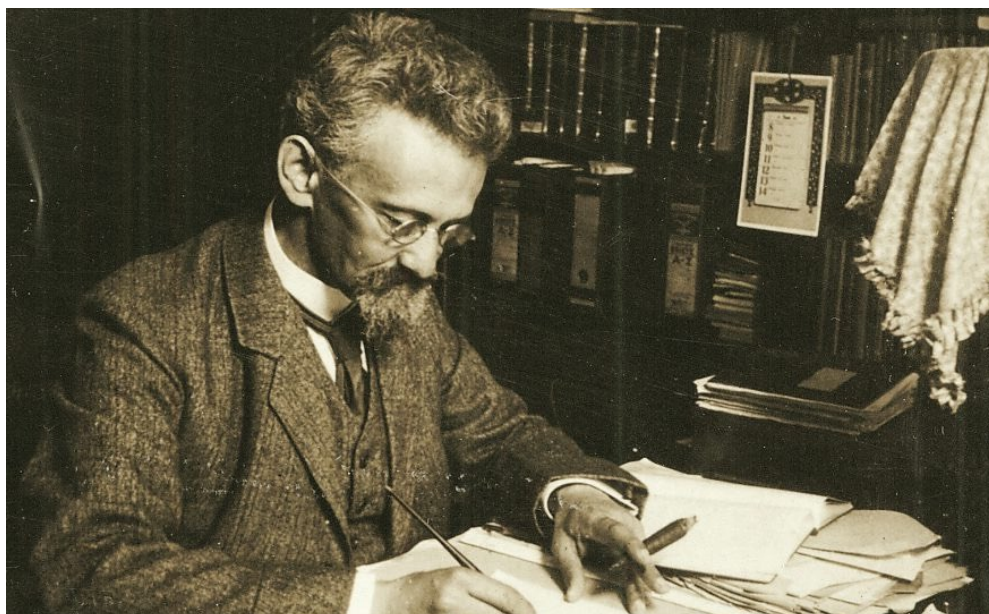


Figure 1.3: Felix Hausdorff in the early 1920s¹⁰³

With the Nuremberg decrees, Hausdorff's emeritus status in 1935¹⁰⁴ — he was 67 years old at this point — was revoked and his pension halved; his 40-year career was marked by an abrupt severance of all official ties. No longer permitted to access the library of his institute in Bonn, Hausdorff continued to work under-resourced and in solitude at home, publishing no less than seven papers on topology and set theory in Polish mathematical magazines *Studia Mathematica* and *Fundamenta Mathematicae* until 1938. During this time, Hausdorff made no attempt to emigrate, unlike many professional mathematicians who fled to the USA, UK and Soviet Union, which his biographers attribute to his misguided belief that the Nazis were not too concerned with the elderly Jews and would leave them in relative peace. Having adopted a more realistic view in the wake of 1938's *Kristallnacht*, Hausdorff, then over 70 years old, tried and failed via his connections to negotiate a position at Brown University.¹⁰⁵ In a way that is cruelly ironic, Hausdorff's accomplishments ultimately formed the greatest hurdle: despite Richard Courant's and Hermann Weyl's efforts, as Siegmund-Schultze explains, "his research field had become so fashionable in the U.S. that the Americans did not need older and more expensive foreign

¹⁰³ Reproduced from "The Double Life of Felix Hausdorff/Paul Mongré," 37.

¹⁰⁴ Unlike several colleagues across Germany, Hausdorff was temporarily spared the immediate dismissal of non-Aryan academics according to the *Gesetz zur Wiederherstellung des Berufsbeamtentums* in 1933, due to President Hindenburg's insistence on three exceptional amendments to the law, one of which protected civil servants who were in place before 1914 and the outbreak of the First World War.

¹⁰⁵ He appealed in February 1939 to former Göttingen professor Richard Courant, who had been employed at New York University in the USA, for help to arrange the position. Then in May 1939, Hungarian mathematician George Pólya wrote to another Göttinger Hermann Weyl, who secured a position at Princeton University, asking him to advocate for Hausdorff there, stressing in the letter his friend's impoverished existence in Bonn. Cf. Reinhard Siegmund-Schultze, *Mathematicians Fleeing from Nazi Germany: Individual Fates and Global Impact* (Princeton and Oxford: Princeton University Press, 2009), 97.

professors to cultivate it.”¹⁰⁶ In short, his landmark text of 1914 was so well-known that a younger and cheaper lecturer could better appeal to the “traditionally commercial” US-American university system.¹⁰⁷

While Europe lurched into the second war of the century in 1939 and Germany’s measures of persecution against the Jews accelerated after 1941, Hausdorff and his wife, Charlotte, remained in Bonn. In January 1942, they were ordered to present themselves at a government-seized cloister in Endenich, a suburb of Bonn, for what they suspected was deportation to a concentration camp. Together with Charlotte’s sister, Edith Pappenheim, who at that point lived with them, the Hausdorffs opted to take their own lives at home on 26th January by overdosing on veronal. Earlier that day, Hausdorff penned a final letter to his friend Hans Wollstein, a Jewish lawyer, explaining their decision, and Hausdorff’s propensity for playing with words lingered to the end, for he could not refrain from one final, gloomy *Wortspiel* on the Bonn suburb to which they had been summoned: “Auch Endenich ist noch vielleicht das Ende nich!”¹⁰⁸ As records of deportation from the cloister show, Hausdorff’s instincts were correct when he predicted Endenich would not be the end: those interned there were subsequently moved onto several concentration camps, with the majority to Auschwitz-Birkenau death camp.¹⁰⁹ After Hausdorff’s death, his *Nachlass* was preserved by a family friend Hans Bonnet, an Egyptologist, who eventually passed it onto the university library in Bonn, where they are archived to this day. As a small and symbolic gesture of restitution, the mathematics institute at the Universität Bonn is now named after Hausdorff, one of its longest serving and certainly most renowned educators.

From this outline of Hausdorff’s professional and personal life, the moment at which extra-mathematical influences materialise is evidently during that period of a short few years either side of 1900, in which the irreverent Saxonian philosopher Friedrich Nietzsche became a central pre-occupation. With his mathematical practice and interests either side of this period taking remarkably different forms, it is natural to wonder if, as Gray writes, “his philosophical ideas *may* have influenced him to make a more detailed study of mathematics.”¹¹⁰ Such cautious phrasing, of course, indicates a willingness to acknowledge *some* amount of extra-mathematical

¹⁰⁶ Reinhard Siegmund-Schultze, “Not in possession of any *Weltanschauung*: Otto Neugebauer’s Flight from Nazi Germany and His Search for Objectivity in Mathematics, in Reviewing, and in History,” in A. Jones, C. Proust and J. Steele, *A Mathematician’s Journeys: Otto Neugebauer and Modern Transformations of Ancient Science* (Cham: Springer International, 2016), 94.

¹⁰⁷ *Ibid.*, 95.

¹⁰⁸ The letter is reproduced in Egbert Brieskorn, ed., *Felix Hausdorff zum Gedächtnis — Aspekte seines Werkes, Band I* (Munich: Teubner Verlag, 2013), 265.

¹⁰⁹ *Ibid.*, 258.

¹¹⁰ Gray, *Plato’s Ghost*, 222.

influence on Hausdorff, but ultimately, Gray is keen to maintain a clear division between the work of the mathematician and the essayistic and philosophical writings published under the pseudonym.¹¹¹ Then, even more sympathetic accounts of Hausdorff's eclectic interests, like Purkert's "The Double Life of Felix Hausdorff/Paul Mongré," steer clear of positing any explicit influence of Nietzsche on Hausdorff's mathematical practice. Noting how Mongré can be seen variably as a follower, competitor and companion to Nietzsche, Purkert readily acknowledges the engagement with Nietzsche's doctrine of eternal recurrence in both *Sant'Ilario* and *Das Chaos in kosmischer Auslese*, but he is careful not to tether Mongré's various steps towards novel elements of modern mathematics, namely set theory and non-Euclidean geometries, to the common ground he shares with Nietzsche.¹¹² In this sense, the title of the article is more meaningful than at first glance, for the "double life" is thus, in a philosophical sense, a reference to effectively two different people. Arising from the more meticulous scholarly work on Hausdorff's *Nachlass*, however, this partitionary account has been called into question. In an incisive article, historian of mathematics Moritz Epple seems to respond directly to Purkert's terminology when he provocatively asks, "is the case of Mongré the writer and Hausdorff the mathematician a case of a double identity, a multitalented author whose intellectual horizon was just too broad to fit under one roof, or are there intellectual connections between the two?"¹¹³ Seeking to establish grounds for the latter, Epple foregrounds the epistemological claim reached in "Das Raumproblem," namely what Hausdorff calls "besonnener Empirismus," i.e. the suggestion that "beyond mathematics, no scientific knowledge can claim to be more than a more-or-less plausible, more-or-less economic, and more-or-less complex system of beliefs compatible with the empirical information we may have."¹¹⁴ Tracing this back through *Das Chaos in kosmischer Auslese*, Epple probes how Mongré's prolonged preoccupation with Nietzsche's speculative idea of *ewige Wiederkehr des Gleichen* was formative in his reaching a very similar conclusion, noting also how it directed him towards a piecemeal engagement with Cantor's transfinite set theory.¹¹⁵ Ultimately, with Mongré's radical epistemological position resurfacing

¹¹¹ He opines, for example, "the view that mathematics is about arbitrary systems and effectively requires no ontology became a fiercely modernist one in the hands of Paul Mongré around 1898, although not with Hausdorff a few years later." While promising to elaborate on this vaguely worded claim, Gray never really comes round to it, and his discussion of Hausdorff and Mongré, which will be mentioned later, remains quite cursory. *Ibid.*, 29.

¹¹² Purkert, "The Double Life of Felix Hausdorff/Paul Mongré," 42f.

¹¹³ Moritz Epple, "Felix Hausdorff's Considered Empiricism," in *The Architecture of Modern Mathematics*, ed. Jeremy Gray and José Ferreirós (Oxford: Oxford University Press, 2006), 265.

¹¹⁴ *Ibid.*, 266.

¹¹⁵ This is indeed a step beyond what Gray considers in his own cursory discussion of this Mongré text: "The fundamental idea is that the world in itself is unknowable (a Kantian point about the *Ding an sich*), but everyone produces an intelligible cosmos out of the inaccessible, transcendental chaos. To any kind of metaphysical realism or claim that we could know what the world really is, Mongré opposed what he called a transcendental nihilism. Insofar as any position is advocated, it is a critically refined empiricism. [...] The novelty is that Mongré has a way of squaring empiricism with any kind of claim about the absolute. All this built up to the claims, by the end of the

without the pseudonym, Epple thus begins to undermine the hitherto normalised division between Mongré and Hausdorff. This section will build on this crucial case study initiated by Epple, further concretising the impact of Nietzsche not only on Mongré’s epistemological ideas but on the changing mathematical perspective of Hausdorff. Turning, as Epple does, to “Das Raumproblem” as a milestone text, it will be shown firstly how Hausdorff essentially advocates for the two-fold conception of space and spatiality in mathematics put forward by this thesis, i.e. as a turn towards the study of invariant properties throughout transformation that both occasions and is contained by an abdication in mathematical language of the space of the empirical world or any transcendental cognition of it. Anticipating his magnum opus in the field of set theory and topology, “Das Raumproblem” reaches its theoretical climax in the discussion of a *Transformationsprinzip*, the examination of invariant properties under entirely arbitrary transformations, which Hausdorff fuses to a conception of mathematics that is cast in remarkably modern terms. Having ascertained these two spatial precepts in Hausdorff’s text, I then argue that the pathways leading to them in the Mongré texts attest to the guiding presence of Nietzsche throughout, thus furthering Epple’s essential line of inquiry.

Nietzsche and the *Raumproblem*

Let us now turn more closely to “Das Raumproblem” and its timely intervention into the developing discourse of space in mathematics. “An der Lösung des Raumproblems,” begins Hausdorff, “sind nicht weniger als fünf Wissenschaften beteiligt und interessiert: Mathematik und Physik, Physiologie, Psychologie und Erkenntnistheorie,”¹¹⁶ thus recognising immediately the cross-disciplinary import held by the fundamental category of space. Despite this unifying concern, Hausdorff swiftly begins to partition the concept into three spheres. Firstly, there is “der mathematische Raum,” typified by “eine gewisse freie Schöpfung unseres Denkens, keinem anderen Zwange als dem der Logik unterworfen, ein System willkürlich gewählter Voraussetzungen, sogenannte Axiome, nebst den daraus Deduktiv abgeleiteten Folgerungen.”¹¹⁷ Here, there is of course an obvious overlap in phrasing with Einstein’s text — with clear reference to a liberation from burdensome *Zwänge* beyond its own internal logic — but it would be remiss not to remark upon the fact that Hausdorff’s lecture predates Einstein’s *Geometrie und Erfahrung* by some twenty years. Secondly, there is “der empirische Raum,”

book, that the idea that time is linear, continuous, single valued, does not run backwards, and proceeds uniformly, and the idea that space is three-dimensional, continuous, uniform, and Euclidean, are incapable of proof.” Gray, *Plato’s Ghost*, 222.

¹¹⁶ Felix Hausdorff, “Das Raumproblem,” in *Felix Hausdorff - Gesammelte Werke, Band VI: Geometrie, Raum und Zeit*, ed. Moritz Epple (Berlin, Heidelberg and New York: Springer, 2021), 281.

¹¹⁷ *Ibid.*

imagined as a “System willkürlicher Erlebnisse und Erfahrungen” and “subjektiv-psychologisch” in nature, and finally, there is “der absolute Raum” that is composed of “ein gewisses Verhalten der Dinge” independent of observation and is presupposed by intuition alone.¹¹⁸ The distinction between the latter two spaces is, as Hausdorff notes, the usual Kantian one, i.e. the phenomenological one of “Erscheinungen” and the fundamentally unknowable noumenal world. For the “fünf Wissenschaften,” therefore, there are three *Räume* in play, and Hausdorff suggests that any solution to the *Raumproblem* must address the following question: are these three spaces “auf eine einzige, alle Abweichungen ausschließende Art definiert, oder haben wir vielleicht die Wahl zwischen verschiedenen gleichberechtigten Hypothesen?”¹¹⁹

Beginning to answer this question, Hausdorff first rules that the second space, the one of “Erlebnisse und Erfahrung,” is by its definition restricted “als *fait accompli*,” for it is apprehended “in reiner Passivität.”¹²⁰ For the first and third spaces, however, Hausdorff contends that there is in fact an unbounded “Wahlfreiheit” of possible hypotheses. For the first, i.e. mathematical space, this is of course nothing particularly new by 1903 following the developments of the 19th century as previously mapped out, but it certainly serves as a *fachpolitische* alignment with the “Moderne” camp. Yet, for the third space, the “objektive” and “absolute” space that is fundamentally unknowable, this is curious, and indeed Hausdorff is aware of the apparent “Paradoxie” of the claim.¹²¹ At this point, he puts forward yet another tripartite idea that sets the tone for the rest of the lecture, namely a set of three *Spielräume* through which the multiplicity of hypotheses is guaranteed: through “den Spielraum des Denkens, den Spielraum der Anschauung, und den Spielraum der Erfahrung.”¹²² As Epple notes, “this metaphor plays a crucial role in Hausdorff’s thinking,” and he thus leaves it untranslated in his own analysis: “Its meaning comes close to that of a ‘range of possibilities’, a range that leaves room for play, and for active choices.”¹²³

Turning to consider the remits offered by these *Spielräume* for the conception of mathematical space, Hausdorff is quick to nail his colours to the distinctly modernist mast, for the “Spielraum des Denkens” is “eine Freiheit, die sich die Mathematik nicht ohne Kampf gegen

¹¹⁸ Ibid., 281f. Hausdorff’s use of the term “absolute” is perhaps unfortunate here, for the Newtonian connotations could lead to confusion. Newtonian absolute space is not imagined as unknowable per se; it is something of an independent container or stage upon which phenomena occur: “Absolute space, in its own nature, without regard to anything external, remains always similar and immovable.” Isaac Newton, *The Mathematical Principles of Natural Philosophy*, Vol. 1, trans. A. Motte, ed. W. Davis (London: H.D. Symonds, 1803), 6.

¹¹⁹ Hausdorff, “Das Raumproblem,” 282.

¹²⁰ Ibid.

¹²¹ Ibid.

¹²² Ibid.

¹²³ Epple, “Felix Hausdorff’s Considered Empiricism,” 281.

philosophische Unterdrückungsversuche siegreich erstritten hat, und die heute zu den unveräußerlichen Grundbesitz unserer Wissenschaft gehört.”¹²⁴ Drawing on the weight of the previous century’s developments, from non-Euclidean geometry to Hilbert’s *Grundlagen*, Hausdorff proclaims that mathematicians can now, without any hesitation, “jede aprioristische Konstruktion, die den euklidischen Raum [...] als Denknöwendigkeit behauptet [...] *ad acta* legen.”¹²⁵ With an “uferlose” *Spielraum* of pure thought, what restrictions arise in the transition into the others? Considering that geometry can also have an “empirische Gültigkeit,” Hausdorff moves firstly into the “Spielraum der Erfahrung,” which more or less forces the Euclidean model of space as the only one that works *practically* with “Perlen, Drähten, Scheiben, Glasstücken,” for example.¹²⁶ There is, however, a small degree of wiggle-room: given that Euclidean geometry is an approximation, it is conceivable that other non-Euclidean geometries could arise here, so long as the extent to which they deviate from the Euclidean remains “unter der Beobachtungsschwelle.”¹²⁷ Then, while the intermediate “Spielraum der Anschauung” is less restrictive than that of “Erfahrung” — there are, as Hausdorff notes, some noteworthy attempts to intuit non-Euclidean geometries underway — the question of the “Vorstellbarkeit” of an infinite array of alternative geometrical hypotheses is, for Hausdorff, “noch weniger als Wortstreit, nämlich ein Streit um Personen und persönliche Begabung.”¹²⁸ Indeed, with the “Unterdrückungsversuche” against the successes of mathematical formalism mentioned above stemming from a reluctance to give up on Kant’s *Anschauung* as a bridge to the real world, it is with no small measure of irony that Hausdorff tries to discredit the tool of the detractors here: “Der phantasiestarke Mathematiker wird den Gebilden seines Denkens auch die Lebendigkeit der Anschauung einzuhauchen wissen, während Geister von schwächerer Flugkraft oder mehr abstrakter Richtung ihm in sein Reich konkreter Schöpfung und Belebung nicht zu folgen vermögen.”¹²⁹ For mathematical space, therefore, there is a clear hierarchy at play when it comes to the *Spielräume* in which it can operate, with the emancipatory quality unique to one in particular: “Vollkommen *fessellos* bewegen wir uns im Bereich des Gedankens.”¹³⁰

Having characterised “den mathematischen Raum” in explicitly modernist terms, Hausdorff then turns to the third space, the “objective” and “absolute Raum” that is unknowable.

¹²⁴ Hausdorff, “Das Raumproblem,” 283.

¹²⁵ *Ibid.*

¹²⁶ *Ibid.*, 284.

¹²⁷ *Ibid.*

¹²⁸ He continues: “Über denkbar oder undenkbar kann man einig werden, unter geistig normalen Menschen; aber ‘anschaulich vorstellbar’, das bedeutet bei jedem etwas anderes, je nach dem Umfang seiner individuellen Erfahrung und der Stärke seiner analogiebildenden Phantasie.” *Ibid.*, 285.

¹²⁹ *Ibid.*, 286. Cf. Epple, “Felix Hausdorff’s Considered Empiricism,” 283.

¹³⁰ *Ibid.*, 286. Emphasis added.

Hausdorff approaches the problem by questioning the relationship between it and its by-definition limited predecessor “der empirische Raum,” asking whether “der zweite Raum” is to be viewed as “bloßer Abschrift des Dritten oder als selbständiges, unwegdenkbares Erzeugnis unseres Intellekts, als Anschauung *a priori*,” thus rendering “der dritte Raum als identisches Urbild des zweiten,” or if it is simply non-existent.¹³¹ As such, he is of course questioning the viability of the Kantian transcendental aesthetic that bridged rational and empirical conceptions of geometry and assumed the Euclidean nature of both. Principally, “Das Raumproblem” soon turns to a systematic dismantling of this position, which Hausdorff achieves by isolating the “charakteristischen Eigenschaften” of Euclidean geometry — here, they are flatness, free mobility of rigid bodies, 3-dimensionality and connectedness — and observing “wie reich an Voraussetzungen, wie wenig selbstverständlich” they are once alternatives are considered that experience alone would fail to discredit.¹³² Beginning with Riemann’s observations that space could well be of non-zero but small “Krümmungsmaß,” Hausdorff gradually works up towards more peculiar yet theoretically *conceivable* spatial models, for example a cylindrical cosmos, generated by winding “ein Papierblatt um einen Lampenzylinder.”¹³³ He continues: “Denken wir uns in einem solchen Raum lebend, so würden wir die Entdeckung machen, daß von jedem Punkte eine bestimmte Richtung aus geht, in der fortwährend man schließlich wieder zum Ausgangspunkte zurückgelangt.”¹³⁴ Not in possession of a way to test such a movement over “Billionen Meilen Länge,” however, experience cannot rule out that we as observers do not live in such a space.¹³⁵ Even stranger again but *still* not dismissible is the possibility of a Möbius strip spatiality, which would, as Hausdorff imagines, “die Verwandlung rechter in linke Handschuhe gestatten und ein normal gebauter Mensch würde von einer hinlänglich weiten Wanderung mit Dextrokardie behaftet heimkehren.”¹³⁶ At this stage of the lecture, Hausdorff’s vivid renderings of conceivable spaces that deviate from Euclidean norms seem like lightly entertaining illustrations and thought experiments, but in his final turn, their very *thinkability* is brought to bear on the Kantian problem: “der absolute Raum, das zur Erklärung unserer räumlichen Wahrnehmung vorausgesetzte objective räumliche Verhalten der Dinge, [leidet] an völliger Unbestimmtheit und Unbestimmbarkeit.”¹³⁷ As such, while agreeing with the Kantian unknowability of the objective noumenal world, Mongré dispenses with *any* sense of a necessary

¹³¹ Ibid., 282.

¹³² Ibid., 286. Cf. Epple, “Felix Hausdorff’s Considered Empiricism,” 282.

¹³³ Hausdorff, “Das Raumproblem,” 292.

¹³⁴ Ibid.

¹³⁵ Ibid.

¹³⁶ Ibid.

¹³⁷ Ibid., 293f.

correspondence between this realm and that of perception.¹³⁸ As interesting as this finding is, for my purposes it is actually his illustration, more so than the result, that is most relevant, for it is here that his so-called *Transformationsprinzip* takes shape.

“Was muß man von einer brauchbaren geographischen Karte verlangen?”¹³⁹ asks Hausdorff at the beginning of his demonstration. Of course, one can expect neither an exact replica of the original, lest there exist a map the size of the territory it charts, nor “Ähnlichkeit,” for the globe cannot be represented on a rectangular sheet without the well-known distortions that make up the differing map projections commonly available.¹⁴⁰ Rather, a one-to-one correspondence is needed, i.e. “jedem Erdort soll ein Kartenpunkt, jedem Kartenpunkt ein Erdort korrespondieren,” as well as the structural integrity of the map: “Karten, die zusammengehörige Flächenstücke zerreißen, gelten als verfehlt.”¹⁴¹ Principally, however, a “hinreichend feinmaschiges Gradnetz” is required to order the space.¹⁴² Aside from these demands, all else is dispensable.¹⁴³ Equipped with this important “Gradnetz,” the correspondence between the map and the territory is arbitrary; the “Maßstab und Projektion” must simply be stated in the corner.¹⁴⁴ The “empirischer Raum,” the second space in question, “ist solch eine körperliche Karte, ein Abbild des absoluten Raumes,” but we do *not* have the “Eckenvermerk,” and as such, we know *nothing* of the “Urbild”: between the two spaces in question, there is an entirely arbitrary transformation.¹⁴⁵ Nonetheless, Hausdorff stresses, “wir finden uns auf unserer Karte zurecht und verständigen uns mit anderen Kartenbesitzern,” because both the measurer and the measuring apparatus are also equally affected by the transformation.¹⁴⁶ From the previous historical survey of space and geometry, a line of thinking that anticipates not only the field of topology but indeed Hausdorff’s unique delineation of it with respect to “Umgebungen” of points is surely manifest. The “Gradnetz” of the map functions in the *exact* same way, i.e. as a sort of wiggle-room around a point that is preserved in a transformation. As Hausdorff

¹³⁸ As Epple simply notes, the thinkability of these alternative structures arising in the *Spielraum* of thought is “fatal” to the absolute, objective space. Epple, “Felix Hausdorff’s Considered Empiricism,” 281.

¹³⁹ *Ibid.*, 294.

¹⁴⁰ *Ibid.*

¹⁴¹ *Ibid.*

¹⁴² *Ibid.*

¹⁴³ He continues: “Die Karte mag jede beliebige Gestalt haben; sie mag Meridiane und Parallelkreise wieder durch Kreise oder Ellipsen oder Ovale höherer Gattung darstellen; sie mag Europa als Eimer und das gigantische Asien als Henkel daran abbilden, mag aus dem italienischen Stiefel einen Polypen mit Fangarmen und aus dem spanischen Profil eine dünne Landzunge formen; dies alles stört nicht, die verzerrten Konturen haben, auf das entsprechend verzerrte Gradnetz bezogen, die richtige Lage.” *Ibid.*, 294f.

¹⁴⁴ *Ibid.*, 295.

¹⁴⁵ *Ibid.*

¹⁴⁶ *Ibid.*

elaborates on this idea, the topological maxim of “invariance within change” becomes more concrete:

Wenn diese Auffassung richtig ist, so muss man das Urbild einer beliebigen Transformation unterwerfen können, ohne daß das Abbild sich verändert. [...] Denken Sie sich etwa innerhalb eines Hauses alle vertikalen Dimensionen auf die Hälfte verkürzt, die Horizontalen aber ungeändert, sodaß Türen, Fenster, Öfen, Menschen zu breiten, niedrigen Mißgestalten zusammengedrückt werden, wie wir sie in den zylindrisch geschliffenen Vexierspiegeln mancher Zauberkabinette belachen. Bei näherer Überlegung finden wir wirklich, daß wir von dieser Verzerrung weder innerhalb noch außerhalb des Hauses etwas bemerken würden.¹⁴⁷

There is, in short, simply no way of knowing which spatial model governs the objective, absolute realm presupposed by intuition. The transformation that maps this unknowable realm onto the one of perception is arbitrary and unknowable, and moreover, any transformation of this “Urbild” would, so long as it affects all aspects equally, be imperceptible in the empirical realm. Circling back to his all-too-important *Spielräume*, Hausdorff is thus able to reach his most daring conclusion, which he knows may well offend any given “unbesonnener Empirist”¹⁴⁸ in the audience. If any claim about absolute space is essentially axiomatic (i.e. to be presupposed but unfit for proof and by no means necessary), then it is in fact the *non-empirical* “Spielraum des Denkens,” in which all possible spatial hypotheses are nothing more than logical experiments and “freie Schöpfung de Geistes,” that comes to be a more rigorous empiricism than empiricism does itself.¹⁴⁹ As the last *Spielraum* standing, therefore, the task for abstract mathematics is simply to keep its “Spieltrieb” in motion — in short, to keep playing.¹⁵⁰

While it is Epple who begins at this point a possible discussion that links Hausdorff’s “besonnener Empirismus” to an array of contemporary and future philosophical debates (primarily in physics),¹⁵¹ it is enough to note how the 1903 lecture, which “exemplifies Hausdorff’s new approach,” is a culmination of the two-fold conception of space that was set up at the beginning of this thesis and historically grounded in the previous section. Firstly, in this rather imaginative *Transformationsprinzip* at the lecture’s climax, there is an understanding of *Raum* in mathematics that is really just *Räumlichkeit*, i.e. an examination of invariant spatial properties throughout arbitrary transformation, building on the Riemannian discussion of an

¹⁴⁷ He continues: “Von dem zusammengedrückten Fenster geht das zusammengedrückte Lichtstrahlenbündel aus und trifft auf unsere ellipsoidisch zusammengedrückte Netzhaut, sodaß vorher wie nachher dieselben Netzhautpunkte von denselben Strahlen erregt werden und unser Gehirn aus demselben System lokalisierter Empfindungen dasselbe Bewußtseinsbild aufbaut. Auch ein Metermaßstab, mit dessen Hülfe wir uns etwa von der eingetretenen Veränderung überzeugen wollten, würde uns nichts verraten, denn richten wir ihn auf, so schrumpft auch er auf die Hälfte zusammen.” Ibid.

¹⁴⁸ Ibid., 298.

¹⁴⁹ Ibid., 299.

¹⁵⁰ In Epple’s words, this amounts to the task of exploring all “valid conceptions of space.” Epple, “Felix Hausdorff’s Considered Empiricism,” 284.

¹⁵¹ Ibid., 284-9.

infinity of n-dimensional non-Euclidean geometries and Klein's subsequent *Erlanger Programm*. Crucially, the early signs of Hausdorff's own conception of topological spaces in terms of "Umgebungen" of points are also on display with the focus on the "Gradnetz" of a map. Secondly, this *Transformationsprinzip* both engenders and is packaged within a conception of mathematical space as "die schöpferische Freiheit" that is unburdened of ontological commitments in the real world or in Kantian *Anschauung*. It is subject only to the "allergewaltigsten Spielraum"¹⁵² of pure and experimental thought alone. Now holding the two threads of the *Raumkonzeption* of this thesis, the task for identifying Nietzsche's influence during (and more importantly *beyond*) the Mongré years can be rendered more precisely.

In the following, the development of the *Transformationsprinzip* will be tied to Mongré's extended fixation upon Nietzsche's controversial thought experiment of eternal recurrence, which the latter developed most extensively in *Also sprach Zarathustra* (1883), and the broader deontologized characterisation of mathematics in light of its *Raumproblem* will be traced back to an essay published by Mongré in 1903, the very same year as "Das Raumproblem" (and thus one of the final contributions written under the pseudonym), namely "Sprachkritik." The essay, which begins as a discussion of referentiality in language, takes a surprising turn towards abstract mathematics towards its end, and this deployment, I argue, must be considered alongside Mongré's reception of Nietzsche's belatedly published essay "Über Wahrheit und Lüge im außermoralischen Sinne." Before proceeding, a structural unevenness must be noted here. As Epple points out, the claim that Nietzsche's *ewige Wiederkehr* prompted Mongré to turn towards the nascent field of set theory developed by Georg Cantor is "a simple historical observation," even if the process for Mongré was less than straightforward.¹⁵³ Equally, the integral role of Mongré's engagement with Nietzsche's eternal recurrence in the development of the *Transformationsprinzip* that bridges *Das Chaos in kosmischer Auslese* and "Das Raumproblem" is also relatively self-explanatory. As such, this discussion is significantly shorter than the subsequent endeavour that will draw upon Nietzsche's *Sprachkritik* in a novel way and attempt to address a lingering gap on the story of Nietzsche's influence on Hausdorff.

Ewige Wiederkehr and the Transformationsprinzip

Turning to the impact of Nietzsche's famous doctrine of *ewige Wiederkehr des Gleichen* on Mongré and Hausdorff, a combination of existing scholarly work and some moderate historical digging allows us to dwell comparatively briefly on the matter and move off swiftly to explore uncharted

¹⁵² Hausdorff, "Das Raumproblem," 282.

¹⁵³ Epple, "Felix Hausdorff's Considered Empiricism," 265.

terrain. Collected in the seventh volume of the Hausdorff edition, carefully edited by Werner Stegmaier, are the two more substantial philosophical works written under the pseudonym Mongré: *Sant'Ilario: Gedanken aus der Landschaft Zarathustras* (1897) and *Das Chaos in kosmischer Auslese* (1898). The former is a very lengthy collection of aphorisms — over 400 of them, varying in length from a few lines to several pages — that are arranged across nine topics, from “Müßiggang und Wetterglück” to “Zur Kritik des Erkennens”; the final section is the most relevant here. The setting in which *Sant'Ilario* was written lends the Nietzschean allusions in the title something of a double meaning, for the “Landschaft” in which Mongré wrote the text was the Ligurian coastline in Italy — the former stomping ground of an itinerant Nietzsche. Published the following year, the latter text is significantly shorter and less aphoristic; it essentially elaborates and improves on the “germ of Hausdorff’s epistemological views” from the former text.¹⁵⁴ As Stegmaier notes, Mongré’s philosophical works reveal is a mixture of “Nähe” und critical “Distanz” to Nietzsche,¹⁵⁵ but in the case of mathematics present us with surprising conclusions. He notes:

Eine so starke Affinität die europäische Philosophie zur Mathematik hatte, von Pythagoras und Platon über Descartes und Pascal bis zu Husserl [...], Nietzsche hatte sie nicht, und nicht nur aus Unvermögen. Es gehörte zu seiner Philosophie [...], das Denken auch nicht mehr an vorgegebene mathematische und logische Standards zu binden.¹⁵⁶

With mathematics rarely an area of concern for Nietzsche, it is, as Stegmaier remarks, “erstaunlich” that Nietzsche came to influence Mongré/Hausdorff in a mathematical sense with his concept of eternal recurrence.¹⁵⁷ As will be discussed in the following, a clear path from Mongré’s initial engagement with eternal recurrence in *Sant'Ilario* through its refinements in *Chaos in kosmischer Auslese* to the *Transformationsprinzip* of Hausdorff — not Mongré — in “Das Raumproblem” of 1903 can in fact be charted.

To get a sense of what drew Mongré to the idea, let us turn to Nietzsche’s own words more closely. The first discussion of what would become known as the *ewige Wiederkehr des Gleichen* took place in the form of a succinct aphorism entitled “Das größte Schwergewicht” in *Die fröhliche Wissenschaft* of 1882, in which a demon delivers some (potentially) devastating news: “Dieses Leben, wie du es jetzt lebst und gelebt hast, wirst du noch einmal und noch unzählige Male leben müssen; und es wird nichts Neues daran sein [...]”¹⁵⁸ One year later, however, the

¹⁵⁴ Ibid., 286.

¹⁵⁵ Werner Stegmaier, ed., foreword to *Felix Hausdorff - Gesammelte Werke, Band VII: Philosophisches Werk* (Berlin, Heidelberg and New York: Springer, 2004), 31.

¹⁵⁶ Ibid., 32.

¹⁵⁷ Ibid.

¹⁵⁸ He continues: “Die ewige Sanduhr des Daseins wird immer wieder umgedreht – und du mit ihr, Stäubchen vom Staubel’ – Würdest du dich nicht niederwerfen und mit den Zähnen knirschen und den Dämon verfluchen, der so

speculation of a cyclical universe packaged into one short aphorism would be given much more room to breathe, becoming perhaps the central aesthetic principle of *Also sprach Zarathustra*. Although the concept of eternal recurrence is first explicitly raised in the third section, it is anticipated early in the text by an extended deliberation on metamorphosis, “drei Verwandlungen” of the human spirit: “wie der Geist zum Kameele wird, und zum Löwen das Kameel, und zum Kinde zuletzt der Löwe.”¹⁵⁹ Finding validation in its capacity to take on heavy burdens, the “tragsame Geist” kneels, “dem Kameele gleich” and carries its load into the wilderness, but here “geschieht die zweite Verwandlung”: in search of freedom, “zum Löwen wird hier der Geist,” becoming thus the “Herr sein in seiner eignen Wüste.”¹⁶⁰ Yet, in the face of its final foe — not a God, but a great dragon representing thousands of years of values — the spirit must do what the lion cannot, namely “neue Werthe schaffen,” and thus “muss der raubende Löwe auch noch zum Kinde werden”:¹⁶¹

Unschuld ist das Kind und Vergessen, ein Neubeginnen, ein Spiel, ein aus sich rollendes Rad, eine erste Bewegung, ein heiliges Ja-sagen.

Ja, zum Spiele des Schaffens, meine Brüder, bedarf es eines heiligen Ja-sagens: *seinen* Willen will nun der Geist, *seine* Welt gewinnt sich der Weltverlorene.¹⁶²

With this story of the three metamorphoses mapping onto Zarathustra’s own trajectory, as Robert Gooding-Williams explores in some detail,¹⁶³ this recurring “Neubeginnen” becomes the “abgründliche Gedanken” that it is itself a *burden* to be carried.¹⁶⁴ As he climbs a mountain, a dwarf-like spirit latches onto Zarathustra and taunts him to reveal his most fearsome idea:

Von diesem Thorwege Augenblick läuft eine lange ewige Gasse *rückwärts* hinter uns liegt eine Ewigkeit. Muss nicht, was laufen *kann* von allen Dingen, schon einmal diese Gasse gelaufen sein? Muss nicht, was geschehn *kann* von allen Dingen, schon einmal geschehn, gethan, vorübergelaufen sein? Und wenn Alles schon dagewesen ist: was hältst du Zwerg von diesem Augenblick? Muss auch dieser Thorweg nicht schon — dagewesen sein? Und sind nicht solchermaassen fest alle Dinge verknotet, dass dieser Augenblick *alle* kommenden Dinge nach sich zieht? *Also* — sich selber noch? Denn, was laufen *kann* von allen Dingen: auch in dieser langen Gasse *hinaus* — *muss* es einmal noch laufen! [...] Müssen wir nicht ewig wiederkommen?¹⁶⁵

redete? Oder hast du einmal einen ungeheuren Augenblick erlebt, wo du ihm antworten würdest: ‘du bist ein Gott und nie hörte ich Göttlicheres!’” Friedrich Nietzsche, “Die fröhliche Wissenschaft,” in *Friedrich Nietzsche: Sämtliche Werke, Kritische Studienausgabe, Band 3*, ed. Giorgio Colli and Mazzino Montinari (Munich, Berlin and New York: Deutscher Taschenbuch Verlag and Walter De Gruyter, 1999), 570.

¹⁵⁹ Friedrich Nietzsche, *Also sprach Zarathustra* (Stuttgart: Reclam, 1994), 24.

¹⁶⁰ *Ibid.*, 24f.

¹⁶¹ *Ibid.*, 25.

¹⁶² *Ibid.*

¹⁶³ Robert Gooding-Williams, “Zarathustra’s Three Metamorphoses,” in *Nietzsche as Postmodernist: Essays Pro and Contra*, ed. Clayton Koelb (Albany, NY: State University of New York Press, 1990), pp. 231-246.

¹⁶⁴ Nietzsche, *Also sprach Zarathustra*, 162.

¹⁶⁵ *Ibid.*, 163f.

At first a terrible weight, the nature of the thought experiment in Zarathustra's mind itself metamorphoses, soon becoming that which is celebrated in song, a holy "Ja-sagen" as before, with Zarathustra himself the "Lehrer der ewigen Wiederkunft."¹⁶⁶ From this brief overview, it is already apparent that there are certain levels of thought that *could* compare well to some of the previous spatial ideas in the history of mathematics sketched out above. In essence, Nietzsche's idea could be read as an encapsulation of the nuanced relationship between invariance and change: there are recurrent processes of transformation so sweeping that they regularly occasion and destroy the cosmos itself but that ultimately leave *everything* intact. While traditionally understood as a thought experiment that has principally moralistic interpretations, as opposed to being a proposed model for the structure of the cosmos,¹⁶⁷ the ostensibly anti-mathematical Nietzsche did in fact try to sketch out a proof of the idea, which is where Mongré's drawn-out contemplations of the concept begin, and the irony is not lost on the latter.¹⁶⁸

Late into *Sant'Ilario* (aphorism 405 of 411), Mongré moves off from a discussion of how different beings, from humans to elephants and mosquitos, each have their own "Bewusstseinswelten" and arrives at his deliberation of "Nietzsches glänzende Speculation,"¹⁶⁹ in which he sees two possible interpretations:

Man kann in einem doppelten Sinne von der ewigen Wiederkunft sprechen. Eine beliebige erfüllte Zeitstrecke kann in der absoluten Zeit beliebig oft hintereinander abgespielt werden, ohne daß diese Wiederholung ins empirische Bewusstsein der die Zeitstrecke erlebenden Wesen fällt. Dies gilt unabhängig vom Inhalt der Strecke als ein aus dem Begriff der Zeit folgender Satz *a priori*. Andererseits wäre es möglich, dass unser empirischer Zeitinhalt als Ganzes eine geschlossene Linie darstellte; das ist der Sinn, in welchem Nietzsche die uralte Vorstellung einer ewigen Wiederkehr aller Dinge als poetische Hypothese wieder aufgenommen hat. Diese Wiederkehr ist aber eine Aussage *a posteriori*, geschöpft aus dem Inhalt unserer speziellen Zeitlinie des Ensembles oder Continuum von Weltzuständen, das wir bilden und erfahren.¹⁷⁰

On the back of the previous discussion of "Das Raumproblem" and its central question concerning the possibility of spatial models that could not be dismissed by experiential data, it is perhaps a surprise to find that Mongré turns his attention solely to the second interpretation, which he claims (perhaps with too little reflection) is Nietzsche's own.¹⁷¹ As will be seen shortly,

¹⁶⁶ *Ibid.*, 231.

¹⁶⁷ Consider, for example, Heidegger's often repeated discussion to this effect in *Nietzsche, Band II* (Pfullingen: Günther Neske Verlag, 1961). As Heidegger asserts, it is the this aforementioned burdensome nature of the question itself that is Nietzsche's central concern.

¹⁶⁸ He quips: "Beweise sind bei allen Philosophen das Verdächtige und überdies Langweilige, eine bloße Stubenhockerei aus Missverständener Gewissenhaftigkeit." Paul Mongré, "Sant'Ilario: Gedanken aus der Landschaft Zarathustras," in *Felix Hausdorff - Gesammelte Werke, Band VII: Philosophisches Werk*, ed. Werner Stegmaier (Berlin, Heidelberg and New York: Springer, 2004), 443.

¹⁶⁹ *Ibid.*

¹⁷⁰ *Ibid.*, 439.

¹⁷¹ As Epple notes, it is the former that "did not involve any empirical consciousness of recurrence." Epple too is careful not to directly attribute the second interpretation to Nietzsche; that remains Mongré's own. Spelled out

it is Mongré's subsequent book that turns to the former in more detail. In the next aphorism, Mongré proceeds to discredit Nietzsche's own attempted proof that was found in his *Nachlass*. As Epple explains, Nietzsche proposed: "(a) there are only finitely many possible physical states in which the world may happen to be, while (b) time is infinite. Consequently [...] the recurrence of similar time intervals [...] is a necessity."¹⁷² Focusing on the first premise, Mongré draws upon contemporary discussions of Cantor's infinite sets to conclude that, while Nietzsche's idea is an empirical possibility, it cannot be considered necessary.¹⁷³ Mongré's criticism, however, is undermined, as Epple notes, by the fact that he was clearly "unaware of Cantor's basic result that there exist bijections between point continua of dimensions,"¹⁷⁴ which attests to just how unfamiliar Hausdorff, a trained applied mathematician, was with some novel results in pure mathematics. Crucially, however, Mongré would return more forcefully to the *ewige Wiederkehr* just one year later in *Chaos in kosmischer Auslese*, where he makes full and accurate use of Cantor's transfinite set theory to strengthen his criticism of Nietzsche's flawed proof.¹⁷⁵ The significance of this prompt change has not been lost on the scholars working on Hausdorff's literary estate: while Purkert uses this examination with Nietzsche's idea to date Hausdorff's encounter with set theory, a field in which he would later emerge as a leading voice with *Grundzüge der Mengenlehre*, this serves for Epple as a key instance to undermine the division between Hausdorff and the pseudonymised Nietzschean writer Mongré.¹⁷⁶

Significant as this is, with a possible connection to the prototopological *Transformationsprinzip* in mind, the significant role played by Nietzsche's *ewige Wiederkehr* can be further concretised. Although Epple does not continue the discussion of Nietzsche's influence beyond the above, he makes the very simple observation in his examination of "Das Raumproblem": the closing "besonnener Empirismus" is but a repetition of the central argument of the 1898 text and its discussion of "transcendenten Nihilismus."¹⁷⁷ Upon closer inspection, it is clear that

roughly, this was a "possible hypothesis, conceivable under the plausible assumption that in historical consciousness, discontinuities have happened, caused, e.g. by geological revolutions or catastrophes of cosmic character.' A less discontinuous historical memory or shorter recurrence times [...] should have empirical effects on human consciousness, but even this could be imagined by means of a 'glance of phantasy into the possible'. Consequently, and given the possible differences of the time-scales of perception in different species, it might just be a consequence of human organization that we do not actually experience such effects." Epple, "Felix Hausdorff's Considered Empiricism," 271.

¹⁷² Ibid.

¹⁷³ Epple summarises: "Mongré simply attacked the first premise of Nietzsche's argument, pointing out that according to all scientific conceptions of their day, even the set of possible physical states of just 3 material atoms (billiard balls) in ordinary (Euclidean) space had ∞^3 elements [...]. Mongré further argued that ∞^2 'times' such as ours (a one-dimensional continuum) would be necessary to exhaust all these possible configurations, a far cry from recurrence." Ibid.

¹⁷⁴ Ibid.

¹⁷⁵ Ibid., 272.

¹⁷⁶ Ibid.

¹⁷⁷ Ibid., 281.

Hausdorff's deliberations in his lecture on all of the possible spatialities conjurable in the "Spielraum des Denkens" are essentially lifted (in some cases verbatim) from *Das Chaos in kosmischer Auslese*. Here, he likewise dwells upon the Riemannian spaces of non-zero "Krümmung,"¹⁷⁸ the shrunken and stretched spaces that turn the averagely built person "in einen schmalen Riesen oder breiten Zwerg," and the imperceptibility of these deformations because of the lack of a measuring device that has not also been affected.¹⁷⁹ Just like in the subsequent lecture, Mongré is able to build on these increasingly bizarre but thinkable spatial arrangements and determine what is recognisably the *Transformationsprinzip*, only without the distinctive partitioning of space into three zones: "zwischen den Zeitpunkten, Raumpunkten und Raumzeitpunkten des empirischen Bereichs einerseits, des transzendenten andererseits bestehen vollkommen *willkürliche Transformationen*."¹⁸⁰ In this light, the prototopological tool used by Hausdorff towards the end of "Das Raumproblem" is nothing new; in fact, the illustration of the idea in terms of cartographical maps is the only facet that is particularly novel in the lecture. The fact this arises from an extended, repeated discussion of Nietzsche's *ewige Wiederkehr* is most significant, if by now not at all surprising. As was noted above, with his 1898 text, Mongré has returned to the first interpretation of the idea from *Sant'Ilario*, which he left undeveloped there, i.e. the notion that a "beliebige erfüllte Zeitstrecke kann in der absoluten Zeit beliebig oft hintereinander abgespielt werden, ohne daß diese Wiederholung ins empirische Bewusstsein der die Zeitstrecke erlebenden Wesen fällt."¹⁸¹ As such, Nietzsche's speculative idea of a cyclical cosmological structure is just one of these infinite possible spatialities that cannot be dismissed within the bounds of observation alone, and the thinkability of these spatial forms is the bedrock of what would explicitly become the *Transformationsprinzip* of Hausdorff's lecture a few years later. In fact, in a much shorter essay on eternal recurrence written in 1900 — the year of Nietzsche's death in Weimar — Mongré specifically casts "Nietzsches sphäro-cyklischen Weltanschauung" as none other than a version of Riemann's elliptic geometry: "jener Raum, dessen kürzeste[n] Linien in sich selbst zurücklaufen und in dem der Mensch, mit hinlänglich scharfen Fernrohr ausspähend, als fernsten Gegenstand seinen eigenen Hinterkopf erblicken würde."¹⁸²

¹⁷⁸ Paul Mongré, "Das Chaos in kosmischer Auslese," in *Felix Hausdorff - Gesammelte Werke, Band VII: Philosophisches Werk*, ed. Werner Stegmaier (Berlin, Heidelberg and New York: Springer, 2011), 673f.

¹⁷⁹ Ibid., 687. In his introduction, Stegmaier places certain passages from both *Das Chaos in kosmischer Auslese* and "Das Raumproblem" side-by-side to stress the point. Stegmaier, introduction to *Gesammelte Werke VII*, 55ff.

¹⁸⁰ Mongré, "Das Chaos in kosmischer Auslese," 737. Emphasis in original.

¹⁸¹ Mongré, "Sant'Ilario," 439.

¹⁸² Paul Mongré, "Nietzsches Lehre von der Wiederkunft des Gleichen," in *Felix Hausdorff - Gesammelte Werke, Band VII: Philosophisches Werk*, ed. Werner Stegmaier (Berlin, Heidelberg and New York: Springer, 2011), 896. Note as well the similarity in phrasing with the passage in "Das Raumproblem" cited above: Hausdorff considers the cylindrical model of the universe, in which "von jedem Punkte eine bestimmte Richtung aus geht, in der

In sum, by moderately extending this stock-take of existing scholarship on Mongré’s philosophical texts, there is a remarkably clear trajectory from Mongré’s determined engagement with Nietzsche’s *ewige Wiederkehr des Gleichen* and the *Transformationsprinzip* he would deploy as the “working mathematician” Felix Hausdorff in 1903. This is to say, Nietzsche’s influence on Hausdorff’s developing of spatial ideas, which would culminate in his magnum opus on topology over a decade later, is now demonstrably more extensive than existing scholarship would have it. For all the significance of this finding, which marks out Nietzsche as a guiding hand in Hausdorff’s pathway towards topological thinking, it is necessary to acknowledge that topology, though “impeccably modernist” for Gray, does not *by itself* account for Hausdorff’s particularly radical advocacy for mathematical formalism parsed as “eine gewisse *freie Schöpfungen unseres Denkens*, keinem anderen Zwange als die der Logik unterworfen,” operating within the “Spielraum des Denkens” alone. While the *Transformationsprinzip* anticipates his later work on topological spaces, Hausdorff clearly builds upon the work and projective-geometrical language of Felix Klein (the forebearer of Mehrten’s “Gegenmoderne”), and topology was the field of study of L.E.J. Brouwer, Hilbert’s intuitionist rival. In short, topology alone doth not a modernist make. Therefore, while the existing work on Hausdorff’s pathway to modern mathematics has begun to expose the Nietzschean structural supports underfoot, a crucial final step remains unaccounted for: there is a lingering gap between Mongré and “radically modernist mathematician” Felix Hausdorff. In his mathematical transition via philosophy, therefore, with a glance at existing scholarship, it would seem that Nietzsche only accompanied him halfway. As will be argued in the following section, it is necessary to dispense with this notion.

Spielräume: Towards a Modernist Language of Mathematics

In one of the last publications before Hausdorff’s mathematical career took flight in 1903, Mongré turns his attention away from the conception of space towards the contentious field of *Sprachkritik*, which he connects, in no uncertain terms, to a conception of mathematics as a formal language of “de-ontologized”¹⁸³ signs and symbols, to use Mehrten’s term again. This is to say, he arrives via a critique of language at a form of mathematics rooted in the “Spielraum”

fortwandernd man schließlich wieder zum Ausgangspunkte zurückgelangt.” Hausdorff, “Das Raumproblem,” 292. It is worth mentioning that some scholar have suggested Nietzsche may well have been aware of Riemann’s geometry when conceiving of the *ewige Wiederkehr* via his own reception of Friedrich Zöllner, thus calling somewhat into question the common assumption that Nietzsche was essentially uninterested in engaging with mathematics in his philosophical ideas. See Friedrich Ulfers and Mark Daniel Cohen, “Zarathustra, the Moment, and Eternal Recurrence of the Same: Nietzsche’s Ontology of Time,” in *Nietzsche’s Thus Spoke Zarathustra: Before Sunrise*, ed. James Luchte (London: Bloomsbury, 2011), 79f. This discussion builds on a previous paper by Alistair Moles which attempts to explicitly model Nietzsche’s idea via Riemannian geometry. Alistair Moles, “Nietzsche’s Eternal Recurrence as Riemannian Cosmology,” *International Studies in Philosophy* 21, no. 2 (1989): 21-35.

¹⁸³ Mehrten, “Mathematics and National Socialism,” 164.

of pure thought alone, and most significantly, it is argued here, Nietzsche's ideas on language were just as decisive in constructing this theoretical bridge as the eternal recurrence was for the *Transformationsprinzip*. This scholarly gap can perhaps be attributed to the fact that Mongré began to distance himself from Nietzsche's works that followed *Also sprach Zarathustra*. As the editors of the Hausdorff Edition stress, it is the early critical Nietzsche to whom Mongré is drawn,¹⁸⁴ not the Nietzsche that is manifest in his final project *Der Wille zur Macht*. In a 1902 essay on Nietzsche's final text, Mongré denounces his former idol as "subjektiv übelwollend, dialektisch, unbedenklich in der Wahl seiner Kampfmittel."¹⁸⁵ Adopting the same biopolitical vocabulary that one finds in Nietzsche's posthumous *Meisterwerke* to diagnose a regrettable degradation of its author, Mongré continues:

Nietzsches Kritik der christlichen Werthe, hier und im 'Antichrist', ist nicht der sachliche Richterspruch eines Darüberstehenden, eines Freien, der das Christentum 'unter sich' sieht, vielmehr ein leidenschaftliches Ringen und Nichtloskommen von einer fixen Idee, das polemische Fieber des inficirten Organismus, der einen Fremdkörper vergeblich auszustoßen trachtet.¹⁸⁶

Unlike the "jüngere Nietzsche," whose radical ideas in *Also sprach Zarathustra* had been so formative for Mongré,¹⁸⁷ he now finds something sinister: "In Nietzsche glüht ein Fanatiker."¹⁸⁸ Mongré's analysis of the text is grimly prophetic, especially when his own cruel fate as a Jewish academic in Nazi Germany in 1942 is considered, for he remarks that Nietzsche's later ideas could become a "weltgeschichtlicher Skandal, gegen den Inquisition und Hexenprozeß zu harmlosen Verirrungen verblassen" some decades prior to their infamous deployment by an ascendant fascist regime.¹⁸⁹ Indicative of the common frustration at the contradictory nature of reading Nietzsche's *Werk* as a whole, Mongré glumly concludes with a stark juxtaposition:

Nur das darf noch gesagt werden, daß eben da, wo wir die Unruhe und Ungerechtigkeit des allerletzten Nietzsche beklagen, der kritische Maßstab von keinem Anderen hergenommen ist als das von Nietzsche selbst: von dem gütigen, maßvollen, verstehenden Freigeist Nietzsche und von dem kühlen, dogmenfreien, systemlosen Skeptiker Nietzsche und von dem Triumphator des Ja- und Amenliedes, dem weltsegnenden, allbejahenden Ekstastiker Zarathustra.¹⁹⁰

¹⁸⁴ Stegmaier, introduction to *Gesammelte Werke, Band VII*, 8.

¹⁸⁵ Paul Mongré, "Der Wille zur Macht," in *Felix Hausdorff - Gesammelte Werke, Band VII: Philosophisches Werk*, ed. Werner Stegmaier (Berlin, Heidelberg and New York: Springer, 2004), 905.

¹⁸⁶ *Ibid.*

¹⁸⁷ *Ibid.*, 906.

¹⁸⁸ *Ibid.*, 907. Mehrrens sees this retreat from Nietzsche as another manifestation of Hausdorff's general desire to create a "heitere Distanz" to critiques of civilization, finding freedom instead in "Kälte, Denken, Einsamkeit." Mehrrens, *Moderne-Sprache-Mathematik*, 170.

¹⁸⁹ Mongré, "Sprachkritik," 907.

¹⁹⁰ *Ibid.*, 909.

Darkly ironic, the very antidote to the “inficirten Organismus” that this late Nietzsche embodies would have been his earlier self, who rejected all attempts to explain the world around him with any absolutising philosophy, and Mongré evidently laments the loss of that “freie Denker” of the 1870s.¹⁹¹

Returning to Hausdorff and the question at hand, in 1903, just one year after his bleak assessment of *Der Wille zur Macht* and the year of his inaugural lecture in Leipzig, Mongré published an essay simply entitled “Sprachkritik” in the *Neue Deutsche Rundschau*. Here he enjoys one final philosophical soirée with the earlier Nietzsche, whose own incisive essay “Über Wahrheit und Lüge” of 1873 was belatedly published with other *Nachlass* texts in 1896. While one may not expect this early Nietzsche essay, in which the idea that mathematics is a means to access *Wahrheit* is casually dispensed with in a brief aside,¹⁹² to come to be a source of influence for a mathematician at the beginnings of a career breakthrough, Mongré’s more nuanced appreciation of Nietzsche’s critique of language secures it as a steppingstone in his development of a modernist mathematical language. On the face of it, however, Nietzsche is not the central focus of “Sprachkritik”; rather, it is the language-theorist Fritz Mauthner. The latter’s three-volume *Beiträge zu einer Kritik der Sprache*, published between 1902 and 1903, was enthusiastically received by Hausdorff: it forms the main subject of assessment in Mongré’s essay,¹⁹³ and it does so to the extent that “Sprachkritik” reads in several places like a critical review of Mauthner’s ideas.

Challenging as it is to encapsulate Mauthner’s work in brief, it is the latter’s view that “die Sprache, für sich allein, als Mittel der Verständigung nicht viel wert sei” that Mongré lauds as

¹⁹¹ It must of course be noted — in partial defence of Nietzsche — that the writings that would come to populate the infamous text can be traced back to his time in Turin, where his mental state rapidly decayed before his eventual and final breakdown. Moreover, the ideological leanings of the editor of this volume, his sister Elisabeth Förster-Nietzsche, and the pernicious influence these had on the final publication must be taken into account. See, for more detail, Bernd Mangus and Kathleen M. Higgins, eds, *The Cambridge Companion to Nietzsche* (Cambridge, U.K. and New York: Cambridge University Press, 1996), 57 and Carol Diethe, *Nietzsche’s Sister and the Will to Power: A Biography of Elisabeth Förster-Nietzsche* (Urbana and Chicago: University of Illinois Press, 2003), 83.

¹⁹² He writes: “Wer von dieser Kühle [der Mathematik] angehaucht wird, wird es kaum glauben, daß auch der Begriff, knöchern und achteckig wie ein Würfel und versetzbar wie jener, doch nur als das *Residuum einer Metapher* übrigbleibt, und daß die Illusion der künstlerischen Übertragung eines Nervenreizes in Bilder, wenn nicht die Mutter, so doch die Großmutter eines jeden Begriffs ist.” Mathematics and its underpinning logic rely, therefore, on the same empty metaphors as language. Friedrich Nietzsche, “Über Wahrheit und Lüge im außermoralischen Sinne,” Friedrich *Nietzsche: Sämtliche Werke, Kritische Studienausgabe Band 1*, ed. Giorgio Colli und Mazzino Montinari (Munich, Berlin and New York: Deutscher Taschenbuch Verlag and Walter de Gruyter, 1988), 882.

¹⁹³ The separate use of Hausdorff and his pseudonym here is intentional. In laudatory correspondence with Mauthner, in which he eagerly anticipates the release of the third volume of Mauthner’s work, he signs off with “Dr. F. Hausdorff” and references his reluctance to reveal the name under which his creative and philosophical writings may be known. Felix Hausdorff, correspondence in “Sprachkritik: Kommentar,” *Felix Hausdorff - Gesammelte Werke, Band VIII: Literarisches Werk*, ed. Friedrich Vollhardt and Udo Roth (Berlin, Heidelberg and New York: Springer, 2010), 585.

one of his “liebsten und feinsten Gedanken.”¹⁹⁴ In essence, Mauthner denounces language as any kind of “Werkzeug’ der Erkenntnis,” and he does so by methodically revealing the inherent “Unzuverlässigkeit” of language and all of its components.¹⁹⁵ In its scope Mauthner’s work is incredibly far-reaching. It calls upon an array of disciplines and social structures — from psychology, mythology and religion to journalism and even hypnosis — and it references literary works spanning from the Medieval Icelandic *Prose Edda* and Dante to the German canon of Goethe and Schiller. Framing this irremediable “Impotenz der Sprache”¹⁹⁶ in *Beiträge* are a number of overarching notions. Crucially, Mauthner’s critique of language is rooted in his insistence that *Erkenntniskritik* necessarily reduces to *Sprachkritik*, because *Denken* and *Sprechen* are — for him — one and the same: “Wer denkt, der spricht. Und umgekehrt: Wer spricht, der denkt.”¹⁹⁷ At the close of his first volume, Mauthner decries the impossible position into which *Denken* has fallen throughout the course of Western philosophy, “ewig hin und her geworfen zwischen Erkenntnis und Welt,” and the only conceivable (and indeed desirable) end is the product of the *Trieb* that found its most potent expression in German Romanticism: *die Todessehnsucht*.¹⁹⁸ Like Goethe’s sorrowful Werther, the only solution for *Verstand* in Mauthner’s eyes is to bring about its own demise, “das Ende seines Denkens,” for only then can a philosophy of any worth be recovered: “*Qui potest mori, non potest cogi*” — he who is able to die will not be forced to provide.¹⁹⁹ Then, in light of the rigid equivalence of thinking and speaking, a gloomy corollary for *Sprache* is therefore constructed: “Und weil das Denken Sprache ist, ist diese neue Philosophie aus der Todessehnsucht des Denkens ein Selbstmord der Sprache.”²⁰⁰ Perhaps predictably, therefore, the only feasible path in the wake of Mauthner’s critique of language is purposeful *silence*: “Es wäre Zeit, wieder schweigen zu lernen.”²⁰¹ This overriding pessimism can be extrapolated back to a more general philosophical conundrum, however. Mauthner is plagued, ultimately, by the central paradox of critiquing language by means of language itself, or in Mongré’s words: “über das Denken denken zu müssen, die Grenzen der Vernunft mit Hilfe der Vernunft abzustecken, Sprachkritik mit den Mitteln der Sprache zu treiben.”²⁰² This difficulty characterises Mauthner’s works throughout, and he illustrates this —

¹⁹⁴ Ibid., 560.

¹⁹⁵ Fritz Mauthner, *Beiträge zu einer Kritik der Sprache. Band I: Sprache und Psychologie* (Stuttgart: J.G. Cotta’sche Buchhandlung, 1901), 5.

¹⁹⁶ Ibid.

¹⁹⁷ Ibid.

¹⁹⁸ Ibid., 656.

¹⁹⁹ Ibid., 657.

²⁰⁰ Ibid., 656.

²⁰¹ Ibid., 215. Cf. Christopher Ebner, *Sprachskepsis und Sprachkrise: Fritz Mauthners Sprachphilosophie im Kontext der Moderne* (Hamburg: Diplomica Verlag, 2014), 55.

²⁰² Mongré, “Sprachkritik,” 555.

as something of a disclaimer — with a short parable in the introduction to his first volume, which concerns the unfortunate death of the Pope along with his bedbugs:

Was die Wanzen tötet, tötet auch den Popen.

Es war einmal ein Pope, der war Pope genug, um Wanzen in seinem Bette zu haben, und Freigeist genug, um seine Wanzen als etwas Häßliches oder doch Fremdes zu empfinden. Umsonst wandte er nacheinander hundert Mittel an, seine Wanzen zu vernichten. Eines Tages aber brachte er aus der großen Stadt, wo die Universität ist, ein Pulver mit, welches ihn untrüglich befreien sollte. Er streute es aus und legte sich hin. Am anderen Morgen waren alle Wanzen tot, aber auch der Pope war tot. Was die Wanzen tötet, tötet auch den Popen.²⁰³

Mauthner finds himself in an inescapable quandary: he must rely on the very tools he seeks to critique for the criticism itself. Likening this to destroying the rungs of the very ladder he needs to climb, Mauthner acknowledges his unenviable philosophical position: “keine Philosophie ist so traurig wie eine, die sich vermißt, die Welt von der Sprache zu erlösen und das mit armen Worten.”²⁰⁴ Much like the proverbial fly walking along the surface of the Möbius strip, there is no outside, no external vantage point from which Mauthner can begin his attack; his *Sprachkritik* is forever stuck within *Sprache* itself. The Pope, in short, is doomed.

To assess and critique Mauthner’s ideas, however, is to necessarily engage with Nietzsche’s views on language, truth and knowledge,²⁰⁵ and scholars have indeed probed the extent of Nietzsche’s influence on Mauthner via his collections of aphorisms.²⁰⁶ The central Nietzsche source in question in this chapter, however, is “Über Wahrheit und Lüge” — Nietzsche’s most extensive critique of language, despite its relative brevity. Mauthner’s knowledge of this essay remains unknown, and the aforementioned publication history of Nietzsche’s essay and Mauthner’s works can perhaps account for this. Although Mauthner’s *Beiträge* were published in 1902 and 1903, he began work on them around 1891, which predates the belated publication of Nietzsche’s essay by four years, when it was made available with other *Nachlass* materials.

²⁰³ Mauthner, *Beiträge*, 2.

²⁰⁴ Ibid.

²⁰⁵ Mongré’s “Sprachkritik” warrants only a brief mention in Herbert Mehrtens’ survey of modern mathematics, which is surely surprising given the central role of *Sprache* in his analysis. Mehrtens rightly notes how Hausdorff “preist die radikale Sprachkritik Fritz Mauthners” in his suggestion of mathematics as “ein Beispiel sprachlosen Denkens,” but the influence of Nietzsche receives no mention. Mehrtens is also somewhat dismissive of Hausdorff’s undersanding of Mauthner’s views — a claim that this chapter seeks to undermine by unearthing Nietzsche’s role in Mongré’s essay. Herbert Mehrtens, *Moderne-Sprache-Mathematik: eine Geschichte des Streits um die Grundlagen der Disziplin und des Subjekts formaler Systeme* (Frankfurt am Main: Suhrkamp, 1990), 168.

²⁰⁶ Mauthner briefly references the formative role of Nietzsche’s own attacks on language in his thought development, remarking that the eleventh aphorism of *Menschliches, Allzumenschliches*, published in three parts from 1878 to 1880, “einen [s]einer Grundgedanken ausspricht.” Mauthner, *Beiträge*, 331. In this vein, Peter Kampits asks whether and to what extent Mauthner is indeed just a “Nachfolger” of Nietzsche in his analysis of language or a pioneering theorist in his own right — a “Vorläufer der ordinary-language theory.” His work follows Elizabeth Bredeck’s 1984 article “Fritz Mauthners Nachlese zu Nietzsches Sprachkritik,” which indicates that Mauthner’s indebtedness to Nietzsche also revolves around certain passages from “Vom Nutzen und Nachteil der Historie für das Leben” in *Unzeitgemässe Betrachtungen*, published in 1874. Cited in Ibid., 32.

Friedrich Vollhardt and Udo Roth, the editors of Hausdorff/Mongré's literary edition, contend that this is evidence enough that Mauthner was unacquainted with the essay.²⁰⁷ This line of questioning is not without reason, for with it a crucial nuance in the story of influence between Nietzsche and Mauthner emerges, complicating any attempt to characterise Mauthner's *Beiträge* as embracing Nietzsche's ideas with unquestioning assent. At the very least, the question is not lost on Mongré. A short way into "Sprachkritik" he highlights the similarity of Mauthner's ideas to Nietzsche's text in particular:

Sehr verwandte Ideen hat Nietzsche ausgesprochen, in zahllosen Aphorismen und besonders in dem zusammenhängenden Fragment 'Über Wahrheit und Lüge im außermoralischen Sinne', das sich wie ein Programm und glänzendes Résumé der gesamten Sprachkritik liest; nur mühsam widerstehe ich der Verlockung, ganze Seiten aus dieser skeptischen Thronrede hierherzusetzen, und beklage es mit Mauthner, daß der Umwerter aller Werte seinen stärksten Angriff gegen die praktischen Begriffe gerichtet, gegen die theoretischen nur einige aufhellende Lichtblitze geschleudert hat. Neben der menschlichen Erkenntnis ist die menschliche Moral ein armseliges Problem, gut genug für Tatsachensammler und Evolutionsschwätzer.²⁰⁸

While the time that has elapsed since Mongré's assessment of *Der Wille zur Macht* has allowed for a somewhat lighter tone when discussing Nietzsche, the sting of the previous year clearly still lingers: how could the bearer of such (regrettably scant) "aufhellende Lichtblitze," whom Mongré swiftly recognises as the earlier, "erkenntniskritische" Nietzsche, get lost in the supposedly paltry concerns of human morality?²⁰⁹ Mauthner, quite clearly, is not the only subject of Mongré's essay. It is noteworthy, of course, that Mongré grumbles "mit Mauthner" that Nietzsche's critical energy could have been more impactful in the critique of language if it had not been directed elsewhere. Mauthner expresses this frustration in very similar terms:

Nietzsche hätte eine Sprachkritik mit gewaltigeren Sprachmitteln herstellen können, als es hier geschieht, wenn er sich nicht einseitig mit moralischen Begriffen abgegeben hätte, und wenn ihn nicht seine prachtvolle Sprachkraft verführt hätte, Denker und zugleich Sprachkünstler sein zu wollen.²¹⁰

According to Mauthner, Nietzsche's versatility got the better of him, but this criticism extends beyond Nietzsche's engagement with the moral dimension in his philosophy. Rather, it is Nietzsche's artistry in language and prose, in Mauthner's eyes, that prevented a more thorough critique from taking shape, and he thus concludes: "So ist Nietzsche, trotzdem er mit dem

²⁰⁷ Friedrich Vollhardt and Udo Roth, eds, "'Sprachkritik': Kommentar," *Felix Hausdorff - Gesammelte Werke, Band VIII: Literarisches Werk*, ed. Friedrich Vollhardt and Udo Roth (Berlin, Heidelberg and New York: Springer, 2010), 582.

²⁰⁸ Mongré, "Sprachkritik," 562.

²⁰⁹ Ever the mathematician, Mongré cannot resist the urge to wryly tally the pages of Mauthner's work to illustrate a contrast to Nietzsche's concise "Fragment": "Mauthners Buch hat drei Bände und 657 + 735 + 651 = 2043 Seiten; damit ist alles gesagt. Beim Barte des Polonius, es ist zu lang, zu lang! [So] viel Geduld hat kein moderner Leser mehr." Mongré, "Sprachkritik," 557.

²¹⁰ Mauthner, *Beiträge*, 331.

Hammer zu philosophieren glaubte, nicht der Kritiker der Sprache geworden.”²¹¹ Surpassing Mongré’s complaints, Mauthner has therefore diverged philosophically from Nietzsche to a certain extent when it comes *Sprachkritik*. Significantly, this divergence hinges on the relationship between rigorous critique of language and the capacity of language as *Kunst* — the central thematic pillars of “Über Wahrheit und Lüge.” This blend of harmony and discord between Mauthner and Nietzsche comes, as will be shown, to inform Mongré’s own assessments, and it provides a fitting structure for the following analysis. Firstly, it will be shown how Mongré synthesises the works of his predecessors with respect to metaphor and memory, likewise diagnosing in language its inadequacy as an *Erkenntniswerkzeug*. Secondly, I argue that Mongré’s concluding turn towards mathematics in light of this critique can best be explained with respect to a fundamental divergence in the ideas of Nietzsche and Mauthner. More precisely, it is Nietzsche’s inspired proposal concerning the possibility of *Kunst* to create the radically new on the back of this demolition of language — the source of Mauthner’s break with Nietzsche — that facilitates in turn Mongré’s own break from Mauthner and a conceptualisation of mathematics as “sprachloses Denken.”

Convergence: “Worte ohne Wirklichkeit”

Building on the common ground between his predecessors, Mongré first frames language as entirely insufficient as an epistemological apparatus, decrying something of a *Gegenstandsproblem* of language. The attempt by Mongré in “Sprachkritik” to synthesise Nietzsche’s belatedly published essay and Mauthner’s *Beiträge* can be seen on a stylistic level from the very outset. In a linguistically ornate introduction, Mongré lays out something of a loud and vivid story of origins, tracing the path of the first *Reiz* from phenomena to their problematical capture within language. The essay opens with the following:

... Und im Anfang war traumlose Tiefe.
Über die graugrün dämmernde Fläche wogen Purpurwolken. Grenzenlosen Brausen verdichtet sich da und dort zu dröhnenden Schwellungen, dumpfe Tonschatten fluten darüber. Schwebende Schleier gleiten durch den Nebel, Kommendes kündigt sich an.
Aus dem blassen Trüben blitzt stechend scharf, strahlend, schmerzend ein Punkt. Der erste Reiz wird empfunden.²¹²

A reference to Mauthner is immediately obvious: the opening line, as Vollhardt dutifully notes, doubly “persifliert” the beginning of Mauthner’s *Beiträge*, which recites the scriptural “Im Anfang war das Wort,” and “verfremdet den biblischen Schöpfungsbericht” of the Book of

²¹¹ Ibid.

²¹² Ibid., 551.

Genesis.²¹³ Aside, perhaps, from the colourful prose, Nietzsche's presence is less superficial, and it is made known as a stylistic influence by way of form: Mongré's opening is, in short, a parable of origins.

Let us dwell on the content of this tale for a moment. In the lines immediately thereafter, in which "andere Punkte flammen auf, schwirren, tauchen wieder unter,"²¹⁴ a plurality of phenomena emerges: "Dieser scheint anders gespürt zu werden als jener; manche geben einen kühlen Kitzel, andere berühren zitternd und hauchend. Töne, Farben, Düfte."²¹⁵ With a sequencing that discloses an indebtedness to the immediate history of German philosophy prior to the essay, Mongré's phenomena then give rise to the awareness of "Dinge," not the other way around:

Und sonderbar, daß manche dieser Berührungen und Erlebnisse sich immer zusammen aufdrängen. Dieses Glatte und Runde und jenes Rote ist, zu einander gestellt, von Süßigkeit begleitet. Eine eigentümlich lockende und spannende Erregung meldet sich, wenn Glatt, Rund, Rot erscheinen: das Süße wird gewollt, die Frucht ergriffen. Es ist die Frucht vom Baume der Erkenntnis; nun gibt es Dinge.²¹⁶

With yet another playful quip at the expense of Judeo-Christian scripture, it is from the multiplicity of sense perceptions, therefore, that a proclaimed knowledge of objects arises. Then, in a final stage, these "Dinge" are apprehended in "Laute" and gesticulations, sparking the inception of language:

Eines Tages kauern zwei Menschentiere vor dem erjagten Wild. Ein Blitzstrahl kracht nieder und zerschmettert die Fichte drüben, der Donner brüllt wie zehntausend Stiere. Die beiden starren mit schreckblöden Augen. Das Weib deutet mit dem Finger auf das Wunder, des Mannes Zunge stammelt ein bewusstloses Da! ... Da! lallt ihm die Männin nach, dann stürzen sie fort in atemloser Flucht.

Da sie das nächste Mal in ihr Jagdweg wieder in die Nähe der gebrochenen Fichte führt, sehen sich beide an und biegen scheu in weitem Kreise aus. Da! lallt wieder der Mann, Da! ahmt das Weib nach. Und in den blöden Augen dämmert das Licht einer unendlichen Zukunft — die armen Menschentiere haben geahnt, daß dieses Da ihnen ein Erinnerungsmal ist für das gemeinsame Erlebnis, dass man mit Lauten auf etwas hindeuten kann, was nicht laut ist, daß Laute etwas bedeuten, etwas bezeichnen, etwas mitteilen und überliefern können.²¹⁷

Seized by "Da!" as some rudimentary exclamation, the "Dinge" — themselves an amalgamation of sense perceptions — can now be indicated and their presence communicated: a referential language is thus born. Yet, despite the explosive beginnings, Mongré is quick to perspectivise all that has emerged in the depths of celestial space: "der flüchtige Bewußtseinsschimmer um die Gegenwart des lebenden, und doch wie wenig! Eine Eisscholle im Meere, die immer wieder

²¹³ Vollhardt and Roth, "Kommentar zu 'Sprachkritik,'" 588.

²¹⁴ Mongré, "Sprachkritik," 551.

²¹⁵ Ibid.

²¹⁶ Ibid.

²¹⁷ Ibid., 552.

zerschmilzt, ein Flackerfeuer in der grenzlosen Nacht.”²¹⁸ Here, in this alternative story of cosmic beginnings, it is difficult, however, to overlook a nod to the caustic opening of Nietzsche’s own essay, which likewise begins a short tale that serves something of an astronomic reality-check:

In irgend einem abgelegenen Winkel des in zahllosen Sonnensystemen flimmernd ausgegossenen Weltalls gab es einmal ein Gestirn, auf dem kluge Tiere das Erkennen erfanden. Es war die hochmütigste und verlogenste Minute der ‘Weltgeschichte’: aber doch nur eine Minute. Nach wenigen Atemzügen der Natur erstarrte das Gestirn, und die klugen Tiere mußten sterben. – So könnte jemand eine Fabel erfinden und würde doch nicht genügend illustriert haben, wie kläglich, wie schattenhaft und flüchtig, wie zwecklos und beliebig sich der menschliche Intellekt innerhalb der Natur ausnimmt.²¹⁹

Plunging beyond even the titanic depths of the geological Deep Time, Nietzsche abruptly details in one “Atemzug” both the beginning and the end — the origin and rapid demise of all things within the vast expanse of cosmic time. Much like Mongré’s whirlwind of sense perceptions on the way to their own appropriation by language, “der menschliche Intellekt” that emerged from language is also remarkably pithy in context. Not forgetting Mauthner’s papal tale, it would seem that Mongré and his sources of influence all have a particular proclivity for parables: Mongré has perhaps committed to paper the “Fabel” that Nietzsche proposes.

Yet the synthesis of Mauthner and Nietzsche in “Sprachkritik” happens not just on a stylistic level, of course, but also on a theoretical one. The key conceptual issues of language criticism assessed in Mongré’s essay are all signposted in this opening fable and then scrutinised in the subsequent, more analytical section. Mongré, in the few paragraphs following his uncovering of the early stages of referential speech, immediately proceeds by exposing this apprehension of *Dinge* by language for it really is, namely *mis*apprehension:

Sie werden ihre Gefährten an die Schreckensstätte führen und mit Da auf die gestürzte Fichte weisen; die Horde wird das Da aufnehmen und es wird vielleicht Fichte, vielleicht Donner, vielleicht Himmel oder Feuer oder Schrecken oder Gott bedeuten — aber die Entdeckung kann nicht wieder verloren gehen, das erste noch schwankende, noch vieldeutige Wort der künftigen Sprache ist gewonnen.

Und andere Horden bilden andere Lautzeichen. Bei Kampf und Tausch, Wanderung und Eroberung mischen sich auch die Laute, verbreiten sich herüber und hinüber, die Geschichte der Sprachen beginnt.²²⁰

The instability of this “Da!” has thus been disclosed, for this “hindeutende” function of language is easily misused, and in the ensuing chaos of civilisation, language evolves as a fundamentally disordered, inconsistent and unreliable instrument. The history of language

²¹⁸ Ibid., 551.

²¹⁹ Nietzsche, “Über Wahrheit und Lüge,” 875.

²²⁰ Mongré, “Sprachkritik,” 552.

becomes, in short, a messy history of misappropriations. It is in this context that two central themes that come to underpin this *Gegenstandsproblem* of language in Mongré's later analysis are raised, namely the notion of collective *Gedächtnis* and the structure of *Metapher*. He continues:

Wunderbar lichtet und klärt sich nun die Welt. Das Abwesende, Ferne, Aussetzende wird im Lautbild weitergetragen, Dauer und Beharrung wird den Dingen zugesprochen, ja wirklich *zugesprochen*, eingeredet, angesagt. Von einer empfundenen Gegenwart zur andern spannt sich die Regenbogenbrücke des Wortes. Was sonst, wenn es den Sinnen entschwand, in Vergessen sank, wirkt im Gedankensymbol fort. Der Vater sagt es dem Sohne, daß der Apfel süß und die Tollkirsche giftig ist, Einzelerfahrungen werden erspart, ererbt und aus tausend Versuchen und Merkmalen baut sich ein erstes Weltverständnis. In den Greisen des Stammes lebt alle Weisheit, und in feierlichen Zaubersprüchen geht sie von Mund zu Munde. Noch einmal, da die tönende Rede allzuflüchtig und wandelbar ist, wird das Wunder verknüpfender Zuordnung vollbracht und ein *Bild des Bildes* geschaffen. Wie das Wort an die Dinge heranwächst, so wächst an das Hörbare ein Sichtbares, an das Lautzeichen ein Schriftzeichen heran. Die Kette der Geschlechter sammelt und ordnet ihr Ererbtes, die Menschheit hat ihr Gedächtnis empfangen.²²¹

Interwoven in this passage are thus two overarching ideas. Firstly, “das Wort” serves as a metaphor in the *absence* of the original “Reiz” that has been lost to “Vergessen”; it survives solely as a contested symbol in a staged process of irrevocable distancing from its original object, from a noise to a written sign. Secondly, the “Weltverständnis” of humanity is the product of these metaphors passing through generations — “von Geschlecht zu Geschlecht”²²² — becoming, as such, objects of an evolutionary cultural memory. Quick to remind us of the ever-widening gap between the original sense perception and the inherited “Schriftzeichen,” Mongré notes: “Da begibt sich ein Seltsames. Vom Bezeichneten löst sich das Zeichen und *lügt sich* ein eigenes Leben.”²²³ Akin to Nietzsche’s essay, Mongré thus frames the problem of language from the outset as one of truth and lies, and these two aspects — metaphor and memory — then come to inform Mongré’s later analysis of language with respect to the works of Mauthner and Nietzsche.

Considering first the former aspect, Nietzsche asks in his essay: “wie steht es mit jenen Conventionen der Sprache? Sind sie vielleicht Erzeugnisse der Erkenntnis, des Wahrheitssinnes, decken sich die Bezeichnungen und die Dinge? Ist die Sprache der adäquate Ausdruck aller Realitäten?”²²⁴ As if to answer the question, Mongré summarises Mauthner’s assessment of *Sprache* and *Wirklichkeit*:

Alle von uns beobachtete Sprachenveränderung bringt Mauthner unter den Sammelbegriff Metapher; für ihn ist wie für Jean Paul die Sprache ein ‘Wörterbuch vergilbter Metaphern’. In dieser Allgemeinheit scheint das beinahe selbstverständlich; da die Wirklichkeit nicht Sprache,

²²¹ Ibid.

²²² Ibid., 551.

²²³ Ibid., 552. Emphasis added.

²²⁴ Nietzsche, “Über Wahrheit und Lüge,” 878.

die Sprache nicht Wirklichkeit ist, so kann zwischen beiden keine Identität, sondern höchstens Korrelation, Zuordnung und metaphorische Übertragung bestehen. Aber auch die bloße Schallnachahmung, die Onomatopöie ist metaphorisch; der Kuckuck ruft gar nicht Kuckuck, der Hahn nicht Kikeriki.²²⁵

The parametrical structure of metaphor thus defines the relationship between language and reality: between objects of *Wirklichkeit* and words that seek to define them there is at best an imperfect mapping. This chimes, of course, with Nietzsche's more visceral characterisation of the misguided "Sprachbildner" who, unable to access the *Ding an sich*, draws upon "die kühnsten Metaphern zu Hilfe"²²⁶ in a phased process of describing the relations between objects and humans:

Ein Nervenreiz, zuerst übertragen in ein Bild! Erste Metapher. Das Bild wieder nachgeformt in einem Laut! Zweite Metapher. Und jedesmal vollständiges Überspringen der Sphäre, mitten hinein in eine ganz andre und neue. [...] Wir glauben etwas von den Dingen selbst zu wissen, wenn wir von Bäumen, Farben, Schnee und Blumen reden, und besitzen doch nichts als Metaphern der Dinge, die den ursprünglichen Wesenheiten ganz und gar nicht entsprechen. Wie der Ton als Sandfigur, so nimmt sich das rätselhafte X des Dings an sich einmal als Nervenreiz, dann als Bild, endlich als Laut aus. Logisch geht es also jedenfalls nicht bei der Entstehung der Sprache zu, und das ganze Material, worin und womit später der Mensch der Wahrheit, der Forscher, der Philosoph arbeitet und baut, stammt, wenn nicht aus Wolkenkuckucksheim, so doch jedenfalls nicht aus dem Wesen der Dinge.²²⁷

Language is therefore but a sequence of metaphors, a twofold process of distancing from the elusive thing in itself, which Nietzsche takes to be the purest — yet unattainable — expression of *Wahrheit*. Much like Mongré's "Bild eines Bildes" in his prose section, therefore, repeated metaphorical transferences characterise for Nietzsche the fraught relationship between language and truth. Clearly, Mongré's more surface-level discussion of metaphor in Mauthner's work reveals a close proximity to Nietzsche's ideas that are best articulated in "Über Wahrheit und Lüge," and when Mongré's further discussion of metaphor is considered, this proximity shrinks even more.²²⁸ Similarly, the positing of language as a product of collective memory in Mongré's introductory tale returns to inform his analysis of Mauthner, who, as Mongré quickly notes, renders "das Gedächtnis zu weltverschlingender Größe."²²⁹ Mauthner's own wording indicates that Mongré's claim is by no means overblown, for the centrality of memory in his work is made

²²⁵ Mongré, "Sprachkritik," 563f.

²²⁶ Nietzsche, "Über Wahrheit und Lüge," 879.

²²⁷ Ibid.

²²⁸ Nietzsche continues his discussion of metaphors by undermining in quickfire succession inconsistent and misleading aspects of language, from unquestioning use of subjective "Reizung" to the use of gendered nouns: "Wir teilen die Dinge nach Geschlechtern ein, wir bezeichnen den Baum als männlich, die Pflanze als weiblich: welche willkürlichen Übertragungen! Wie weit hinausgeflogen über den Canon der Gewißheit!" Nietzsche, "Über Wahrheit und Lüge," 878. In unison, Mongré brands the "Geschlecht der Hauptworte" as "das lächerlichste aller Metaphern," remarking its fortunate absence within English and indicating more sensible distinctions in Inuit languages "zwischen belebten und leblosen Dingen." Mongré, "Sprachkritik," 565.

²²⁹ Ibid., 562.

very clear: “Meine Überzeugung ist, daß die Rätsel der Sprache mit Schlüsselworte Gedächtnis zu lösen seien, oder vielmehr daß die Rätsel [...] zurückzuschieben seien auf das Wesen des menschlichen Gedächtnisses.”²³⁰ As Mongré explains, it is in the construction of *Begriffe* on the back of the metaphors encountered above that memory asserts itself: “Gedächtnis vergleicht die Sinneseindrücke, bemerkt Ähnlichkeiten, klassifiziert, bildet Begriffe und dehnt sie metaphorisch auf neue Erfahrungen aus [...].”²³¹ A concept, therefore, is generated from the amalgamation of many similar metaphors into one, i.e. when *Gedächtnis* begins speak in metaphors of its own.

As Mauthner sees it, however, the “Wesen des menschlichen Gedächtnisses,” the agent in the assembly of *Begriffe*, is in fact its own inherent *Unzuverlässigkeit*. Mongré summarises: “Und zwar verdanken [...] der Ungenauigkeit des Gedächtnisses; auf dem Ähnlichsehen das Ungleichen, dem Übersehen der Unterschiede, also dem flüchtigen und unscharfen Sehen beruht Klassifikation, Begriffsbildung, Sprache.”²³² With yet another blow, language in its entirety — a collection of concepts that are themselves just the product of imperfect metaphors — is seen to rest not on the merits of memory but on its faults and liabilities. The overarching notion of the “Impotenz der Sprache” in the works of all three thinkers can now be no surprise, for a malfunctioning process cannot yield a functioning product: “Bei genauem Gedächtnis gäbe es keine Sprache, bei genauer Erblichkeit keine Entwicklung.”²³³ Forgetting, not remembering, is the root of all language. Notably, Mongré’s summary of language and memory, cited above, encroaches on mathematical terminology, namely the notion of equality and its erroneous attribution on the basis of similarity. He reiterates: “so sprechen wir eine wahrgenommene Ähnlichkeit fälschlicherweise als Gleichheit aus.”²³⁴ Arising from the flawed structure of memory, language propagates an untruth, disguising the different as the same: “Ein exakter Beobachter dürfte kein Baumblatt mit einem anderen verwechseln, käme also nicht in die Lage, beide dem Begriff Blatt zu subsumieren.”²³⁵ To form a concept is thus to abuse perhaps the most commonplace mathematical tool available, namely the equation “=” of two things.

Mongré’s assessment of Mauthner creates, therefore, a close network of terms that underpin the critique of language, namely metaphor, (failures of) memory, concepts and a misused notion of equality. Mongré’s example of the “Baumblatt” might, however, strike an avid Nietzsche

²³⁰ Mauthner, *Beiträge*, 408.

²³¹ Mongré, “Sprachkritik,” 562.

²³² Ibid.

²³³ Ibid.

²³⁴ Ibid., 564.

²³⁵ Ibid., 562.

reader with a sharper memory than the kind described above as familiar, for this appraisal of ideas once again converges clearly on Nietzsche's own thoughts from the 1870s. Having likewise highlighted the metaphorical structure of language from its inception onwards, Nietzsche too progresses to a discussion of how *Begriffe* transpire, and the fallibility of memory is the argument's fulcrum:

Jedes Wort wird sofort dadurch Begriff, daß es eben nicht für das einmalige ganz und gar individualisierte Urerlebnis, dem es sein Entstehen verdankt, etwa als Erinnerung dienen soll, sondern zugleich für zahllose, mehr oder weniger ähnliche, das heißt streng genommen niemals gleiche, also auf lauter ungleiche Fälle passen muß. Jeder Begriff entsteht durch Gleichsetzen des Nichtgleichen. So gewiß nie ein Blatt einem andern ganz gleich ist, so gewiß ist der Begriff Blatt durch beliebiges Fallenlassen dieser individuellen Verschiedenheiten, durch ein Vergessen des Unterscheidenden gebildet und erweckt nun die Vorstellung, als ob es in der Natur außer den Blättern etwas gäbe, das 'Blatt' wäre, etwa eine Urform, nach der alle Blätter gewebt, gezeichnet, abgezirkelt, gefärbt, gekräuselt, bemalt wären, aber von ungeschickten Händen, so daß kein Exemplar korrekt und zuverlässig als treues Abbild der Urform ausgefallen wäre.²³⁶

Between "Urform" and "Abbild" there is now an uncrossable chasm. The original *Reiz* has been subjected to a two-phased metaphor, which then — due to sheer forgetfulness — as one of many similar metaphors has been subsumed into an unstable concept, forcing the creation of the definitional *Lüge*, the claim that something is that which it is not. Evidently, Mongré has not only carried over Nietzsche's horticultural example: in addition, his framing of *Begriffe* in terms of a problematic course of a metaphor through collective memory, which in turn triggers an unwarranted equation of that which is entirely unequal, characterises Nietzsche's earlier argument in "Über Wahrheit und Lüge" as well.

It is evident now that Mongré's discussion of Mauthner's *Beiträge* reveals just as much of a dependence, both in form and content, on Nietzsche's essay of 1872, despite its solitary mention at the beginning. In his own articulation of the *Gegenstandsproblem* of language, Mongré has essentially fused Mauthner's lesser-known philosophy with Nietzsche's more succinct but no less damning assessments of language, truth and knowledge, rendering the latter an omnipresent source of influence. Emerging in "Sprachkritik" is a conception of language as that which is irreparably compromised in ontological terms. Withdrawn with such force from the original *Reiz*, "das Wort" has lost any claim to the empirical world, exposing the absolute *Bodenlosigkeit* of language with its "bewegliches Heer von Metaphern, Metonymien, Anthropomorphismen" in tow.²³⁷ What remains, in short, is "Worte ohne Wirklichkeit"²³⁸ and their equally indeterminate offspring in *Begriffe*. With a bewilderment like Nietzsche's, who is astonished at

²³⁶ Nietzsche, "Über Wahrheit und Lüge," 879f.

²³⁷ Ibid., 880f.

²³⁸ Mongré, "Sprachkritik," 565.

how something so arbitrary and inconsistent as language has hoodwinked centuries of Western philosophy into a rigid belief in “eine pyramidale Ordnung nach Kasten und Graden aufzubauen, eine neue Welt von Gesetzen, Privilegien, Unterordnungen, Grenzbestimmungen,”²³⁹ Mongré bemoans the lingering potency of language and words in the political and social realms, from the “Massendelirien” of the Medieval witch hunts to Napoleon’s proclaiming of “Europa”: “Noch im taghellen neunzehnten Jahrhundert kann ein Abrakadabra, ein im Halbdunkel zwischen Gefühl und Unsinn schillerndes Zauberwort Geister beschwören und Herzen entflammen.”²⁴⁰ It may all be based on precisely nothing, but like Nietzsche’s monstrous, lumbering “Bau der Begriffe” lacking foundations, a baseless concept can nevertheless exert influence. Careful not to underestimate this, Mongré soberly proclaims: “Das Wort macht Geschichte, ein Nichts wandelt die Welt.”²⁴¹

With respect to the overarching question of Nietzsche’s influence, it may seem logically sufficient to wrap up this line of enquiry here and conclude that the Nietzschean overtones in Mauthner’s work are testament enough to Nietzsche’s influence upon Mongré’s “Sprachkritik” — an indirect relationship with Mauthner as a mediator. Yet this convenient conclusion would be somewhat unsatisfying, for it does little to explain the turn towards mathematics at the end of the essay beyond the comparable idea of a *Gegenstandsproblem*. Something more is required to bridge the baselessness of language and Mongré’s inspired mathematical intervention. For all of these similarities, however, Mauthner, on the back of his aforementioned misgivings surrounding Nietzsche’s “Sprachkraft,” does not harmonise with Nietzsche in full, and these reservations, it will be argued, are the key to completing the theoretical bridge commenced above. A closer examination of Nietzsche’s and Mongré’s respective essays leads to a thought-provoking conclusion: the impact of Nietzsche’s ideas on language on Mongré/Hausdorff lies not in their similarity with Mauthner’s protracted philosophy of language; rather, it lies in their differences. Ultimately, it is not Mauthner who emerges as the philosophical giant upon whose shoulders Mongré stands.

Divergence: Nietzsche contra Mauthner

It is necessary to recall here Mauthner’s central assertion in his *Beiträge* that “Denken” and “Sprechen” are indivisible. While it is beyond the scope of this analysis to fully probe this alleged equivalence, it is sufficient to point out that Mongré, despite his praise of Mauthner and the

²³⁹ Nietzsche, “Über Wahrheit und Lüge,” 881.

²⁴⁰ *Ibid.*, 569.

²⁴¹ *Ibid.*

former's assertiveness on this topic, remains unconvinced. Latching onto Mauthner's pessimistic claim that language and thus also thought itself contain nothing but "die tauben Nüsse der Tautologie," Mongré proposes mathematics, in something of a twist, as an example of pure thought that is uncontaminated by *Sprechen*:

Daß es aber eine Logik gibt, die nicht 'die tauben Nüsse der Tautologie trägt', daß eine Wissenschaft von selbstständigen, aber nicht platt selbstständigen Erzeugnissen des menschlichen Denkens existiert, die keine 'Lokalangelegenheit der sogenannten indoeuropäischen Menschheit' ist, dafür haben wir doch ein klassisches Zeugnis in jener Wissenschaft, deren Möglichkeit dem alten Kant als erstaunliches Problem aufging: in der Mathematik!²⁴²

This fundamental turn in "Sprachkritik" towards mathematics is quickly contextualised by Mongré as an attempt to distance himself from Mauthner's claim: "seine Stellung zur Mathematik ist mir nicht völlig klar geworden, aber mir scheint, daß man auf ein klares Verhältnis zu dieser Wissenschaft verzichtet, wenn man Denken und Sprechen gleichsetzt."²⁴³ There is thus a certain potential within mathematics to thrive despite the *Nichtigkeit* of language, which is overlooked when *Denken* and *Sprechen* are unquestioningly fused together. Indeed, Mongré observes in Mauthner's work an unfortunate tendency to collapse all other concepts into language alone:

Es kann bei dieser Gelegenheit ausgesprochen werden, daß Mauthner die Unklarheit unserer wissenschaftlichen Begriffe nicht nur kritisiert, sondern in vielen Fällen steigert [...]. Was setzt er nicht alles der Sprache gleich! Denken, Gedächtnis, Bewußtsein, Ich, Individualität, Weltanschauung, — die Liste ließe sich weiterführen. Denken ist Sprechen, Sprache ist Gedächtnis, Gedächtnis ist Bewußtsein. Wozu diese Konfusion, diese nächtliche Auftrennung des Gewebes, das die arme Menschheit mühsam an Tagen gesteigerter Besonnenheit spinnt und weiterspinnt?²⁴⁴

Countering this recursion of everything to speech, Mongré has identified "in der Mathematik" an *Ausweg* from Mauthner's prison of language. He reiterates: "Wir haben vorhin in der Mathematik ein Beispiel sprachlosen Denkens, neologischer, nicht tautologischer Denkens genannt, das zu wiederlegen der [Mauthner'schen] Sprachkritik aufgegeben sei [...]."²⁴⁵ A sharp divergence from Mauthner, who to this point in Mongré's essay is subject only to acclaim, is certainly on display here. This naturally gives rise to a crucial question: how did Mongré arrive at this mathematical turning point that breaks through the stubborn equation of *Denken* and *Sprechen*? Mongré's short explanation of the hypothesis cited above provides some initial clues:

Was Kant ungenau fühlte, als er bestreitbarer Weise die Sätze der Mathematik synthetische, nicht analytische Urteile nannte, können wir noch viel ungenauer, aber unwidersprechlich so

²⁴² Ibid., 577.

²⁴³ Ibid.

²⁴⁴ Ibid., 578.

²⁴⁵ Ibid.

ausdrücken: die Sätze der Mathematik sind nicht tautologisch, sie bringen Neues, sie stehen nicht auf der kläglichen Stufe des berühmten Cajus, der sterblich ist, weil alle Menschen sterblich sind.²⁴⁶

One thing is immediately apparent: Kant is back, albeit not in a way that is entirely unchallenged. Yet a shift in focus straight to Kant and his conception of mathematics in *Kritik der reinen Vernunft* would be to bypass a crucial bridging point: how Mongré is able to diverge from Mauthner lies firstly with Nietzsche's fiery essay on language, truth and artistic creativity. The guiding notion here is Mongré's contention that mathematical statements "bringen Neues," or in other words, that mathematics is equipped with an ability to create anew.

It is necessary to make this Nietzschean turn more concrete before turning to Kant. Retracing the steps of his essay, it must be remembered that "Über Wahrheit und Lüge" is — despite its compactness — a dilogy. The aforementioned denunciation of language as an epistemological tool, whereby Nietzsche (like Mauthner) exposes this insurmountable *Gegenstandsproblem* of language, forms the larger first section of the essay. In a shorter follow-up, however, a clear divergence between Mauthner and Nietzsche can be observed. In the first section of his essay, Nietzsche makes reference to the fundamentally "schaffendes" nature of the thinking subject, and he frames this claim in the context of "Vergesslichkeit":

Nur durch das Vergessen jener primitiven Metapherwelt, nur durch das Hart- und Starrwerden einer ursprünglichen, in hitziger Flüssigkeit aus dem Urvermögen menschlicher Phantasie hervorströmenden Bildermasse, nur durch den unbesiegbaren Glauben, *diese Sonne, dieses Fenster, dieser Tisch* sei eine Wahrheit an sich, kurz nur dadurch, daß der Mensch sich als Subjekt, und zwar als *künstlerisch schaffendes* Subjekt, vergißt, lebt er mit einiger Ruhe, Sicherheit und Konsequenz: wenn er einen Augenblick nur aus den Gefängniswänden dieses Glaubens herauskönnte, so wäre es sofort mit seinem 'Selbstbewußtsein' vorbei.²⁴⁷

By way of this congelation of perceptual metaphors over time, an illusory notion of truth develops through the convention-oriented construction of language. In an act of mass forgetfulness, which is to say the failure to acknowledge that "*diese Sonne, dieses Fenster, dieser Tisch*" are nothing but perceptual metaphors that are *necessarily* devoid of any absolute truth, the inherently creative drive of the *Mensch* — a "*künstlerisch schaffendes* Subjekt" — becomes collateral damage. Creativity is thus, as Kampits notes, "der Preis der Sicherheit."²⁴⁸ It is usurped by the very states of being that are often met with the most contempt and derision in Nietzsche's works, namely "Ruhe, Sicherheit und Konsequenz" — the creature comforts of the mediocre *Heerdentier*.²⁴⁹ Though it appears in the first section of the text as a fleeting remark, the notion

²⁴⁶ Ibid., 577.

²⁴⁷ Nietzsche, "Über Wahrheit und Lüge," 883.

²⁴⁸ Kampits, "Der Sprachkritiker Fritz Mauthner," 34.

²⁴⁹ It is perhaps in this sense that "Über Wahrheit und Lüge" serves as an early snapshot of the moral philosophy of the later Nietzsche, where the vociferous elitism with which he is often associated, becomes manifest.

of *künstlerisches Schaffen* is further developed in the second section, where Nietzsche turns his attention fully to the inherently artistic nature of the “Trieb zur Metapherbildung.”²⁵⁰ Unvanquished by the rigid “Bau der Begriffe,” this drive seeks new realms for activity, and finds it, according to Nietzsche, “im *Mythos* und überhaupt in der *Kunst*.”²⁵¹ Much is gained from this acquisition of *Spielraum*, for it facilitates that which honeycombs any archetypal modernist manifesto, namely the creation of *das Neue*:

Fortwährend verwirrt er die Rubriken und Zellen der Begriffe dadurch, daß er *neue* Übertragungen, Metaphern, Metonymien hinstellt, fortwährend zeigt er die Begierde, die vorhandene Welt des wachen Menschen so bunt unregelmäßig, folgenlos unzusammenhängend, reizvoll und *ewig neu* zu gestalten, wie es die Welt des Traumes ist.²⁵²

Newness, here, is redolent of the exhilarating and chaotic influence of the Dionysian, as Nietzsche framed it in *Die Geburt der Tragödie*, with its messy, incoherent appeal to originality. It is, therefore, contingent on the breakage of the conventional, systematic and illusory — perhaps thus Apollonian — framework of concepts and metaphors, an undoing of the “Vergessen” described in the previous section.²⁵³ What, though, does such a process entail?

With the taxonomy that would shape his polemical *Zur Genealogie der Moral* of 1887, that of masters and slaves, Nietzsche assesses the potential of the intellect — “jener Meister der Verstellung” — and its innovative capacities once freed from its “sonstigen Sklavendienste”²⁵⁴:

Nie ist er üppiger, reicher, stolzer, gewandter und verwegener: mit schöpferischem Behagen wirft er die Metaphern durcheinander und verrückt die Grenzsteine der Abstraktionen, so daß er zum Beispiel den Strom als den beweglichen Weg bezeichnet, der den Menschen trägt, dorthin, wohin er sonst geht. [...] Jenes ungeheure Gebälk und Bretterwerk der Begriffe, an das sich klammernd der bedürftige Mensch sich durch das Leben rettet, ist dem freigewordenen Intellekt nur ein Gerüst und ein *Spielzeug* für seine verwegenen Kunststücke: und wenn er es zerschlägt, durcheinanderwirft, ironisch wieder zusammensetzt, das Fremdeste paarend und das Nächste trennend, so offenbart er, daß er jene Notbehelfe der Bedürftigkeit nicht braucht und daß er jetzt nicht von Begriffen, sondern von Intuitionen geleitet wird.²⁵⁵

Unlike the deceived “bedürftige Mensch,” who has forgotten that *Wahrheit* is mere linguistic convention, the emancipated intellect embraces the inherent artificiality of concepts and their ancestral metaphors, and in an act of mutiny it throws these metaphors into chaos, defiling the rigid scaffold of meaning, in an environment of *play*. In short, *das Neue* is generated when language — its claims to truth now soundly ridiculed — is turned against itself and becomes a

²⁵⁰ Nietzsche, “Über Wahrheit und Lüge,” 887.

²⁵¹ Ibid.

²⁵² Ibid. Emphasis mine.

²⁵³ Here, of course, any posited comparison with the Dionysus-Apollo opposition of *Die Geburt der Tragödie* must contend with the notion that Nietzsche suggests no seamless coalescence in this essay, rather a defeat of the dry edifice of concepts at the hands of the liberated intellect.

²⁵⁴ Ibid., 888.

²⁵⁵ Ibid. Emphasis added.

“Spielzeug.” With this playful turn, Nietzsche has laid out a position that surely anticipates Hausdorff’s “Das Raumproblem,” for creativity is now to be found in a “Spielraum” — not one of “Anschauung” or “Erfahrung,” but one of emancipated thought, “freies Denken.”

While building to a closing juxtaposition of “der vernünftige Mensch” and “der intuitive Mensch,” the latter representing the *Sprachkünstler* who can accomplish the above, Nietzsche is quick to reassert, however, that the originality achieved by such ironic vandalism of traditional language by no means unlocks the essence of things, the inaccessible *Ding an sich*. Rather, it captures at least to some extent the *impression* of intuitions:

Von diesen Intuitionen aus führt kein regelmäßiger Weg in das Land der gespenstischen Schemata, der Abstraktionen: für sie ist das Wort nicht gemacht, der Mensch verstummt, wenn er sie sieht, oder redet in lauter verbotenen Metaphern und unerhörten Begriffsfügungen, um wenigstens durch das Zertrümmern und Verhöhnern der alten Begriffsschranken dem Eindrucke der mächtigen gegenwärtigen Intuition schöpferisch zu entsprechen.²⁵⁶

Just as there is no direct path between intuitions and the stale realm of concepts, the *Gegenstandsproblem* of language is not overcome by the “verbotenen Metaphern und unerhörten Begriffsfügungen” of the “intuitive Mensch.” It remains insuperable, and the latter “Mensch” is only capable of breaking the conceptual apparatus of the former one. Crucially, therefore, this resilience of the *Gegenstandsproblem* is not a disadvantage for Nietzsche: it *must* remain unresolved for this “Schöpfung des Neuen” to take flight, for the “Spiel” to begin. In an optimistic turn, Nietzsche thus sees in the “Nichtigkeit der Sprache”²⁵⁷ the opportunity for an almost biblical moment: the creation of something from nothing. Nietzsche’s use of the coordinating conjunction “oder” in the above passage is thus decisive, for it demarcates the two options available once the failure of language to access *Wahrheit* is understood: “Verstummen,” on one hand, and this “Vertrümmern und Verhöhnern der alten Begriffsschranken” by way of *Kunst* on the other. This awareness of an alternative pathway underlines the central difference between Nietzsche and Mauthner in their otherwise similar critiques, because Mauthner was evidently only aware of the former: “Sobald wir wirklich etwas zu sagen haben, sind wir gezwungen zu schweigen.”²⁵⁸ As will be shown shortly, this ancillary *Ausweg*, whose trail is lit by Nietzsche alone, makes all the difference for Mongré.

It is necessary to ask, however, how this philosophical difference emerged. Having suggested that Nietzsche was spread too thinly in disciplinary terms, i.e. that his ability as a *Sprach- und*

²⁵⁶ Ibid., 888f.

²⁵⁷ Kampits, “Der Sprachkritiker Fritz Mauthner,” 25.

²⁵⁸ Kampits elaborates on Mauthner’s position, connecting the latter’s insight that any rigorous critique of language “endet in einem Appell an das Schweigen” to Wittgenstein’s subsequent “totales und umfassendes Schweigen.” Ibid.

Erkenntniskritiker was hindered by his focus on morality and art, Mauthner exposes the binary nature of his own thinking in this regard when he reiterates: “Nietzsche wäre mit der Sprache fertig geworden, wenn er zwischen der Sprache als Kunstmittel und der Sprache als Erkenntniswerkzeug deutlich genug unterschieden hätte.”²⁵⁹ According to Mauthner, therefore, Nietzsche’s problem is one of consistency and rigour: he failed to conduct a critique of language with respect to aesthetics that matched in thoroughness his stinging epistemological assessments. Locating the blame, ultimately, in Nietzsche’s vanity, Mauthner concludes: “Um das grobe Wort auszusprechen, er war zu eitel, um sich bei der Stellung eines Kritikers zu begnügen. Er war ein Niederreißer und wollte ein Schaffender heißen.”²⁶⁰ For Mauthner, there is in Nietzsche’s “Auflösung der Sprache in das Spiel der Metapher” thus an impermissible contradiction: “[sie] führt — wie Mauthner meint — durch die Konzentration auf die Metapher wieder in den Bannkreis der Sprache zurück, aus dem Nietzsche auszubrechen versuchte.”²⁶¹ Rightly, Kampits is quick to trace this difference back to Mauthner’s overarching double-bind as a *Sprachkritiker* trying to critique language with the mechanisms of language itself.²⁶² Nietzsche thus overlooks the central quandary that envelops Mauthner’s *Sprachkritik*, in which the position of the critic is also rendered untenable. Working with Mauthner’s taxonomy, in his eyes, therefore, it would appear that Nietzsche falsely thinks he can somehow eradicate the bedbugs and spare the aggravated Pope. Mauthner’s insistence on the mutual demise of the pontiff and his pests negate any opportunity to create anew, as Nietzsche advocates. In short, unlike for Nietzsche, “die Schöpfung des Neuen” is an unattainable goal for Mauthner, and it fails to account for the compromised position of the critic in the *Kritik*.

Was Mongré lured and misled, therefore, by Nietzsche’s “prachtvolle Sprachkraft” (as with Nietzsche himself) into the same unsustainable position? Such a conclusion, especially when coupled with the undeniable success of Hausdorff’s revolutionary mathematics, would no doubt cast a shadow over the way in which Mongré builds upon this very divergence from Mauthner

²⁵⁹ Mauthner, *Beiträge*, 331.

²⁶⁰ Ibid. As Kampits points out, Nietzsche makes space for “die schöpferische Tätigkeit des Dichters” in his assessment of metaphors and truth, calling for a transition “zu einer künstlerischen Freiheit par excellence,” while Mauthner, conversely, “geht freilich nicht so weit” and remains “zwiespältig.” Kampits, “Der Sprachkritiker Fritz Mauthner,” 34f. Here Kampits aligns himself with Bredeck’s analysis of Mauthner’s standpoint: “[Nietzsche] wäre der Mann gewesen, mit unvergleichlicher Sprachkraft Sprachkritik zu treiben, wenn er den Dichter in sich selbst und den Denker auseinandergehalten hätte.” Elizabeth Bredeck, “Fritz Mauthners Nachlese zu Nietzsches Sprachkritik,” in *Nietzsche-Studien* 13, no. 2 (1984): 587f. Cited in Kampits, “Der Sprachkritiker Fritz Mauthner,” 32.

²⁶¹ Ibid., 35. Elaborating on this contradiction, he writes: “Mauthner geht freilich nicht so weit. Immerhin verweisen aber seine Anleihen bei Nietzsche auf die Voraussetzungen und auch Widersprüche der eigenen Position: das Verfangenbleiben im Wortaberglauben, das Mauthner Nietzsche vorwirft, trifft nicht allein auf seine eigenen skeptischen Überlegungen zu, sondern zeigt auch die Gründe des Scheiterns der sprachskzeptischen Position an.” Ibid.

²⁶² Ibid.

in his turn towards mathematics as “sprachloses Denken.” The answer is perhaps a simple one: the problem lies with Mauthner, whose assessment of Nietzsche rests upon a misunderstanding of the latter’s position. The theoretical discord lies with Mauthner’s aforementioned complaint that Nietzsche failed to distinguish between language as “Kunstmittel” and as an “Erkenntniswerkzeug,” leaving him caught between two poles: Nietzsche the “Niederreißer” and Nietzsche the “Schaffender.” Herein lies the fatal mistake. As was established above, Nietzsche’s two sections of his essay, in which he first discredits language as an epistemological tool before advocating for the radical creation of that which is entirely new in *Kunst*, are not disjointed theories that expose inconsistencies in Nietzsche’s ideas, but rather they are fundamentally tethered together. Only in exposing the awkward truth that the lumbering “Bau der Begriffe” stands not on solid ground but on running water, that language is epistemologically *bodenlos*, can this “künstlerische Schöpfung” by way of “verbotenen Metaphern und unerhörten Begriffsfügungen” take shape. In short, it is precisely the *Gegenstandsproblem* of language that equips it so well for “freie Schöpfung des Neuen.” Nietzsche’s awareness that *Niedereißen* and *Schaffen* are by no means mutually exclusive, and that the former can even facilitate the latter, is that which makes him the more visionary thinker here.

Recalling Mauthner’s short parable of the endangered Pope, it is perhaps fitting to illustrate this difference between Mauthner and Nietzsche in similar terms. Enquiring as to the nature of parables, Giorgio Agamben asks in *The Fire and the Tale* what relationship the content of the parable has with its form. With reference to Jesus’ parables in the Gospels, Agamben concludes that the Kingdom of Heaven and the parable that describes it — the Parable of the Sower — engender such “proximity” that the Kingdom *is* the parable.²⁶³ Melting the distinction between form and content, Agamben asserts: “To speak in parable [*parabolare*] is simply to speak [*parlare*]: *Marana tha*, ‘Come Lord!’”²⁶⁴ In this light, with collapse of the (indeed questionable) form and content duality, the parable of *Sprachkritik* is the *Sprachkritik* itself. Mauthner is unable to forgo, therefore, the boundary that Agamben has just swiftly eradicated: beyond an appeal to silence, he cannot see past the paradox, the cycle of destruction that poisons the Pope along with his insectile bedfellows. Nietzsche’s success, on the other hand, lies in his ability to stand *outside* of the paradox, which is to say outside of the parable, to know that the paradox of criticism *is* criticism nonetheless, to then embrace this contradiction and integrate it into a wider creative system. Whereas the contradiction represents a totalising endpoint for Mauthner, from which the only *Ausweg* is the “Selbstmord der Sprache” in the form of staunch silence, it is for

²⁶³ Giorgio Agamben, *The Fire and the Tale*, transl. Lorenzo Chiesa (Stanford: Stanford University Press, 2017), 24.

²⁶⁴ *Ibid.*, 32.

Nietzsche merely the point of departure. The papal prognosis, however, remains bleak, for the Pope is not rescued by Nietzsche's ingenuity, rather he is sacrificed (albeit, not alone) in the service of *künstlerisches Schaffen*. Nietzsche's brusque "Über Wahrheit und Lüge" thus becomes something of an instructive blueprint: how to kill the Pope and get away with it.

As has now been established, *Widersprüche* simply sit more comfortably with Nietzsche than with Mauthner, which can now guide the shift in focus to the question of mathematics. One might expect a burgeoning mathematician, who in a clear allusion to his disciplinary bias readily acknowledges that he "vielleicht einer Wissenschaft zu nahe [steht]," to regard contradictions with utmost suspicion. When "Sprachkritik" is closely examined, however, it becomes clear that he aligns himself to Nietzsche's defiant "Schöpfung" and not to the "Schweigen" of Mauthner. One brief comment on language and metaphor is particularly revealing in this regard: "Je entfernter die Ähnlichkeit, desto stärker, bewußter die Metapher [...]. In der Metapher liegt die künstlerische Macht und die logische Schwäche der Sprache."²⁶⁵ This corresponds, quite simply, to the two sections of Nietzsche's earlier essay: metaphors are testament to the sheer baselessness of language in epistemological terms, but they also, in the hands of a daring *Künstler*, allow for the creation of something new *precisely* because of the insurmountable gap between language and objects. The *Gegenstandsproblem* that plagues the *Sprachkritiker* is the seed of an opportunity for the artist, whose resolve is no doubt toughened by Nietzsche's biting philosophy. Mongré does not, however, indulge in any further discussion of *Kunst* and *Poesie*, but indeed he does not need to, for art is not the only realm in which the creation of something new is at hand. Let us return to Mongré's proposal that statements of mathematical nature, as was cited above, "sind nicht tautologisch, sie bringen Neues." Having identified Nietzsche's farsightedness as that which draws Mongré away from Mauthner and towards a conception of mathematics as "sprachloses Denken," it must be asked why this is the case from a mathematical perspective. As was discussed previously, a reinvigorated return to Kant via Nietzsche's philosophy of the eternal recurrence became evident in Hausdorff/Mongré's work (with the *Transformationsprinzip*); a very similar pattern emerges here. In the same breath as the claim that mathematics generates something *new*, Mongré references Kant's "ungenau[e]" suggestion that mathematical statements have "synthetische, nicht analytische Urteile." Once again, an excursion through Nietzsche's philosophy prompts a return to Kant, albeit not without a degree of scepticism. This mediation by Nietzsche makes all the difference, for an unquestioning

²⁶⁵ Mongré, "Sprachkritik," 564.

engagement with Kant would not equip Mongré with the tools to establish the mathematics for which Hausdorff is credited.

In Kant's *Kritik der reinen Vernunft*, two of the most well-known binaries in the history of modern philosophy are developed: the distinction between *a priori* and *a posteriori* knowledge, on the one hand, and the distinction between “analytische und synthetische Urteile” on the other. Despite the canonical status of these terms, their significance to Mongré warrants a reminder of their original definitions. The former distinction appears in Kant's opening paragraph of the 1781 edition:

Solche allgemeine Erkenntnisse nun, die zugleich den Charakter der innern Notwendigkeit haben, müssen, von der Erfahrung unabhängig, vor sich selbst klar und gewiß sein; man nennt sie daher Erkenntnisse *a priori*: da im Gegenteil das, was lediglich von der Erfahrung erborgt ist, wie man sich ausdrückt, nur *a posteriori*, oder empirisch erkannt wird.²⁶⁶

Kant's binary juxtaposes, in short, knowledge independent of experience and knowledge that relies upon empiricism. Structurally, therefore, the distinction is one of inner and outer worlds, for *a priori* knowledge is entirely internal to the mind, as opposed to *a posteriori* knowledge, which hinges upon that which is outside of the thinking subject: the experiential world around us. Similarly, Kant introduces the second conceptual pairing, shifting focus from the empirical *Erfahrungswelt* to the relationship between grammatical subjects and predicates:

In allen Urteilen, worinnen das Verhältnis eines Subjekts zum Prädikat gedacht wird, (wenn ich nur die bejahenden erwäge: denn auf die verneinenden ist die Anwendung leicht) ist dieses Verhältnis auf zweierlei Art möglich. Entweder das Prädikat B gehört zum Subjekt A als etwas, was in diesem Begriffe A (versteckter Weise) enthalten ist; oder B liegt ganz außer dem Begriff A, ob es zwar mit demselben in Verknüpfung steht. Im ersten Fall nenne ich das Urteil analytisch, im andern synthetisch. Analytische Urteile (die bejahenden) sind also diejenigen, in welchen die Verknüpfung des Prädikats mit dem Subjekt durch Identität, diejenigen aber, in denen diese Verknüpfung ohne Identität gedacht wird, sollen synthetische Urteile heißen.²⁶⁷

In a linguistic sense, this binary is yet another expression of the inside-outside opposition. When the predicate is entirely internal to the subject, suggesting no outward point of reference, the statement is analytical, and when the predicate is external to the subject, demanding some form of “Verknüpfung” beyond identity, the statement is synthetic. While logicians have explained the difference in countless ways, Kant's original elaboration is perhaps most apt, for he offers an innately spatial example:

[W]enn ich sage: alle Körper sind ausgedehnt, so ist dies ein analytisches Urteil. Denn ich darf nicht aus dem Begriffe, den ich mit dem Wort Körper verbinde, hinausgehen, um die Ausdehnung als mit demselben verknüpft zu finden, sondern jenen Begriff nur zergliedern, d.i. des Mannigfaltigen, welches ich jederzeit in ihm denke, nur bewußt werden, um dieses Prädikat darin anzutreffen; es ist also ein analytisches Urteil. Dagegen, wenn ich sage: alle Körper sind

²⁶⁶ Kant, *Kritik der reinen Vernunft*, 42.

²⁶⁷ *Ibid.*, 56.

schwer, so ist das Prädikat etwas ganz anderes, als das, was ich in dem bloßen Begriff eines Körpers überhaupt denke. Die Hinzufügung eines solchen Prädikats gibt also ein synthetisches Urteil.²⁶⁸

The claim that all physical bodies are extended in space is, of course, inherent to the concept of a “Körper” from the outset, whereas the notion of its weight exceeds the logical boundaries of the term. Synthetic judgements, as Kant points out, rely on “Hinzufügung” in the simplest possible sense: a term *outside* of the subject is introduced — “ein etwas anderes (X).”²⁶⁹ Kant’s example raises, of course, the connection between the two binaries introduced: to ask whether a physical body is “schwer” is to engage with the distinction between *a priori* and *a posteriori* knowledge, for it appeals to the reliance on the empirical world.

Kant is quick to explore the overlap. In a fusion of both distinctions, four possible permutations are created: analytic *a priori*, synthetic *a priori*, analytic *a posteriori* and synthetic *a posteriori* statements. The third pairing here — analytic *a posteriori* — struck Kant as a contradiction,²⁷⁰ which leaves three remaining. The first and last permutations are relatively self-explanatory: analytic statements are always *a priori*, and a statement that is *a posteriori* cannot be anything but synthetic.²⁷¹ The second combination, the notion of synthetic *a priori* statements, is conceptually much more complicated and piqued Kant’s interest: “Wenn ich *außer dem Begriffe* A hinausgehen soll, um einen andern B, als damit verbunden zu erkennen, was ist das, worauf ich mich stütze, und wodurch die Synthesis möglich wird, da ich hier den Vorteil nicht habe, mich im Felde der Erfahrung danach umzusehen?”²⁷² In other words, can that extra “Etwas” of synthetic statements come from anywhere other than the *Erfahrungswelt* of *a posteriori* knowledge? Can something, recalling Nietzsche’s deliberations, really come from nothing? As an illustration, Kant considers the thorny issue of causality: “Man nehme den Satz: Alles, was geschieht, hat seine Ursache. In dem Begriff von etwas, das geschieht, denke ich zwar ein Dasein, vor welchem

²⁶⁸ Ibid., 56f.

²⁶⁹ Ibid., 58.

²⁷⁰ The very idea of *a posteriori* knowledge brings this “etwas anderes (X)” into play, which contradicts the original definition of analytical statements as self-contained.

²⁷¹ He explains: “Bei empirischen oder Erfahrungsurteilen hat es hiermit gar keine Schwierigkeit. Denn dieses X ist die vollständige Erfahrung von dem Gegenstande, den ich durch einen Begriff A denke, welcher nur einen Teil dieser Erfahrung ausmacht. Denn ob ich schon in dem Begriff eines Körpers überhaupt das Prädikat der Schwere gar nicht einschließe, so bezeichnet er doch die vollständige Erfahrung durch einen Teil derselben, zu welchem also ich noch andere Teile eben derselben Erfahrung, als zu dem ersteren gehörig, hinzufügen kann. Ich kann den Begriff des Körpers vorher analytisch durch die Merkmale der Ausdehnung, der Undurchdringlichkeit, der Gestalt usw., die alle in diesem Begriff gedacht werden, erkennen. Nun erweitere ich aber meine Erkenntnis, und, indem ich auf die Erfahrung zurücksehe, von welcher ich diesen Begriff des Körpers abgezogen hatte, so finde ich mit obigen Merkmalen auch die Schwere jederzeit verknüpft. Es ist also die Erfahrung jenes X, was außer dem Begriffe A liegt, und worauf sich die Möglichkeit der Synthesis des Prädikats der Schwere B mit dem Begriffe A gründet.” Ibid.

²⁷² Ibid., 60.

eine Zeit vorhergeht usw. und daraus lassen sich analytische Urteile ziehen.”²⁷³ Yet the idea of a cause is something that has been synthesised — it is “Verschiedenes” with respect to the initial subject of something that happens. Kant, however, claims that the empirical world plays no role here:

Was ist hier das X, worauf sich der Verstand stützt, wenn er außer dem Begriff von A ein demselben fremdes Prädikat aufzufinden glaubt, das gleichwohl damit verknüpft sei. Erfahrung kann es nicht sein, weil der angeführte Grundsatz nicht allein mit größerer Allgemeinheit, als die Erfahrung verschaffen kann, sondern auch mit dem Ausdruck der Notwendigkeit, mithin gänzlich *a priori* und aus bloßen Begriffen diese zweite Vorstellungen zu der ersteren hinzufügt. Nun beruht auf solchen synthetischen d.i. Erweiterungs-Grundsätzen die ganze Endabsicht unserer spekulativen Erkenntnis *a priori*; denn die analytischen sind zwar höchst wichtig und nötig, aber nur um zu derjenigen Deutlichkeit der Begriffe zu gelangen, die zu einer sicheren und ausgebreiteten Synthesis, als zu einem wirklich neuen Anbau, erforderlich ist.²⁷⁴

The notion of causality is, according to Kant, one of generality, which cannot be explained away by the *Erfahrungswelt*, which gives rise to the specific. His suggestion as to how this annexation comes to be, however, is somewhat nebulous: it is some form of conceptual “Notwendigkeit” that gives rise to this “X,” generating a synthetic statement that is nonetheless entirely based upon *a priori* knowledge. When his more direct treatment of mathematics is considered, however, the contested and imprecise notion of *Anschauung* rears its head again.

Mathematics, as Kant famously argues in *Kritik*, functions in much the same way: “Mathematische Urteile sind insgesamt synthetisch.”²⁷⁵ In the 1781 edition, Kant lays claim to this in the second section “Die transzendente Analytik,” in which he considers first the arithmetic case before the spatial one in terms of synthesis:

Daß $7+5=12$ sei, ist kein analytischer Satz. Denn ich denke weder in der Vorstellung von 7, noch von 5, noch in der Vorstellung von der Zusammensetzung beider die Zahl 12, (daß ich diese in der Addition beider denken solle, davon ist hier nicht die Rede; denn bei dem analytischen Satze ist nur die Frage, ob ich das Prädikat wirklich in der Vorstellung des Subjekts denke). Ob er aber gleich synthetisch ist, so ist er doch nur ein einzelner Satz. Sofern hier bloß auf die Synthesis des Gleichartigen (der Einheiten) gesehen wird, so kann die Synthesis hier nur auf eine einzige Art geschehen, wiewohl der Gebrauch dieser Zahlen nachher allgemein ist. [...] Dagegen ist die Zahl 7 nur auf eine einzige Art möglich, und auch die Zahl 12, die durch die Synthesis der ersteren mit 5 erzeugt wird.²⁷⁶

This simple numerical expression is, according to Kant, synthetic despite its supposedly self-evident nature: the number “12” is *outside* of the unity “7+5” that generates it. Moreover, it is *a priori* because no direct appeal to the empirical world is made, thus effecting the permutation “synthetische Urteile *a priori*” in full. Yet, the process by which this synthesis takes place remains

²⁷³ Ibid.

²⁷⁴ Ibid., 60f.

²⁷⁵ Ibid., 63.

²⁷⁶ Ibid., 263.

as unclear in this outline as in the above question of causality: on what basis does the unity of 7 and 5 yield this entirely separate 12, which is in this case the “andere X” in question? Curiously, in the second edition of *Kritik*, Kant tries to make this point more concretely. Suggesting a heightened appreciation of this idea’s significance, Kant pulls the discussion of mathematics and the same question of addition up into the introduction of the 1787 revision, where he designates it as the prime example of “synthetische Urteile *a priori*” in somewhat clearer, more assertive terms. Reiterating the strictly *a priori* nature of mathematics, “weil sie Notwendigkeit bei sich führen, welche aus Erfahrung nicht abgenommen werden kann,”²⁷⁷ Kant writes:

Man sollte anfänglich zwar denken: daß der Satz $7 + 5 = 12$ ein bloß analytischer Satz sei, der aus dem Begriffe einer Summe von Sieben und Fünf nach dem Satze des Widerspruches erfolge. Allein, wenn man es näher betrachtet, so findet man, daß der Begriff der Summe von 7 und 5 nichts weiter enthalte, als die Vereinigung beider Zahlen in eine einzige, wodurch ganz und gar nicht gedacht wird, welches diese einzige Zahl sei, die beide zusammenfaßt. Der Begriff von Zwölf ist keineswegs dadurch schon gedacht, daß ich mir bloß jene Vereinigung von Sieben und Fünf denke, und, ich mag meinen Begriff von einer solchen möglichen Summe noch solange zergliedern, so werde ich doch darin die Zwölf nicht antreffen.²⁷⁸

Recognising once again that the simplicity of the statement “ $7 + 5 = 12$ ” would cause most to assume a tautological, analytical nature, Kant has seemingly reasserted his claim in somewhat more accessible terms, designating 12 as wholly *other* than the “Vereinigung” of the prior two terms. Much more importantly, however, in an immediate follow-up, Kant attempts to underpin this synthesis in a very revealing manner:

Man muß über diese Begriffe hinausgehen, indem man die Anschauung zu Hilfe nimmt, die einem von beiden korrespondiert, etwa seine fünf Finger, oder (wie Segner in seiner Arithmetik) fünf Punkte, und so nach und nach die Einheiten der in der Anschauung gegebenen Fünf zu dem Begriffe der Sieben hinzutut. Denn ich nehme zuerst die Zahl 7, und, indem ich für den Begriff der 5 die Finger meiner Hand als Anschauung zu Hilfe nehme, so tue ich die Einheiten, die ich vorher zusammennahm, um die Zahl 5 auszumachen, nun an jenem meinem Bilde nach und nach zur Zahl 7, und sehe so die Zahl 12 entspringen. Daß 7 zu 5 hinzugetan werden sollten, habe ich zwar in dem Begriffe einer Summe $= 7 + 5$ gedacht, aber nicht, daß diese Summe der Zahl 12 gleich sei. Der arithmetische Satz ist also jederzeit synthetisch [...].²⁷⁹

This more detailed discussion of the arithmetical *Sätze* thus explicates in part the process upon which this “Vereinigung” rests, namely an almost infantile *Anschauung* by way of counting fingers. Despite Kant’s insistence that the empirical world is nowhere in sight — as the expression is entirely *a priori* — this suggestion exposes nonetheless a tense association with this very *Erfahrungswelt* from which he seeks to create distance: is the “Hilfe” provided by counting fingers, perhaps the most primitive counting process known to every child, as free from

²⁷⁷ Ibid., 65.

²⁷⁸ Ibid., 65. In this 1787 version, the discussion of addition that was in the 1781 volume is also present at a later point. This new description in the introduction is separate and ancillary; it is not a replacement.

²⁷⁹ Ibid., 65f.

empirical reality as Kant would have it? When Kant moves onto geometrical concepts in his assessment of mathematics, this lack of clarity is by no means allayed. Writing in the introduction to the second edition, Kant emphasises:

Ebensowenig ist irgendein Grundsatz der reinen Geometrie analytisch. Daß die gerade Linie zwischen zwei Punkten die kürzeste sei, ist ein synthetischen Satz. Denn mein Begriff vom Geraden enthält nichts von Größe, sondern nur eine Qualität. Der Begriff des Kürzesten kommt also gänzlich hinzu, und kann durch keine Zergliederung aus dem Begriffe der geraden Linie gezogen werden. *Anschauung* muß also hier zu Hilfe genommen werden, vermittels deren allein die Synthesis möglich ist.²⁸⁰

At the heart of Kant's conception of both arithmetic and geometry is thus his mediatory concept of *Anschauung* outlined earlier in this chapter — the intuitive construction of mental imagery in the mind of the mathematician. In this murkily defined zone, therefore, the creation of new mathematical “Urteile” of both an arithmetical and geometrical nature takes place. The original German term carries crucial connotations that in the common English translation “intuition” are lost, namely the inherently visual nature of this process: the mathematician “schaut etwas an” as a means to intuit certain geometrical facts. An implicit accusative object — a *Gegenstand* — that is *perceived* is an omnipresent companion in Kant's critique of geometry, which complicates the assertive break from the empirical space of the world that he seeks to maintain. Moreover, it is now clear that this understanding of geometry can be traced back to Kant's idea of space in general as an *Anschauungsform* that bridges the space of pure reason and “Räume der Erfahrung.” As was outlined previously, Kant's conception of space, which relies on the Euclidean model, was by 1903 no longer tenable; why, then, does Mongré circle back to the now tainted Königsberg theorist? Any attempt by Mongré to situate the mathematical “Schöpfung des Neuen” within Kant's *Anschauung* would point him in a very different direction than that of Hausdorff, but of course, Mongré does not return to Kant unarmed.

Notably, Mongré's aforementioned reference to Kant's binaries sits alongside a hint of scepticism: the hypothesis is “ungenau” and reasoning “bestreitbar” when Kant attributes to mathematics synthetic *a priori* judgements with *Anschauung* as the conceptual floor. There is something in this claim worth salvaging for Mongré, but only when it is radicalised by the detour through Nietzsche's ideas, which is revealed when Mongré's example of mathematics as “sprachloses Denken” is closely considered. He illustrates this most succinctly with reference to an ancient geometric conundrum that has vexed thinkers both real and fictional, from the

²⁸⁰ Ibid., 67.

Pre-Socratic Anaxagoras²⁸¹ to Joyce's Leopold Bloom in *Ulysses*,²⁸² and has even made its way into common parlance: the impossibility of squaring the circle. The problem, which asks whether one can construct a square from a given circle with ruler and compass such that the area of the shape is preserved, was proved impossible in 1882 by Munich-based mathematician Carl Louis Ferdinand von Lindemann. In his essay, Mongré mocks the time it took to finally settle the issue:

Das Problem der Quadratur des Kreises, zweitausend Jahre vor Christi Geburt den Ägyptern bekannt, ist gegen Ende unseres 19. Jahrhunderts erledigt worden: sollte die Arme Menschheit vier Jahrtausende gebraucht haben, um eine Selbstverständlichkeit einzusehen? Und doch liegt die Transcendenz der Kreiszahl schon im Begriff des Kreises, den jeder Bauernjunge hat; die Unmöglichkeit, ein dem Kreise gleiches Quadrat mit Zirkel und Lineal zu zeichnen folgt mit rein logischer Sicherheit aus dem Umstande, daß die Punkte der Kreislinie gleichen Abstand von Mittelpunkt haben! Also Logik und doch nicht Tautologie, reines Denken und doch nicht leeres Wortgeräusch! Eben so wenig aber war hier eine Berufung auf Erfahrung, auf die 'Wirklichkeitswelt' notwendig, die dem Sensualisten Mauthner als einzige Quelle wertvoll erzählender, nicht geschwätzig wortumschreibender Urteile gilt.²⁸³

Using this problem as a fitting example, Mongré has thus demonstrated the productivity that can be gained from an acceptance of the loss of both an empirical *and* mental *Gegenstand* — the latter a step too far for Kant. This is to say, Mongré's description rests upon the acceptance that mathematical *Räume* are no longer of the "Wirklichkeitswelt" — the observable space of reality — nor of some internalised Euclidean space of mental imagery in line with the philosophy of *Anschauung*. The "Kreisproblem" is not resolved with idealised forms of shapes that occur in the real world, as Kantians would have it, but when the terms themselves are liberated from any ontological burdens, which is to say, simply when one frames it as a detached question of language alone. The ancient riddle, as Mongré reiterates, "läßt sich rein arithmetisch fassen"²⁸⁴: abstraction, it seems, yields results.

This is, of course, very much the territory of "Das Raumproblem" and its conception of mathematics as "eine gewisse *freie Schöpfungen unseres Denkens*, keinem anderen Zwang als die der

²⁸¹ Wilbur Richard Knorr, *The Ancient Tradition of Geometric Problems* (New York: Dover Publications, 1993), 29.

²⁸² Bloom is on several occasions mentioned to be interested in the "quadrature of the circle" for the prize money associated with its solution — "government premium £ 1,000,000 sterling." James Joyce, *Ulysses* (St Ives: Wordsworth Classics, 2010), 622. Joyce's unfortunate protagonist is painfully unaware that the issue had been resolved four years previously in 1882, and, for reasons that are explained below, his focus on this curious, mind-bogglingly long yet nonetheless finite number would have kept him in the mathematical dark.

²⁸³ Mongré, "Sprachkritik," 577.

²⁸⁴ *Ibid.* For explanation, the proof of the impossibility of squaring the circle is a mere corollary of a preceding proof that the "Kreiszahl" π is a transcendental number, which is to say that it is not the root of some polynomial (and to Bloom's downfall, it must necessarily be an irrational number, thus exhausting the "reams of India paper" *ad infinitum*). To avoid potential misconceptions, it must also be noted that while the mention of "Zirkel und Lineal" suggests an appeal to physical movement in the empirical space of the world, the expression is merely linguistic convention in mathematics, and "constructability with compass and straightedge" is now discussed abstractly within modern algebra — in symbols and sets.

Logik unterworfen” that resides within the “Spielraum des Denkens.” The radicalising impact of Nietzsche on Mongré’s thought process, therefore, is most apparent. Well aware that Kant’s understanding of mathematics as a bearer of synthetic statements that generate new knowledge is of merit, Mongré, once mathematics can be secured as the “Beispiel sprachlosen Denkens” that eludes Mauthner’s pessimism, is able to bypass that which suffocates it: the problematic notion of *Anschauung*. The key to unlocking this potential, undoing Mauthner’s binding equation of *Denken* and *Sprechen*, is the embrace of the *Gegenstandsproblem* of language, which emancipates “das Wort” from any object of real, empirical space and — crucially — using this newfound freedom not to lapse into stunned silence but to create anew. No less creative than Nietzsche’s “intuitiver Mensch,” mathematics has for Mongré a fundamental capacity for the “Schöpfung des Neuen,” but only when this something is based, paradoxically, on nothing — a mathematical conjuring act that becomes possible in the wake of Nietzsche’s defiant critique. In short, the more extensive *Einflussgeschichte* that uncovers the indispensable impact of Nietzsche’s philosophy on a mathematician on verge of a breakthrough into modern mathematics is now manifest, and the veil between the pseudonym Paul Mongré and Felix Hausdorff has fallen.

Summary and Aftermath(ematics): “The Poetry of Logical Ideas”

To summarise the results of this line of inquiry, by tracing out the history of mathematics and its relationship to the concept of space, two key characterisations of space in modern mathematics (and the development thereof in a German context) were identified: (i) a shift towards abstract examination of invariance throughout spatial transformations; and (ii) the emergence of a formalist, ontologically “inhaltsleere” conception of mathematics as a whole, which both encircles this spatial model and is occasioned by it. By converging upon the curious figure of Felix Hausdorff, his doggedly modernist formulation of these two tenets of modern mathematics were then put forward as case studies with the view to excavating influences behind them that are shared with modern art and literature, in this case Friedrich Nietzsche. As such, this section sought to build upon and surpass the existing scholarship on Hausdorff’s Nietzschean ideas by Mehrrens, Gray and Epple by undermining the neat separation of the two aspects of Hausdorff’s “double life” and positioning Nietzsche as a source of influence for Hausdorff’s unconventional mathematical development in particular.

Firstly, in a shorter and more self-evident section, Mongré’s interpretation of Nietzsche’s *ewige Wiederkunft des Gleichen* as a fundamentally prototopological idea was foregrounded, i.e. as invariance within transformation. Here, Hausdorff’s cartographical *Transformationsprinzip* in

“Das Raumproblem” was traced back through Mongré’s writings to Nietzsche’s hypothetical recurring universe, prompting a turn towards the rupture of non-Euclidean geometries and their ramifications for empiricism and the Kantian position. Then, a close examination of “Sprachkritik” indicates that it is Friedrich Nietzsche, not Fritz Mauthner, who equips Mongré with the tools to establish an independent philosophical position on language, in which a thoroughly modernist conception of mathematics that resurfaces in Hausdorff’s first outing as a pure mathematician takes centre stage. In a clear break from Mauthner, who cannot overcome the paradoxical hurdles of language criticism, Nietzsche’s assimilation of the paradoxical and counter-intuitive into an innovative aesthetic redirects Mongré’s attention back to Kant’s *Erkenntniskritik*. Here, he can repurpose the synthetic nature of mathematical statements in the pursuit of new knowledge. Despite the unfortunate distance forced by Nietzsche’s turn towards a dangerous and explosive moral philosophy, Mongré’s admiration for the younger, sceptical and unruly Nietzsche is still very much alive in 1903, and moreover, it is no less impactful. In short, both the *Transformationsprinzip* and the “Spielraum des Denkens,” which constitute Hausdorff’s inaugural lecture in 1903 and emergence on the modern mathematical landscape, are propped up to no small degree by the unruly ideas of the troubled Saxonian *Antiphilosoph*.

Stepping back to consider the overarching aims of this project, which seeks to undermine the enduring boundaries between mathematics and the Arts, the importance of these findings cannot be overstated. Firstly, Hausdorff’s *Transformationsprinzip* can be traced back via Mongré’s epistemological critiques to a Nietzschean idea, the eternal recurrence, that itself found an astonishing degree of impact among modern artists, writers and thinkers from 1900 onwards. Then, the insights of “Über Wahrheit und Lüge” were aligned with Mongré’s understanding of mathematics in “Sprachkritik,” freed of ontological burden. As the very conception of mathematics that seeps into the breakthrough work of Felix Hausdorff, the “radically modernist mathematician,” a crucial scholarly step forwards has been taken. Mathematics as the “freie Schöpfung” in the “Spielraum des reinen Denkens” is indebted to a text that was not only vastly influential, like the eternal recurrence, in the artistic realm, but that is itself an explicit a theory of *Kunst*. Modern mathematics becomes, in the case of Hausdorff, nothing short of an art form. Significant though these developments are (and indeed aware of the international impact of Hausdorff’s study of topology), it must be stressed of course that the focus of this section zoomed in on the case of one mathematician alone, and as such, no attempt here is made to render Nietzsche as widespread an influence in modern mathematics as he undeniably is in aesthetic modernism. Indeed, reflecting on methodology, this was never the point. In an effort to mitigate against the threat of imprecision and the loss of clarity that comes with sweeping

definitions and overly ambitious geographical range, this dissertation has contented itself with the more localised perspective (in the national context and on key figures therein), with the hope of opening up potential routes forward for further research into the question of influence and cross-cultural exchange. Nevertheless, it is necessary to maintain that the key spatial doctrines of modern mathematics identified for the purposes of this thesis *are* of course more widespread, and they certainly need to be for the subsequent comparative analyses of chapters 2, 3 and 4 to have firm footing. Furthermore, an awareness that these doctrines can be connected to a sense of creativity on par with the arts and literature is, as it happens, also not confined to the case of Hausdorff alone. In order to gesture towards ways of working slowly outwards, all the while not losing sight of the specific insights that have emerged in this more confined context, let us gently widen scope for a moment.

Most indicative of the growing awareness of Hausdorff's legacy in mathematics is perhaps a more widely accessible form of dissemination, namely a travelling exhibition "Transcending Tradition" that toured Germany between 2006 and 2016. Showcased first in Bonn, the exhibition, in which Hausdorff is afforded a central position, foregrounds the contributions of Jewish mathematicians in the Wilhelmine era and the subsequent Weimar Republic, focussing on four mathematical hubs during that era: Bonn, Berlin, Frankfurt am Main and, of course, Göttingen.²⁸⁵ The prominence of Hausdorff within the exhibition is matched perhaps only by one other mathematician in the group, namely Emmy Noether. While both Hausdorff and Noether are rightly recognised by historian of mathematics David Rowe as having "contributed to shaping the face of modern mathematics," they are rarely discussed together in the analysis of the subject's history.²⁸⁶ Gesturing to the extra-mathematical influences on Hausdorff that were exhumed in this chapter, Rowe is aware that nothing of the sort can be found in Noether's work; there is no indication that she engaged in a scholarly way with the philosophy of mathematics or was influenced by thinkers other than her direct mathematical forebearers. Moreover, Noether was, as Rowe notes, "not a particularly prolific mathematician," in that her name is not attached to a long list of publications that one could expect of someone singled out

²⁸⁵ Its success has since led to an accompanying publication, which reproduces and expands upon the material of the exhibition. Alongside a discussion of the "period of flourishing cooperation between Jewish and non-Jewish mathematicians" in the Weimar era, the exhibition is careful to also bear witness to the disastrous effects of the NSDAP's seizure of power in 1933 and "enormous damage done when hatred and discrimination threaten the lives of those who had been, and could still have been, crucial members of a thriving scientific culture." Birgit Bergmann, Moritz Epple, and Ruti Ungar, eds, *Transcending Tradition: Jewish Mathematicians in German-Speaking Academic Culture* (Berlin and Heidelberg: Springer, 2012), ii.

²⁸⁶ "It would be hard to imagine two mathematicians whose works, personalities and influence differed so sharply. Nor does it appear that they had more than perhaps fleeting contacts with one another, since Hausdorff rarely attended the annual meetings of the German Mathematical Society, an event Noether rarely missed." David E. Rowe, *Emmy Noether – Mathematician Extraordinaire* (Cham: Springer International, 2021), xx.

for such legendary status in her discipline.²⁸⁷ “*Pauca sed matura*” [few but ripe], the famous credo of Gauß, who refrained from publishing work that was not by his own estimation beyond criticism, is seemingly one that applies to Noether as well. Unlike Gauß, who is infamous for his *lack* of generosity with his ideas, ripe or otherwise, it is precisely Noether’s “unselfish generosity” and keenness to collaborate that made her so influential.²⁸⁸ Having left, therefore, few tangible breadcrumbs to historians trying to piece together her life and work, Noether occupies a curious position in the history of mathematics: while she is broadly recognised as a trailblazing figure with an astonishing and lasting impact in mathematics, most of what is known about her has been drawn from the writings of her contemporaries and peers. A common characterisation that runs through most accounts, however, is that Noether’s work was remarkably *creative*, and not just in the loose sense of the word.²⁸⁹ Rowe pins this onto her fundamental outlook on mathematics: “For Emmy Noether [...] mathematicians were in the first instance artists, not scientists.”²⁹⁰ In light of the overarching aims of this thesis, it is necessary to dwell on these allusions to Noether’s creative zeal. If modern mathematics is truly to be brought under the modernist banner, this attempt must account for and accommodate its disciplinary breadth, and as Emmy Noether’s fingerprints are to be detected on an astonishing proportion of modern mathematics.

Emmy Noether was born in 1882 in Erlangen into a wealthy Jewish family that enjoyed a clear affinity for mathematics: her father, Max Noether, was well established within the mathematical community in Germany and was based at the University of Erlangen, and her younger brother, Fritz Noether, would eventually gain employment as a professor of mathematics at the Russian state university in Tomsk.²⁹¹ As many scholars have indicated, the perceived inaccessibility of mathematics is in some ways rooted in a societal tendency to believe in the myth of the lone (and often lonesome) male genius. Once again, Gauß, whose reputation as a child prodigy is often related to his successes in the field as an adult, is a commonly cited example here.²⁹² If we

²⁸⁷ Ibid., viii.

²⁸⁸ Ibid., ix.

²⁸⁹ Ibid., x.

²⁹⁰ Ibid. This is drawn from recollections of Noether’s relatives regarding jovial debates with her brother Fritz, an applied mathematician who primarily worked on modelling turbulence in dynamic systems, who unsurprisingly held the opposite view. Cf. David Rowe and Mechthild Koreuber, *Proving It Her Way: Emmy Noether, a Life in Mathematics* (Cham: Springer International, 2020), viii. As Rowe and Koreuber note, with their book, they “hope to show that people like her, who engage in mathematical research at the highest levels, can and should be considered as artists of a special kind.” Ibid., ix. As with the case of Hausdorff’s biography, to avoid excessive footnoting, it is to be assumed that the biographical details discussed here are taken from Rowe and Koreuber’s opening portrait of Noether in the book (pp. 13-17), unless otherwise stated.

²⁹¹ Fritz Noether was later executed in 1941 during a Stalinist purge for his alleged distribution of anti-Soviet propaganda.

²⁹² For some contemporary discussions, see Heather Mendrick, *Masculinities in Mathematics* (Maidenhead: Open University Press, 2006), 56; Carlo Cellucci, *Rethinking Logic: Logic in Relation to Mathematics, Evolution, and Method*

as scholars are to emancipate ourselves from this Procrustean bed, Noether is a fitting place to start, for recovered school reports from the Höhere Töchterschule in Erlangen, which she attended between 1889 and 1897, indicate something very different. As Auguste Dick notes, the young Noether was not singled out as particularly remarkable, and she was described by her teachers simply as “ein kluges, freundliches und liebenswertes Kind.”²⁹³ With mathematics generally reserved for boys’ schools, she was not formally taught the subject, but she proved to be a gifted linguist, passing English and French with great ease; in contrast, she failed *Haushaltsführung* somewhat spectacularly, with her instructors noting that she finished “ohne bleibenden Erfolg.”²⁹⁴ As was deemed more customary for educated young females in the German Reich, Noether was advised to work towards a career in language teaching, and she completed her training for this in 1900. Rowe and Koreuber suggest, however, that Noether had no intention of teaching and that she merely used the *Staatsprüfung* to obtain guest status at the University of Erlangen.²⁹⁵ Only with the expressed permission of the lecturers involved, Noether was able to audit lectures in history, languages and — for the first time — mathematics. When a change in Bavarian law in 1903 allowed for the full enrolment of women, Noether became a full-time student of mathematics. In 1907, under the supervision of the so-called “König der Invariantentheorie,” Paul Gordan, Noether completed a doctoral thesis that was essentially computational in approach, for she calculated over 300 distinct invariants of ternary biquadratic forms — a thesis she herself would later deride as “Mist” for its lack of generality and abstraction.²⁹⁶ Unable, as a woman, at this stage to progress to any higher academic grade, Noether continued to work on invariant theory in Erlangen for the first half of the 1910s, lecturing (unpaid) in place of her father when he became ill. During this time, her work became progressively more abstract, touching on ideas she would later develop in the 1920s, and she became acquainted with the work of eminent Göttingen mathematicians David Hilbert and Felix Klein. Indeed, Klein’s *Erlanger Programm* prompted Noether’s work on more abstract invariant theory. With a handful of publications winning Noether some name-recognition, her work soon caught the attention of Hilbert and Klein in particular. In the era of rapid advancements in physics, the Göttingen stronghold had been tasked with ironing out uncertainties in Einstein’s theories of relativity, with both Hilbert and Klein working on the

(Dordrecht, Heidelberg and New York: Springer, 2013), 234ff; and Samuli Siltanen, *Step into the World of Mathematics: Math Is Beautiful and Belongs to All of Us* (Cham: Springer Nature, 2021), 109ff.

²⁹³ Auguste Dick, *Emmy Noether, 1882-1935* (Boston: Birkhäuser, 1981), 11.

²⁹⁴ *Ibid.*

²⁹⁵ Rowe and Koreuber, *Proving It Her Way*, 16.

²⁹⁶ Renate Tobies, “*Aller Männerkultur zum Trotz*”: *Frauen in Mathematik, Naturwissenschaften und Technik* (Frankfurt am Main: Campus Verlag, 2008), 56.

problem of energy conservation in Einstein's equations of gravitation. At an impasse and struggling to comprehend this aspect of Einstein's work, they invited Noether to Göttingen for assistance in 1915, given her expertise in invariant theory. As Yvette Kosmann-Schwarzbach explains, Noether was quickly able to master the material that confounded her academic superiors and reframe in such a way that was comprehensible to them.²⁹⁷ She not only resolved the lingering energy problem; she also discovered a theorem that has been lauded as a groundbreaking feat of creative and abstract thought. While she proved it in 1915, Noether published the result, which is now known as "Noether's theorem," in a playfully named paper "Invariante Variationsprobleme" in 1918. Put simply, the theorem situates symmetry at the heart of all physical processes, with symmetry understood as the invariance of a given property during a transformation. A profound feature of Noether's theorem is its unusual abstractness and broad remit in physics, a science of specifics: its scope spans not just the Newtonian mechanics of classical physics but also the nascent developments of quantum theory in modern physics, deriving the conservation of charges in certain sub-atomic particles. Further applications of her theorem are still being discovered to this day.²⁹⁸ Noether's theorem underlines, in short, with a striking degree of breadth, inherent continuities within processes of change. As Leon Ledermann and Christopher Hill remark, the theorem runs "as deeply into our psyche as the famous theorem of Pythagoras."²⁹⁹

Noether's feats in Göttingen were not, however, met with professional security: despite the best efforts of Klein and Hilbert to secure for her the role of a *Privatdozentin*, the faculty board protested at the thought of a woman in their ranks, provoking Hilbert's famously ill-tempered retort at the board meeting: "Meine Herren, wir befinden uns an einer Universität nicht in einer Badeanstalt!"³⁰⁰ After some negotiation, Noether was permitted only to lecture unpaid under Hilbert's name in Göttingen — as an assistant — and she survived frugally from a small inheritance left by a relative.³⁰¹ Despite her uncommon aptitude in the field of physics, Noether, like Hausdorff, turned her back on the empirical sciences. Instead, she found a home in the

²⁹⁷ Yvette Kosmann-Schwarzbach, *The Noether Theorems: Invariance and Conservation Laws in the Twentieth Century*, transl. Bertram E. Schwarzbach (New York, Dordrecht, Heidelberg and London: Springer, 2010), 65.

²⁹⁸ It states that for any mathematical symmetry, i.e., an invariance, in a physical system, one can derive a corresponding conservation law. For example, if a physical process is symmetric with respect to time — "time invariance" — which is to say it is unaffected by the passage of time, the corresponding conserved quantity is the total energy of the system. In essence, one derives the conservation law of energy. For a full translation and detailed analysis of Noether's theorem (and her other findings from this time), see Kosmann-Schwarzbach's *The Noether Theorems*, in which she also charts the reception of the theorem and the belated recognition of Noether's role.

²⁹⁹ Leon M. Ledermann and Christopher T. Hill, *Symmetry and the Beautiful Universe* (New York: Prometheus Books, 2008), 21.

³⁰⁰ Cited in David Rowe, "The Göttingen Response to General Relativity and Emmy Noether's Theorems," in *The Symbolic Universe: Geometry and Physics 1890-1930*, ed. Jeremy Gray (Oxford: Oxford University Press, 1999) 197.

³⁰¹ *Ibid.*

abstract study of algebraic structures, which is known as “modern” or “abstract” algebra and sits alongside topology as a flagship subdiscipline within modern mathematics. Common in secondary-level mathematics classrooms, classical algebra is concerned with the computation of unknowns — “finding x ” — in systems of equations. Arising from the studies of the algebraic structure of groups discussed earlier (see footnote 67 on page 43), abstract algebra, on the other hand, tries to uncover the processes at play *beneath the surface* of such computations.³⁰² A topic thus rooted in the very objective that Noether demonstrated most profoundly in her theorem, namely *generality*, abstract algebra systematises and generalises mathematical symmetries, i.e. invariance, with certain algebraic structures.



Figure 1.4: Emmy Noether on the way to Königsberg, 1930³⁰³

³⁰² Familiar functions like addition ‘+’ and multiplication ‘ \cdot ’ are generalised to some arbitrary operation ‘*’ on arbitrary sets, and the algebraist explores sets and operations, by which, for example, an operation on any two elements of a set produces another element of that set. An increasing list of restrictions, such as an identity element, i.e., an element that has no effect on others when composed with it by some operation, yield more specific structures: groups, rings, fields and ideals etc. For example, when one takes the set of even numbers, any addition or multiplication of two members will yield another member of that set, i.e., another even number. Charles Pinter calls this “the lofty perspective” when looking at operations, for the mathematician is no longer concerned about what the exact operation *is*, but rather how operations between sets work more generally. Charles Pinter, *The Book of Abstract Algebra* (New York: Dover, ²1990), 19.

³⁰³ Taken by colleague and friend of Noether’s, Helmut Hasse, reproduced in Mechthild Koreuber, *Emmy Noether, die Noether-Schule und die moderne Algebra: Zur Geschichte einer kulturellen Bewegung* (Berlin and Heidelberg: Springer Spektrum, 2015), 303.

In the wake of the First World War and collapse of the *Kaiserreich*, the easing of restrictions for women in the Weimar Republic allowed for Noether's return to Göttingen as an *außerordentliche Professorin* in 1922, for which she initially received a small stipend before securing a proper (but nonetheless moderate) teaching salary in 1923. This point marks the beginning of her most productive period as a working mathematician, discovering new algebraic structures and leading what became informally known as the “Noether-Schule” of modern algebra — a collection of fervent students with whom she pioneered many remarkable results. For its conceptual-structural approach, this facet of mathematics soon took on the name *begriffliche Mathematik*, which is nicely captured by Dutch algebraist Bartel van der Waerden, one of Noether's most successful students, in a description of her work contained in his textbook *Moderne Algebra*³⁰⁴ of 1935:

Die Maxime, von der sich Emmy Noether immer hat leiten lassen, könnte man folgendermaßen formulieren: Alle Beziehungen zwischen Zahlen, Funktionen und Operationen werden erst dann durchsichtig, verallgemeinerungsfähig und wirklich fruchtbar, wenn sie von ihren besonderen Objekten losgelöst und auf allgemeine *begriffliche* Zusammenhänge zurückgeführt sind. [...] Sie konnte nur in *Begriffen*, nicht in Formeln denken, und darin lag gerade ihre Stärke.³⁰⁵

With the deliberations on the rise of modern mathematics of this chapter, it is easy to recognise just how modern this all is: *begriffliche Mathematik* functions, to use Hausdorff's terms, with recourse to the “Spielraum des Denkens” alone. Any kind of empiricism or even *Anschauung* through which it may be filtered is clearly not in consideration.³⁰⁶

Although she is remembered primarily for this work in modern algebra, Noether's penetrating mind illuminated a pathway to unifying disparate new areas of mathematics. From the descriptions of Noether's work, a convergence on the main ideas behind topology is evident, i.e. the central role of invariance within processes of change. Such a connection was, however, far from obvious in the developmental stages of these fields and remained unrealised until Noether began in the late 1920s to collaborate with Russian topologist Pavel Alexandrov, whom she quickly befriended.³⁰⁷ Alexandrov, who recorded much of his collaboration with Noether,

³⁰⁴ Koreuber describes van der Waerden's text as effectively “das Manifest der Noether-Schule.” Koreuber, *Emmy Noether*, xiv.

³⁰⁵ Bartel van der Waerden, “Nachruf auf Emmy Noether,” *Mathematische Annalen* 111 (1935): 469-476, here 469. Cited in Koreuber, *Emmy Noether*, 6.

³⁰⁶ In an attempt to better ground this term, Koreuber draws upon Ernst Cassirer — a “Zeitzeuge” of the mathematical crisis of foundations — and his differentiation between two forms of concepts and their formation in *Substanzbegriff und Funktionsbegriff* of 1910. Koreuber, *Emmy Noether*, 83ff. This connection proves to very useful for the purposes of this thesis and will resurface in Chapter 5 and its discussion of Dadaism.

³⁰⁷ Her trips to Russia are often credited for her turn to pacifism and Marxism, which caused Noether trouble in her own lodgings. The pair also consulted Amsterdam-based Brouwer, the bothersome figurehead of intuitionism, who is best known for his own work on fixed-point theorems — yet another manifestation of invariances within transformative processes. Cf. Rowe and Koreuber, *Proving It Her Way*, 36; and Plotnitsky, *Logos and Alogon*, 216f.

notes that she was quick to notice the underlying overlap with her own research and soon suggested re-examining topology through the lens of algebraic structures, triggering the genesis of *algebraic topology* and uniting two strands of mathematics under a common banner.³⁰⁸ As Rowe explains, Alexandrov became something of a “mediator” between Hausdorff and Noether,³⁰⁹ with Hausdorff, on the back of the new algebraic influence in his field, joking in a letter: “Ich muss wohl doch auf meine alten Tage (ich werde wirklich am 8. Nov. 60 Jahre alt!) Topologie lernen.”³¹⁰ This remark, however flippant, is testament to the scale of impact of Noether’s thought processes: just like her breakthrough in physics, Noether’s fresh perspective and capacity to see common ground ushered in a remarkable growth in the discipline of modern mathematics. Perhaps more than any other modern mathematician, Noether thus came the closest to occasioning what might provocatively be called a *Gesamtkunstwerk* of modern mathematics, a “different kind of beauty” not unlike Woolf’s “whole of shivering fragments,” cited at the opening of this chapter.

With her Göttingen period interrupted only by two guest professorships in Frankfurt am Main and in Moscow at the end of the 1920s, Noether’s diligence in Germany’s most distinguished school of mathematics led to what is regarded by many as the crowning achievement in her career: in 1932, Noether was invited to give a plenary lecture at the International Congress of Mathematicians (ICM) in Zurich — the first time in the congress’s history that a woman held an address.³¹¹ While only another “first time” in a sequence of them for Noether, given the ICM’s position as the most prestigious and impactful platform for mathematical research to this day, the significance of this moment cannot be overstated. As her colleague Hermann Weyl later recalled, she henceforth became known by the grammatically masculine moniker “der Noether” in her professional circle — a nod, “in ehrfürchtigem Spott,” to her ballooning status in the mathematical community.³¹² A moment of relaxation during the ICM, a steamboat cruise, is one of the few photographs of Noether in existence:

³⁰⁸ Koreuber, *Emmy Noether*, 270ff.

³⁰⁹ Rowe, *Mathematician Extraordinaire*, xx.

³¹⁰ Cited in Koreuber, *Emmy Noether*, 278.

³¹¹ It was not until 1958 that the second woman, Karen Uhlenbeck, would be a plenary speaker at the congress, this time in Kyoto. See Guillermo Curbera, *Mathematicians of the World, Unite!: The International Congress of Mathematicians — A Human Endeavor* (Wellesley, Massachusetts: A.K. Peters Ltd., 2009), 97.

³¹² Reproduced in Herman Weyl, “Nachruf auf Emmy Noether,” *Scripta Mathematica* 3 (1935): 201-222, here 205. Cited in Koreuber, *Emmy Noether*, 3. More recent biographers have rightly problematized the implied prejudices in Weyl’s nickname, and indeed Weyl is also partly responsible for the inappropriate focus on Noether’s physical appearance in many scholarly works, as many of his discussions of Noether include remarks on her “inelegant” and “unfeminine” appearance and manner. See Koreuber, *Emmy Noether*, 47f.



Figure 1.5: Emmy Noether in Zurich, 1932³¹³

In this most productive and illustrious period, Noether's career was brought to an abrupt halt. Alongside many Jewish academics in the wake of 1933 and the rise of German Nazism, Noether was removed from her lecturing post, which, as Rowe and Koreuber note, she accepted with a characteristic level-headedness, expressing more concern for other colleagues in the same predicament.³¹⁴ Undeterred from her mathematical work, Noether led a covert study group on algebraic field theory in her living room until she secured passage to Bryn Mawr College, a women's liberal arts university in Pennsylvania.³¹⁵ Finding at last financial security in the well-supported and welcoming scientific community in the US, Noether lectured at Bryn Mawr until her untimely death — at the age of 53 — in 1935, a mere eighteen months after her appointment, due to unexpected complications from routine surgery on an ovarian cyst. On 4th May 1935, a moving obituary was published in *The New York Times* by none other than fellow intellectual refugee Albert Einstein, who was uniquely familiar with the fruits of Noether's distinctive way of thinking. Here, the creative flair of her mathematics is expressed in explicit terms:

³¹³ Reproduced in Curbera, *Mathematicians of the World, Unite!*, 97. As Curbera notes, the image is archived at the ETH-Bibliothek Zürich.

³¹⁴ Noether wrote to Helmut Hasse of her concern for her Jewish colleagues who did not have the (very limited) safety net of a family inheritance like she did. Rowe and Koreuber, *Proving It Her Way*, 159.

³¹⁵ A common story told by her biographers is that, when a certain student arrived for one of these sessions in his SA uniform, she took little notice and even joked about it later. Dick, *Emmy Noether*, 76.

Within the past few days a distinguished mathematician, Professor Emmy Noether, formerly connected with the University of Göttingen and for the past two years at Bryn Mawr College, died in her fifty-third year. In the judgment of the most competent living mathematicians, Fräulein Noether was the most significant creative mathematical genius thus far produced since higher education of women began. [...] Pure mathematics is, in its way, *the poetry of logical ideas*. One seeks the most general ideas of operation which will bring together in simple, logical and unified form the largest possible circle of formal relationships. In this effort toward logical beauty spiritual formulae are discovered necessary for the deeper penetration into the laws of nature.³¹⁶

With Einstein's suggestion that Noether's pure mathematics be viewed as the "poetry of logical ideas," we have surely, in a neat rotational symmetry of our own, come full circle: for Noether, one of these "genuine artists, investigators and thinkers,"³¹⁷ mathematics is an art, not a science. Curiously, it is (once again) an acclaimed scientist like Einstein who observes this nature of mathematics most sharply.

To round off, the particular focus on Emmy Noether's unusually extensive role in the propulsion of modern mathematics, serves as a convenient measure of how far-reaching the characterisation of space that this thesis uses to probe both modern mathematics and its possible cultural *Doppelgänger* really is. While Hausdorff is somewhat unique in his engagement with and direct inspiration from Nietzsche's remarkably non-mathematical philosophy, the two tenets of *Raum* in modern mathematics distilled therefrom are of much broader pertinence: the *Transformationsprinzip* and the wider "Spielraum des Denkens" occasioned by a spatial *Gegenstandsproblem*. A form of mathematics imagined as "eine gewisse freie Schöpfung unseres Denkens" and that hosts a wide-ranging yet distinctive concern for invariance throughout (spatial) transformation is certainly alive, well and thriving in the 1920s and early 1930s, with its level of productivity reaching an almost breath-taking pace in Noether's unconventional Göttingen "Schule." This was, of course, not lost on Noether herself, who is ultimately not that surprised by the sudden disciplinary spread of her ideas. She remarks: "Meine Methoden sind wirklich Methoden des Arbeitens und Denkens; deshalb haben sie sich überall anonym eingeschlichen."³¹⁸ With that, the task ahead with the following chapters might be more concisely rendered: they must demonstrate that Noether, with the self-assessment of her uniquely broad range of impact, may have been correct to an extent far beyond even that which she envisages here.

³¹⁶ Albert Einstein, "The late Emmy Noether," *The New York Times*, May 4, 1935, 12.

³¹⁷ *Ibid.*

³¹⁸ The phrase was written by Noether in a letter to Hasse (1931). Cited in Koreuber, *Emmy Noether*, 71.

2

Turning Topologically

Rethinking *Verwandlung* with F.W. Murnau's *Der letzte Mann* (1924)

“Invariantentheorie ist jetzt hier Trumpf.”¹

— Emmy Noether

In the Polish Nobel Prize winner Olga Tokarczuk's *Flights* of 2007, the autofictional narrator dwells on the injurious nature of travel literature and guidebooks: “Describing something is like using it — it destroys; the colours wear off, the corners lose their definition, and in the end what's been described begins to fade, to disappear. This applies most of all to places.”² Having “debilitated places, pinning them down and naming them, blurring their contours,” guidebooks have consequently “ruined the greater part of the planet,”³ which Tokarczuk's narrator then relates to the so-called Paris Syndrome that famously plagues disappointed Japanese tourists to the French capital, upon the discovery that it is not the romantic utopia portrayed in popular culture. To combat this destruction via description, the narrator recommends: “It's better not to use names: avoid, conceal, take great caution in giving out addresses, so as not to encourage anyone to make their own pilgrimage.”⁴ In a sense, the only ethical way to represent places, to describe them in writing, is to step back from the anthropological specificities of *places* altogether. In his discussion of their precise inverse, “non-places” — the transitory sites of supermodernity, like airport terminals, that are often negotiated by Tokarczuk's itinerant narrator — Marc Augé defines these specificities as “identity, relations and history”⁵. With the loss of unique cultural and historical markers of *place*, the settings for much of *Flights* perhaps recede therefore into the much more unstable and abstract realm of *space*.

Yet, the writing of place is not an entirely lost cause for Tokarczuk's narrator, despite her remark one aphorism later that “no books age quite so quickly as guidebooks, which is in fact quite the

¹ Taken from a letter to Ernst Fischer, Noether's remark is the title of Cordula Tollmien's article “Invariantentheorie ist jetzt hier Trumpf: Hundert Jahre Noether-Theoreme,” *Physik in unserer Zeit* 49, no. 4 (2018): 176-182.

² Olga Tokarczuk, *Flights*, trans. Jennifer Croft (London: Fitzcarraldo Editions, 2007), 75.

³ *Ibid.*

⁴ *Ibid.*

⁵ Marc Augé, *Non-Places: An Introduction to the Anthropology of Supermodernity*, transl. John Howe (London and New York: Verso, 1995), 52.

blessing for the guidebook industry.”⁶ She still remains faithful to two texts for their “real passion and a genuine desire to portray the world”: the first is an eighteenth century essay by a Polish Catholic priest, Benedykt Chmielowski, which features “strange and wonderful persons of the world” with alleged bodily deformities, and the second, which is mentioned in a throwaway line at the end of the passage, is Herman Melville’s 1851 adventure epic *Moby-Dick; or, The Whale*.⁷ Let us pick up, for a moment, where Tokarczuk finishes. In the twelfth chapter of Melville’s text, the narrator, Ishmael, remarks upon the South Pacific origins of the ship’s harpooner Queequeg, the first major character he encounters: “Queequeg was a native of Rokovoko, an island far away to the West and South. It is not down in any map; true places never are.”⁸ Ishmael’s short philosophical musing on the tenuous correspondence between cartographical maps and the physical spaces they claim to represent is, of course, not an uncommon one, least of all the in studies following the so-called “spatial turn” across many disciplines in the latter half of the 20th Century.

In her landmark 2002 survey of what she calls the “topographical turn,” cultural analyst Sigrid Weigel opens with the discussion of a “Kartenstreit” involving the *Waldseemüller-Karte*, fashioned on 12 woodcuts by the German cartographer Martin Waldseemüller in 1507, on which the name “America” appears for the first time to demarcate the “neu entdeckten Territorien.”⁹ Viewed in the USA as the “Geburtsurkunde Amerikas,” the map becomes something of a “geographischer Taufschein” and is thus a founding document of American cultural heritage, despite the amusing fact that, as Weigel explains, this name is based on an error.¹⁰ This is of course not to mention the glaring problem with the name “newly discovered territories” and the idea of a geographical baptism in the first place, which further erases the historical presence of indigenous communities on the American continent. Conversely, the German claim rests on the map’s inclusion on the “Liste des geschützten deutschen Kulturgutes,” thus testifying to the German “Fortschrittsgeschichte naturwissenschaftlich-technischen Wissens.”¹¹ This curatorial quarrel, in short, turns the familiar problem of the map and the territory, the disconnect between the space represented and the representation itself, into a quasi-legal question concerning the rights to a significant cultural artefact. Although Weigel’s brief assessment of the spatial turn has become one of the more influential sources for scholars exploring the role of space in art and

⁶ Ibid., 76.

⁷ Ibid.

⁸ Herman Melville, *Moby-Dick; or, The Whale* (New York: Harper and Brothers Publishing, 1851), 61.

⁹ Sigrid Weigel, “Zum ‘topographical turn’. Kartographie, Topographie und Raumkonzepte in den Kulturwissenschaften,” *KulturPoetik* 2, no. 2 (2002): 151.

¹⁰ Ibid., 151f. Waldseemüller erroneously assumed that Amerigo Vespucci, and not Christopher Columbus, made the “discovery” and in later versions removed the name. Ibid., 152.

¹¹ Ibid.

culture, a focus on topography — the study of the features of *place* — would, however, point in a very different direction than the one that establishes a fruitful dialogue with modern mathematics. As was outlined previously, the unique spatial insights of modern mathematics evolved without any explicit or implicit reference to physical, material space. Fortunately, the topographical approach is not the only one in cultural analysis.

Topology and Text

In a 2009 article, German spatial theorist Stephan Günzel juxtaposes what he views as different “Raumparadigmen” that are often referred to collectively as the “spatial turn,” namely Weigel’s “topographical turn” and another, more mathematically oriented “topological turn.”¹² Taking care to clearly separate the two, Günzel frames Weigel’s topographical turn as probing “Fragen der Konstruktion von Raum als einem territorialen und historischen Gebilde,” thus situating her predilection for maps within an explicitly cartographical concern of “Raumvermessung”¹³ for political analysis. He writes: “In erster Linie hat Weigel dabei die Kartographie selbst vor Augen und damit sowohl den medialen Status von Karten als auch die politische Macht, welche Kartographen in ihrer Beschreibung der Welt auszuüben in der Lage sind.”¹⁴ Moreover, with a concern for the “Räume des Wissens,” i.e., the spatialities of medical laboratories and analysis rooms, studied by thinkers like Bruno Latour and Steven Woolgar, for the topographical turn, “geht es somit vordringlich um Kontingenz.”¹⁵ This association with contingency, with perhaps unpredictable change of material space, is very important, for it prepares a clear distinction between Weigel’s topographical turn and the topological one. Suggesting that critics who speak of the “spatial turn” are largely engaging with the former, in an opening explication of the latter, Günzel adopts a stance that perhaps mirrors Tokarczuk’s proposed retreat from definitive spatial markers in *Flights*, albeit for very different reasons. He explains: “Die *topologische Wende* zeichnet sich dadurch aus, dass sie sich nicht dem Raum zuwendet, wie dies dem *spatial turn* nachgesagt wird, sondern sich vielmehr vom Raum *abwendet*, um Räumlichkeit in den Blick zu nehmen.”¹⁶ While a curious turn of phrase, Günzel is correct in the modern-mathematical sense: the real, empirical space is cast aside in the topologist’s analysis of spatiality. Building to a concise outline of the main thrust of topological thinking, Günzel writes:

¹² Stephan Günzel, “Spatial Turn-Topographical Turn-Topological Turn” in *Spatial Turn: Das Raumparadigma in den Kultur- und Sozialwissenschaften*, ed. Jörg Döring and Tristan Thielmann (Bielefeld: Transcript, 2009), 219.

¹³ *Ibid.*, 223.

¹⁴ *Ibid.*

¹⁵ *Ibid.*

¹⁶ *Ibid.*, 221.

Diese Charakterisierung könnte allerdings einem Missverständnis Vorschub leisten, denn Topologie hat es nicht mit der Transformation des Raumes als solchem zu tun, sondern vielmehr mit dem, was sich trotz einer Transformation *nicht* verändert: Eine topologische Beschreibung weist zunächst nicht auf Veränderung hin, sondern auf *Gleichbleibendes*.¹⁷

From the focus on Hausdorff/Mongré in the previous chapter, this is all very familiar territory. Unlike the contingency that reigns over the topographical turn, topological analysis is governed by its counterpart, by “*Gleichbleibendes*” within wider processes of transformations, which allows for a space to be considered in essence the same — despite any scale of stretching, compressing or deforming — if the structural neighbourhood relations on the inside and the outside remain intact. While Günzel makes no direct mention of the modern mathematical thinkers behind the field he is discussing,¹⁸ his indebtedness to Felix Hausdorff and *Grundzüge der Mengenlehre*, the chief architect of topology and his blueprint, is clear from his (perfectly valid) description of “Nachbarschaftsbeziehungen,” which reflects Hausdorff’s innovative way of defining topological spaces via “Umgebungen” in 1914.

Günzel’s restraint in detailing the mathematical origins of his *Wende* in the 1910s and 1920s has evidently not hampered his understanding of their insights. Nevertheless, a glance at that inaugural lecture of the immediately post-Mongré Hausdorff, namely “Das Raumproblem” of 1903, would help ground the development of Günzel’s own theory; in response to Weigel’s focus on cartography, he likewise foregrounds the role of the diagrammatic *Karte*, in this case using the map of the London Underground (see below in Fig. 2.1). Unlike the cartographical map, “Diese Illustrationen sind keine Repräsentationen mehr: Sie erhalten keine Informationen über die topographische Beschaffenheit eines Geländes oder seine räumliche Ausdehnung, sondern über topologische Lagebeziehungen.”¹⁹ Presaged, of course, by Hausdorff’s musings on maps in “Das Raumproblem,” this grounds Günzel’s observation that topology actually *withdraws* from space to better isolate spatial properties: the discussion of territory recedes into the background, and the question as to the relationship between the map and the territory shifts to one of mapping procedures themselves. In short, the map is considered relative to other maps, not an unknowable terrain depicted therein. In a neat inversion of Queequeg’s uncharted homeland of Rokovoko in *Moby-Dick*, a territory with no corresponding map, Hausdorff’s “Spielraum” of pure mathematics and indeed the topological turn announced by Günzel

¹⁷ Ibid., 222. He continues: “Veranschaulichend gesprochen, besagt der Grundgedanke der Topologie, dass, gleich wie stark ein Körper vergrößert oder deformiert wird – wie etwa ein Luftballon, der aufgeblasen wird –, sein variables Volumen in topologischer Hinsicht keine Rolle spielt. Solange der Körper oder seine Hülle nicht zerstört wird bzw. Risse bekommt, sind die Nachbarschaftsbeziehungen der Orte auf der Außen- wie auch der Innenseite unveränderlich.” Ibid.

¹⁸ The closest he comes is in a brief reference to French philosopher Alain Badiou’s (not uncontroversial) use of set theory in *Being and Event*. Ibid., 226.

¹⁹ Ibid., 226.

become, in a sense, a set of maps that are devised without a stable link to corresponding territories. We go, in a sense, from Melville's uncharted territories to topology's unterritorialized charts.

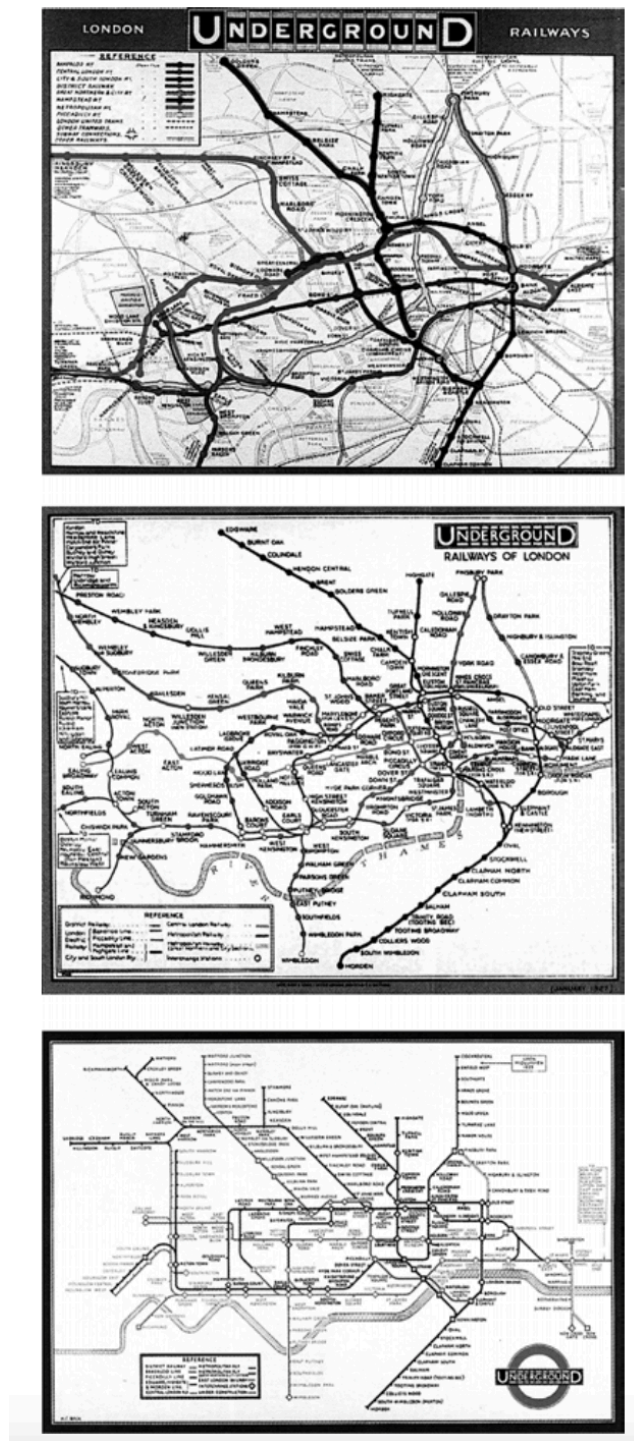


Figure 2.1: Three maps of the London Underground system²⁰

²⁰ Jeremy Black, *Maps and Politics* (London and Chicago: University of Chicago Press, 1997), 49. Reproduced in Günzel, "Spatial Turn-Topographical Turn-Topological Turn," 227.

To get a sense of Günzel's posited topological turn, it is worth briefly considering his suggested protagonists. While he refrains from discussing their topological leanings at great length, Günzel principally sees the structural approach to spatiality as being exemplified by, one might say, the usual suspects: Michel Foucault, Giorgio Agamben, Gilles Deleuze and Felix Guattari, and Jacques Lacan. For example, Günzel views Agamben's expansive project on the *homo sacer* as essentially set-theoretical in approach, for it is principally concerned with spaces, such as "the City," that are generated by a function of interiority (and thus exteriority) alone.²¹ "In Western politics," Agamben writes, "bare life has the peculiar privilege of being that whose exclusion founds the city of men,"²² which he illustrates via the figure of the *homo sacer*, the being "who may be killed and yet not sacrificed" in a ritual ceremony.²³ Serving itself as a function that delineates spatial interiority, the inherent "state of exception" of the *homo sacer* is actually "the hidden foundation on which the entire political system rest[s]."²⁴ Here is not the place to further explore exactly how these philosophers engage with questions of a topological nature — some interesting (and indeed controversial) studies have already been undertaken in this regard.²⁵ Rather, it is more important to reflect upon how Günzel, without much reflection of his own, is quick to undercut the possibility of the topological turn finding relevance in literary analysis when he states: "Es sind maßgeblich Bilder und weniger Texte, welche die Kapazität besitzen, topologische Relationen und Strukturen zum Ausdruck zu bringen."²⁶ Although Günzel is no less than astute in his analysis of such "Bilder" in his chapter — focussing, for example, on Foucault's panopticon — this claim clearly runs counter to the task of this chapter (and indeed of this thesis as a whole). As such, this dismissal cannot go unchecked.

If the topological turn, even according to Günzel's definition, spurns measure and proportion in order to probe structurally invariant properties that run counter to processes of change, there surely is no logical reason why text, or *narrative* more broadly, is less capable of articulating these spatial ideas. If anything, a mathematician aware of the history of the spatial developments that led to mathematical modernisation would know that this ran parallel to a general *decline* in confidence of the capacity for diagrams to accurately convey often counter-intuitive, highly

²¹ Günzel, "Spatial Turn-Topographical Turn-Topological Turn," 225f.

²² Giorgio Agamben, *Homo Sacer: Sovereign Power and Bare Life*, transl. Daniel Heller-Roazen (Stanford: Stanford University Press, 1998), 7.

²³ *Ibid.*, 8.

²⁴ *Ibid.*, 9.

²⁵ See, for example, Ellie Ragland and Dragan Milovanovic (eds.), *Lacan: Topologically Speaking* (New York: Other Press, 2004) for an edited collection of essays on Lacan's famous deployment of topological language. Indeed it was partly the (perceived) misappropriation of topological terms, here the compact topological space, in the works of Deleuze and Guattari that prompted Alan Sokal's scandalous hoax article, an incident now known as the "Sokal Affair."

²⁶ Günzel, "Spatial Turn-Topographical Turn-Topological Turn," 230.

abstract problems posed in mathematical *language*.²⁷ Indeed, it is for this reason that diagrams and visualisations in Hausdorff's *Grundzüge der Mengenlehre*, for example, are actually few and far between. Even with this knowledge alone, Günzel's claim can clearly be identified as a misstep; is there such a thing, therefore, as topological narrative? Firstly, it is a simple observation to note that many of Günzel's key theorists of the topological turn and their spatial ideas populate innumerable *literary* analyses carried out by researchers across the globe. Moreover, work carried out by a small (but not insignificant) number of literary scholars already attests to the baselessness of Günzel's unfortunate exclusion of non-diagrammatic modes of expression. For example, US-American narratologist Elana Gomel asks in *Narrative Space and Time: Representing Impossible Topologies in Literature* (2014) how writers across several genres and epochs have engaged (even obliquely) with non-Euclidean geometries and the related turn from a Newtonian conception of absolute space and time to a relativised Einsteinian one.²⁸ Using various physical and cosmological metaphors to denote "impossible topologies," including "wormholes," "embeddings," and "flickering," she ambitiously examines the work of Charles Dickens, H.G. Wells, Italo Calvino, Jorge Luis Borges, Neil Gaiman and George Orwell, among many others.²⁹ Then, in 2016, the late literary theorist Angus Fletcher published *The Topological Imagination: Spheres, Edges, and Islands* — his final scholarly work before his death in the same year. As was noted in the introduction to this thesis, Fletcher threads topological ideas (tracing them back to Euler's famous problem of the seven bridges of Königsberg) to human cognition of spherical spaces, edges and islands, positing that literary figures across time have drawn on such ideas to articulate their position (broadly imagined) on Earth. The pairing of topology and narrative, therefore, is not without precedent.

Building on these responses, therefore, this chapter seeks to more forcefully connect the central thrust of the topological turn to key moments of German aesthetic modernism, thus beginning the task of ascertaining common modes of expression (following the previous story of common

²⁷ For a thorough account of this, see Silvia De Toffoli, "What are Mathematical Diagrams?," *Synthese* 200, no. 1 (2022): 1-29.

²⁸ Elana Gomel, *Narrative Space and Time: Representing Impossible Topologies in Literature* (New York and London: Routledge, 2014).

²⁹ For its focus more on aspects that pertain to physics (questions as to the geometry of the universe) and the consideration of the temporal dimension, Gomel's text charts a different course to that of this thesis. In many ways it could be read as a more literary version of Linda Dalrymple Henderson's aforementioned study of visual art *The Fourth Dimension and Non-Euclidean Geometries in Modern Art* (1983). While highly interesting analyses are to be found in Gomel's work, her use of the term "impossible topologies" comes to be something of an overused stand-in for any spatial arrangement that is in some way counter-intuitive, and it is not entirely clear what the repeated assimilation of vocabulary from theoretical physics, e.g. "quantum disarray" add to her arguments beyond a surface level metaphor. In certain cases, many of her conclusions could be feasibly drawn without recourse to buzz-words from the sciences that have been popularised via science fiction, e.g. "wormholes." Nonetheless, her analysis certainly undermines Günzel's misguided remark above.

influence in Chapter 1) in modern mathematics and modern art and literature. This is to ask, in short, whether the first tenet of the *Raumkonzeption* of this thesis, i.e. a shift in spatial focus to the study of invariant properties within processes of transformation, makes itself known in German modernism. With respect to isolating a suitable case study for this investigation, however, the two sources cited above, the works of Gomel and Fletcher, are somewhat limited. Insightful as Fletcher's exploration is, due to its efforts to demonstrate *why* topological ideas should be discussed in a literary context, which is of course far from obvious, *The Topological Imagination* does not really amount to a demonstration of *how* to do this. This is indeed down to a practical issue of scope, but as a result, Fletcher's references to literary examples remain quite perfunctory (however plentiful). For example, while Fletcher stresses late in the book that Franz Kafka is to be considered "the ultimate topological author,"³⁰ he does so on the back of a very fleeting assessment:

Like the insurance expert he actually was, Kafka forces us through and beyond the domain of countable quantity, beyond the measurable, where even the idea of the incommensurable is beyond measure. [...] He sees what is critical about the finally ornamental Great Wall of China, whose laborers never finish their work but believe they are builders.³¹

While there are of course valid observations here, such as levels of contemplation that evade measurability, this is surely somewhat unsatisfying. Yet, Fletcher's suggestion of Kafka is still quite a helpful one. Surely, when searching for more a nuanced understanding of transformation, the low-hanging fruit takes the form of a very familiar spatial phenomenon that pervades literary and aesthetic modernism: metamorphosis. At a glance, of course, metamorphosis and invariance seem like unlikely theoretical companions. However, as was explained previously, the relationship between invariance and transformation is a mutually dependent one: abstract spaces (e.g. topological spaces) are made to *undergo* deformations with a view to isolating therein invariant spatial properties. Although a far-reaching survey of metamorphosis as an aesthetic phenomenon would be beyond the scope of this analysis, it suffices to note that the scholarly understanding of it does accommodate topological ways of thinking. In his overview, Kai Mikkonen, focusing heavily on Kafka's *Die Verwandlung* and the wide-spread theoretical deliberations it provoked, thus draws attention to a so-called "residue" that counterbalances the change function of metamorphosis:

What makes metamorphosis interesting as a trope is that when so thing turns 'metamorphically' into something else, some aspect or trace of the original always remains. Although in many modern metamorphosis stories the connection or continuum between the two things may be problematized or challenged, as Michel Foucault's study of Raymond Roussel shows, a sense of

³⁰ Fletcher, *The Topological Imagination*, 154.

³¹ Ibid.

the *residue of sameness* is necessarily maintained. In order for a change to be described as a metamorphosis, it requires a presupposition of the original form.³²

From the topological perspective, however, the idea of “residue of sameness” is more important than it may sound here, for the focus on what remains constant — invariant spatial properties — throughout transformations became in itself the conception of *Raum* in modern mathematics in lieu of an empirical or intuitive one. Turning to Gaston Bachelard’s extended work on metamorphosis, however, Mikkonen begins to pin down the topological maxim that transformations are just tools for uncovering something more fundamental. Noting how “Metamorphosis is the specific function of imagination in the comprehension and production of forms,”³³ he recites Bachelard’s turn of phrase: “imagination does not comprehend a form unless it transforms it.”³⁴ Even this cursory glance at Mikkonen’s stock-take of theories of metamorphosis, therefore, establishes that topological ways of thinking are not unique to the mathematical field alone.

In this light, this chapter will bring the topological leitmotif to bear on a paradigmatic example of Weimar cinema in the 1920s, namely F.W. Murnau’s *Der letzte Mann* of 1924, which has been cast by critical consensus as a showcasing of unrelenting change, transformation and metamorphosis, which manifests not only in the plot but in the *Kinoästhetik* that articulates it. Equipped with the mathematical insights of the topological turn, it will be argued that this characterisation in dominant criticism is ultimately misguided, which becomes most evident when the film is approached with an eye to continuities that, in true topological fashion, are revealed to lie within processes of transformation. To further ground these findings, certain elements of the prose texts by “ultimate topological author,” Franz Kafka, will be brought into conversation with *Der letzte Mann* and used as springboards to re-evaluate the very aspects of the film that are commonly linked to a narrative of unrelenting change. Reflecting upon the overarching aims of this thesis, having made the case for an instance of shared philosophical influence in Friedrich Nietzsche, this chapter thus begins the process of examining commonality of spatial expression in modern mathematics and aesthetic modernism.

³² Kai Mikkonen, “Theories of Metamorphosis: From Metatropé to Textual Revision,” *Style* 30, no. 2 (1996): 310. Emphasis added.

³³ *Ibid.*, 313.

³⁴ *Ibid.*

Murnau's *Der letzte Mann*

While 1922 can now be viewed from a cross-disciplinary perspective as a landmark year for modernism, marking both the release of James Joyce's *Ulysses* and Emmy Noether's overdue promotion at Göttingen's hub of modern mathematics, it was not a good year for businessman Enrico Dieckmann and occultist-cum-set designer Albin Grau, the co-founders of Prana Film GmbH. The short-lived production company, founded in 1921, folded dramatically following the release of its only film, the now cult horror *Nosferatu, eine Symphonie des Grauens*, directed by Friedrich Wilhelm Murnau, when Bram Stoker's estate took legal action against a perceived copyright infringement.³⁵ Despite his entanglement in the bankruptcy, Murnau's career as a director did not follow the fate of his chilling antagonist, the vampire Count Orlok, by going up in smoke. Recruited by the eminent production firm UFA, Murnau would direct *Der letzte Mann* in 1924 and two other literary adaptations *Herr Tartüff* in 1925 and *Faust* in 1926, cementing his reputation in Germany before his departure to Hollywood that very year. Under the Fox Studio banner, he directed the 1927 film *Sunrise: A Song of Two Humans*, which, despite being a financial disappointment, won several categories in the very first Academy Awards ceremony in 1929. Following two largely unsuccessful "talkies," Murnau travelled to Bora Bora to film the "docufictional" *Tabu* — a silent film — with American documentary maker Robert J. Flaherty. Murnau did not witness its release in 1931, for he died shortly after a serious car crash in California one week before the film's premiere.³⁶

Although Murnau's reputation in popular culture is largely to be attributed to the (oc)cult status of his plagiarised *Nosferatu*,³⁷ the technical impact of his work in cinema history is most often associated with *Der letzte Mann*, which is acknowledged as a pioneering example of modern camerawork. With the Austrian photographer Karl Freund as the chief cinematographer, the film is the germinal example of the "entfesselte Kamera" technique, a term coined by Lotte Eisner in *Die dämonische Leinwand* in 1955³⁸ to describe a freely moving camera that facilitates the now ubiquitous use of tracking shots and pan shots.³⁹ This innovative use of the camera in turn

³⁵ For a discussion of *Nosferatu*'s production in historical context, alongside an account of the bankruptcy case and how the film survived it (despite the legal order to destroy any copies), see Kevin Jackson, *Nosferatu (1922): Eine Symphonie des Grauens* (London: Bloomsbury, 2018). See also Raymond T. McNally and Radu Florescu, *In Search of Dracula: The History of Dracula and Vampires* (Boston and New York: Houghton Mifflin Company, 1994), 169.

³⁶ For a detailed account of Murnau's life and work, see Lotte Eisner, *Murnau* (London: Seeker and Warburg, 1973). This monograph was first published by Eisner in French as *F.W. Murnau* (Paris: Le Terrain Vague, 1964).

³⁷ Murnau's grave was broken into and his skull stolen in a suspected occultist ceremony in 2015.

³⁸ Lotte Eisner, *Die dämonische Leinwand* (Frankfurt am Main: Fischer Taschenbuch Verlag, 1980), 96.

³⁹ Freund, like Murnau, departed for the USA in 1929 and later worked on *Dracula* (1931) and *Key Largo* (1948), with his camerawork securing his place in Hollywood. Citing film curator Iris Barry, Siegfried Kracauer writes: "Owing to such unique values, the German screen exerted world-wide influence, especially after the total evolution of its studio and camera devices in *The Last Laugh* (1924) and *Variety* (1925). 'It was the German camera work (in

enabled other distinguishing features of *Der letzte Mann*: in relying almost solely on what Murnau called “der frei im Raum zu bewegendende Aufnahmeapparat”⁴⁰ and the expressions or gestures of actors, he was able to virtually dispense with the traditional use of title cards for exposition — there are only two in the 90-minute film — and tell the story through visual means alone.⁴¹ Briefly summarised, *Der letzte Mann* (with screenplay by Carl Mayer) centres on the humiliation of an aging hotel porter, who proudly mans the door of the cosmopolitan Hotel Atlantic in his quasi-militaristic uniform, which earns him the respect of his neighbours and peers in his more working-class locality. When his increasing frailty prevents him from lifting the heavy trunk of a newly arrived guest, the manager swiftly demotes him to the role of a bathroom attendant and strips him of his regal uniform in exchange for a simple white work shirt. Incapable of withstanding the perceived loss of status, the porter resorts to stealing his old uniform for his walk home in order to elude exposure amongst his fellow residents of the tenements. Once the doorman’s attempts to keep up appearances are thwarted, he is ridiculed and rejected by his neighbours and family, falling into despair before a sudden and improbable change of fortune sees him inherit one. The film closes with his lavish enjoyment of the hotel’s restaurant, now as a wealthy guest, where he showers in luxuries the only other person who was sympathetic to him throughout, the lowly nightshift watchman. Surrounded by the extravagant comforts of the upper classes, the film’s final scene suggests that the old porter gets to relish what the title of the American version of the film promises, namely “the last laugh.”⁴² From this minimal plot outline alone, it is easy to observe the overarching theme of metamorphosis and transformation — it could perhaps even be claimed that some of the more sociological aspects of the plot, such as familial rejection and shame, are redolent of Kafka’s novella — which no doubt speaks to the relevance of the film to this chapter’s deliberations. Change, transformation and metamorphosis are writ large throughout *Der letzte Mann*, and this is made clear from the outset. Opening with one of the only two title cards (Fig. 2.2 below), the film essentially takes the

the fullest sense of that term) which most deeply impressed Hollywood.’ In a characteristic expression of respect, Hollywood hired all the German film directors, actors and technicians it could get its hands on.” Siegfried Kracauer, *From Caligari to Hitler: A Psychological History of German Film* (New Jersey: Princeton University Press, 1947), 4. Film historian Katherina Loew problematises the somewhat generalising term “unchained camera” and the credit often given to Murnau and Freund, noting that pans and tilts had been used in earlier cinematic works in France and the USA, and that tracking shots in particular are the novel feature in *Der letzte Mann* within the context of German cinema. Katherina Loew, *Special Effects and German Silent Film: Techno-Romantic Cinema* (Amsterdam: Amsterdam University Press, 2021), 231-244.

⁴⁰ Friedrich Wilhelm Murnau, cited in Fred Gehler and Ulrich Kasten, *Friedrich Wilhelm Murnau* (Berlin: Henschelverlag Kunst und Gesellschaft, 1990), 141. As is often mentioned in critical literature, Murnau and Freund resorted to strapping the camera onto a bicycle or fixing it to someone’s chest and having them walk around in order to achieve these effects. Eisner, *Murnau*, 155.

⁴¹ Cf. Eisner, *Die dämonische Leinwand*, 207.

⁴² Cf. Thomas Elsaesser, *Weimar Cinema and After: Germany’s Historical Imaginary* (London and New York: Routledge, 2000), 231.

Ovidian maxim that “nothing retains its form” as its point of departure, setting the spectator up for an imminent transformation:

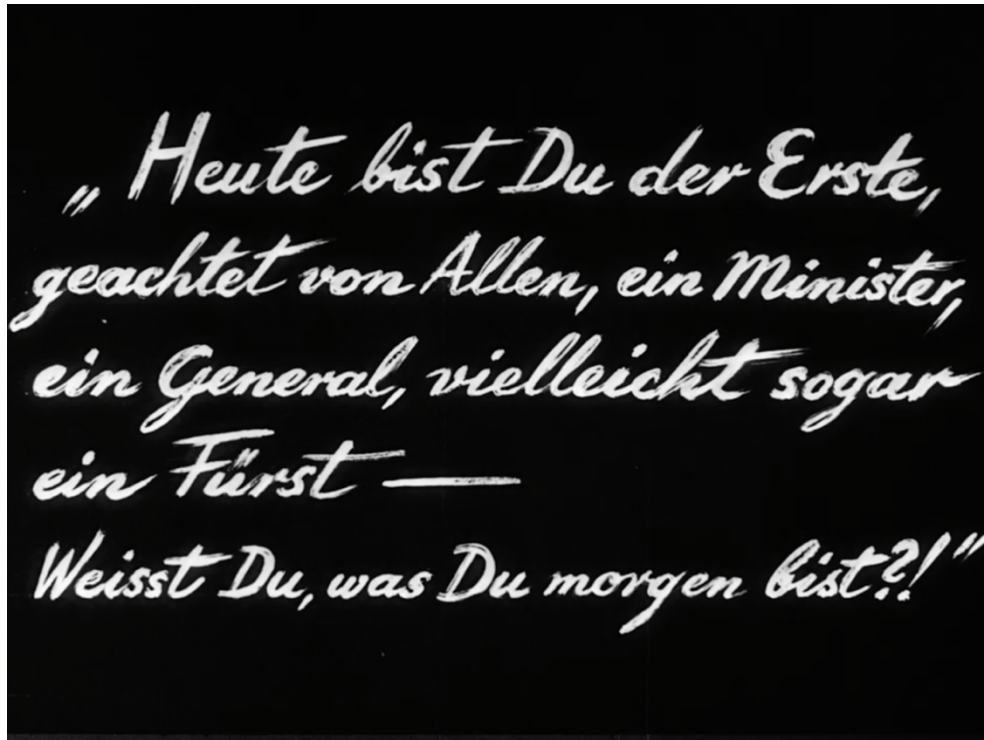


Figure 2.2: The opening caption from Murnau’s *Der letzte Mann*⁴³

With an ominous tone, this caption, considered alongside the film title, gestures rather unambiguously to an ensuing collapse in status, a fall to from the first to the last man, shattering any pretence of stability and continuity in the turbulent modern world.

As several critics have indicated, this sense of transformation and discontinuity is communicated on an aesthetic level by two key elements: the technical feat of the “entfesselte Kamera” and the omnipresent symbol of the hotel’s *Drehtür*, which the porter proudly governs at the beginning of the film. Murnau wastes little time in exposing the viewer to both of these aspects, for they enable the film’s opening sequence, which has become somewhat legendary in the history of cinematography for its capture of swift, sweeping movements. The camera-eye, at first in an elevator, descends into a bustling hotel lobby and, upon the elevator doors opening, pans through the room, light bouncing off its many reflective surfaces, to the revolving door on the façade of the hotel. It then then turns through the door and emerges onto the dark and stormy metropolitan streetscape to capture the busy hotel porter, battered by persistent rain, dealing with the luggage of some well-to-do new arrivals. As Eisner notes, Murnau’s “Einblick[e] in Räume voll hastender Bewegung, voll schwirrenden Lichts” in this opening

⁴³ *Der letzte Mann*, directed by F.W. Murnau (UFA, 1924), 00:01:32.

sequence achieves, on the back of the portable camera, “ein souveränes Fließen von Visionen zuwege, in denen Licht und Bewegung alles bedeuten.”⁴⁴ This sense of flow is then, according to Eisner, immediately translated into a symbol by way of the revolving door: “Das ewige Karussell der Drehtür, das der Portier mit so viel stolz dirigiert, und durch das er das Treiben der Ein- und Ausgehenden beherrscht, wird zum Sinnbild des verändernden und sich erneuernden Lebens.”⁴⁵

Eisner is not alone in her assessment of the inaugural act, for, as Siegfried Kracauer writes in his foundational work *From Caligari to Hitler*, the film “opens with a magnificent travelling shot showing the hotel guests streaming through the ever-turning door, a device employed time and time again until the very end — something between a merry-go-round a roulette wheel.”⁴⁶ For Kracauer just as much as Eisner, this initial pairing of the mobile camera and the spinning door superimposes an overarching sense of change and transformation that chimes with the opening caption, which itself serves as a roulette wheel of sorts. Siding very much with this enduring perspective, Habbo Knoch has concluded more recently that Murnau has “bereits in *Der letzte Mann* die moderne Beschleunigung des urbanen Raums in der Drehtür und in der Kameraführung versinnbildlicht [...],” which, in short, gives voice to “eine krisenhafte gesellschaftliche Obsession mit Bewegung, Veränderung und Verwandlung.”⁴⁷ Unlike the perpetually turning *Drehtür*, the critical consensus on *Der letzte Mann* thus comes, in a sense, to a gentle rest: taken together, the two dominant aesthetic aspects of the film — the dynamic cinematography and the revolving door — articulate an all-encompassing sense of metamorphosis that reflects the film’s careening plot, and Murnau’s film is, from the outset, a dazzling display of motion, change and unsparing transformation. The punishing metamorphosis, the downward social *Bewegung* of the doorman, thus parallels an aesthetic that is, on the surface, informed by movement as well.

At this point, having taken stock of the canonical assessments of Murnau’s classic, it is now necessary to ask whether the topologist, equipped with a more nuanced conception of metamorphosis, might be tempted to stage an intervention. In light of the topological way of thinking, which recasts metamorphosis as a means to identify and isolate its own opposite, is the “krisenhafte gesellschaftliche Obsession mit Bewegung, Veränderung und Verwandlung” the end of the road with respect to *Der letzte Mann*? In an attempt to push the inert critical wheel

⁴⁴ Eisner, *Die dämonische Leinwand*, 191.

⁴⁵ *Ibid.*, 209.

⁴⁶ Kracauer, *From Caligari to Hitler*, 103.

⁴⁷ Habbo Knoch, *Grandhotels: Luxusräume und Gesellschaftswandel in New York, London und Berlin um 1900* (Göttingen: Wallstein Verlag, 2016), 363.

back into motion, I argue here that, for all the swift transitions and persistent turns, Murnau's *Der letzte Mann* is honeycombed with stubborn invariants that a more topologically cognisant perspective can help to unmask. Perhaps unexpectedly, this argument will hinge upon the very two elements that have been pinned onto the notion of unrelenting change and transformation in existing criticism, namely the gyratory *Drehtür* and the "entfesselte Kamera." By reconceptualising of these aspects as means to isolate invariant properties within broader processes of variation, a re-reading is encouraged that calls into question the characterisation of the film as a tale of inexorable and indiscriminate transformation. Again, it must be emphasised that this analysis by no means rejects the presence of change and transformation; rather, just like in the discourse of modern mathematics, metamorphosis itself can be utilised to detect the deeper, underlying structures that resist it. In effect, it will be shown that the modern mathematical way of perceiving metamorphosis is by no means distant from its expression in one of modern German cinema's great *Tragödien*. Throughout, this analysis will both draw upon and withdraw from Kracauer's and Eisner's canonical analyses of Weimar cinema, while leaning at times on more recent contributions to the field, such as Jo Leslie Collier's lesser known monograph *From Wagner to Murnau* (1988), Thomas Elsaesser's *Weimar Cinema and After* (2000) and Katharina Loew's fresh input in *Special Effects and German Silent Film* (2021), alongside Gaston Bachelard's reflections in *The Poetics of Space* (1958). As was signalled previously, this chapter will also consult the prose of "the ultimate topological author" Franz Kafka, so dubbed by Fletcher, to tease out by way of comparison this more subtle interpretation of the film. To ground this notion of invariance within transformation, particular reference will be made to relevant passages from *Die Verwandlung* and, to a lesser degree, *In der Strafkolonie*.

Rotations and Doors

Before suggesting a re-evaluation of the supposedly cataclysmic metamorphosis of *Der letzte Mann*, it is first necessary to question the confidence with which Kracauer and Eisner attribute to the revolving door and the mobile camera an uncompromising sense of transition and change. While the dizzying *Drehtür* of the hotel is indeed in constant motion, the latter is of a form that gestures just as much — if not more — to a sense of stasis as it does to transition. Although we as viewers may not need a Noetherian understanding of the relationship between rotational symmetry and angular momentum to appreciate it, the interdependency of transformation and invariance in the hotel's revolving door is informed rather intuitively by the very nature of circular motion and cyclicity. Let us consider the rotation of an equilateral triangle and a square, shown below in Fig. 2.3. The triangle is said to have *rotational symmetry*

when rotated every 120° either clockwise or anticlockwise about a centre point, for this generates an identical image, i.e. it is thus *invariant* or *symmetric* under such rotations. In mathematical terms, this is called *discrete symmetry*, which is to say that only 120° rotations (or multiples thereof) will yield such an invariance — any more or less and the figure will sit askew. Likewise, a square would have discrete rotational symmetry at multiples of 90° (about the centre) alone.

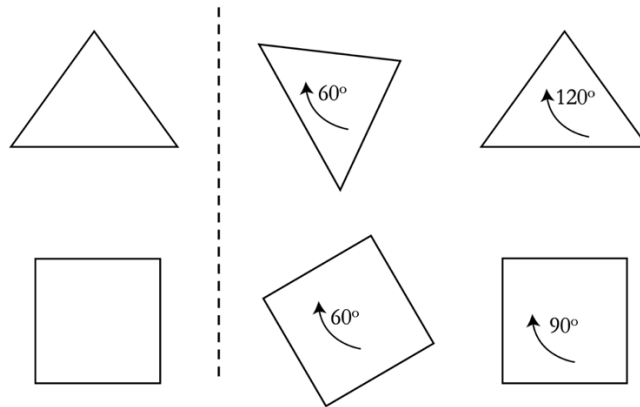


Figure 2.3: The Rotations of Triangles and Squares

A circle, however, is associated with a much more profound type of symmetry, namely *continuous symmetry*, by which *any* arbitrary degree of rotation about the centre is symmetrical. As a figure that is everywhere symmetrical in this regard, it is impossible to rotate the circle about its centre without generating a completely identical shape, shown in Fig. 2.4 below.

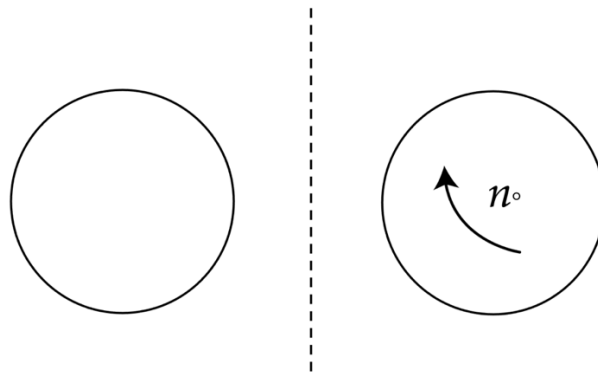


Figure 2.4: The Rotations of a Circle

To spin a circle about its centre, therefore, is always to map it onto itself in repeating cycles. As circular motion around one fixed central axis, the spinning *Drehtür* is thus governed by these mechanical and aesthetic principles. The more it turns, the more apparent the immobility and robustness of the central spine becomes, rendering the door a symbol of cyclicity and repetition, which *utilise* change and process to ultimately foreground a sameness, an invariance

within. The modern mathematical insight that invariance and transformation are mutually dependent, not mutually exclusive, finds a remarkably concise aesthetic expression, therefore, in Murnau's revolving door. Here, of course, Hausdorff's story could be read backwards, traversing onto the all too familiar "Landschaft Zarathustras" and Nietzsche's eternal recurrence. Murnau's Nietzschean leanings are well-documented in scholarship, so it is by no means a stretch to suggest that the focal symbol of *Der letzte Mann* might indicate a phenomenon by which *the same* occurs again and again, and where change itself serves only to facilitate it. At the very least, the mathematics of circles would point in that direction. In a departure from Kracauer and Eisner's rather rigid assessments, it can be argued that the observant viewer is not necessarily primed for relentless change in *Der letzte Mann*; rather, the viewer is encouraged to suspect that some things will remain quite the same despite being forewarned of transformation — a point of disparity with the film's introductory caption, not a moment of coordination.⁴⁸

Before moving on to assess whether these insights can be brought to bear on the story of the film, it is worth lingering on the revolving door to ascertain a grasp of its other topological properties. Another spatial consequence of the *Drehtür* is its inherent complication of the very distinction that begins Hausdorff's careful topological investigations, namely that between interiority and exteriority, in this case the hotel lobby and the streetscape. With its persistent turning, the revolving door generates a space that is paradoxically both open and closed at the same time, blurring the boundary between the inside and outside of the main setting for the plot. Although the revolving door is no doubt the dominant threshold symbol of the film, *Der letzte Mann* is replete with other types of doors and doorways that would appear to be topologically less complex: the manager's door, behind which the porter desperately tries (and fails) to prove his physical strength, the swinging doors to the underbelly of the hotel, where his new role as a washroom attendant is based, and indeed the many doors of his tenement housing block. At a glance, this simple contrast lends to the latter doors a much neater differentiation between the inner and the outer. Another glimpse at Bachelard's explorations, however, would discourage this, for this complication of boundaries is inherent, it seems, to any door, revolving or fixed:

But how many daydreams we should have to analyze under the simple heading of Doors! For the door is an entire cosmos of the Half-open. [...] The door schematizes two strong

⁴⁸ Ironically, Kracauer's brief mention of the revolving door above, "a device employed time and time again until the very end," undermines his conception of it as the symbol of change, for he is correct to note that, on the level of plot structure, the revolving becomes a recurring visual element that opens, closes and regularly punctuates the screenplay. In this very simple sense, we — the viewers and the unfortunate protagonist — never really get away from it.

possibilities, which sharply classify two types of daydream. At times, it is closed, bolted, padlocked. At others, it is open, that is to say, wide open.⁴⁹

For Bachelard, therefore, the very nature of a door demands that it can be both open and closed, which, abstracted somewhat, renders it an object that must be thought of as strictly “half-open” — without the possibility of closure, there is no openness, and without the possibility of openness, no closure. In a way that threatens to thwart any sense of an enduring boundary, to consider a door is identify what the topologist calls a “clopen” space⁵⁰ — a space, like Bachelard’s “Half-open” cosmos, that is simultaneously open and closed. Consider the doorway to the manager’s office, where the fate of the porter is finally sealed, reproduced below (Fig. 2.5):



Figure 2.5: The doorway to the manager’s office from outside⁵¹

While the closed door seems to delineate the space of the office, the camera wanders through the space before the doorway and nonetheless enjoys access from outside by way of the transparent glass panels, which undermines any sense of a stable differentiation between the inside and outside of the space. The camera then crosses effortlessly through the door, and the

⁴⁹ Bachelard, *The Poetics of Space*, 222.

⁵⁰ Without delving too deeply into the mathematics proper, a set, and thereby a space, is said to be closed when it contains its own boundary, which is to say in terms of Hausdorff’s “Umgebungen” that not all points can move an arbitrarily small distance and remain in the space, namely the points on the boundary. However, an alternative definition is that a space A is closed when its complement B (the set of points that is not A) is open, which leaves open the possibility of an open set A whose complement B is open, and A is thus called a “clopen” set.

⁵¹ *Der letzte Mann*, 00:19:54.

perspective is soon inverted to show with clarity the lobby from inside the office, thus tethering that which is beyond each space, the office and the lobby, to their respective interiors. Then, as if this were insufficient to make the point, the camera comes into play once again by adopting the perspective of the doorman as he reads in horror of his demotion, and a curious depiction of the washroom attendant (whom he is to replace) being relieved of his duties and transferred to a care home is superimposed onto the text (Fig. 2.6), bridging on a visual level an event from a totally different location in the hotel to the interior of the office.

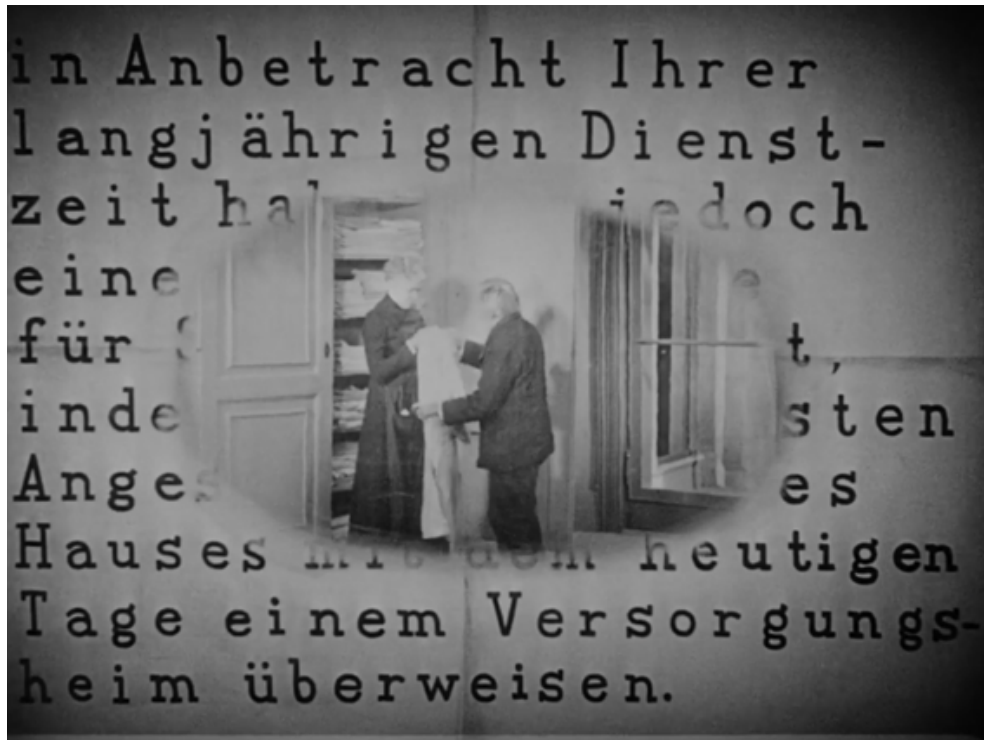


Figure 2.6: Invasive events from beyond the office⁵²

The glass door has thus proved to be a fairly porous boundary, and the distinction between inner and outer spaces is no more robust than in the case of the revolving door that dissolves it completely. In line with this revealing example, the many doors of the film will be shown to function topologically like the *Drehtür*, whether they spin or not. We are readied as viewers, in short, not to expect too much by way of closure and containment from the various doors, and this permeability comes to complement the aforementioned aesthetic of invariance through change as the plot unfolds. On a final note, while it may seem much less convincing to associate the portable camera with any sense of inertia or stasis that underpins the revolving doors, the

⁵² *Der letzte Mann*, 00:20:52.

new capabilities offered to Murnau by the unchaining of the camera, as will demonstrated in the following analysis, likewise converge on invariant properties that resist the passage of change.

Uniform(ity)

Now equipped with a more nuanced understanding of the circularity of the *Drehtiiir*, it remains to be seen whether the notion of invariance through change can be carried over to an analysis of the film as a whole. As a starting point, it is worth examining how the canonical critiques of Kracauer and Eisner bring their understanding of the revolving door and the portable camera as the aesthetic markers of all change to bear on their reading of the story of the porter and his apparent decline. Such a direction is more than just for the sake of consistency; by considering the trajectories of transformation that they indicate, one can, staying true to topological motivation, more easily isolate that which resists metamorphosis. Locating the alleged source of all change in both Kracauer and Eisner's works is, however, a simple task: it is indeed the glistening, gold-buttoned uniform that the doorman proudly dons at the opening of the film. Let us consider first Kracauer's overview of the story:

[The film] resumes the basic motif of its forerunners by contrasting two buildings: a gloomy tenement house crowded with lower middle-class people, and a palace hotel for the rich, who keep the revolving doors in and the elevators in permanent motion. Yet *The Last Laugh* differs from the previous films in that it shows the two social spheres united by strong ties. Wearing his sparkling uniform with an inimitable dignity, Emil Jannings as the old hotel porter not only ushers the guests through the revolving door, but also offers candies to the children in the yard of the tenement house where he lives with some relatives. All the tenants, in particular the female ones, are awed by his uniform which, through its mere presence, seems to confer a mystic glamour to their modest existence. They revere it as a symbol of supreme authority and are happy to be allowed to revere it. Thus the film advances, however ironically, the authoritarian credo that the magical spell of authority protects society from decomposition. In the case of the hotel porter, however, this spell is suddenly destroyed. [...] This rather humane administrative measure entails a catastrophe. Since the film implies that authority, and authority alone, fuses the disparate social spheres into a whole, the fall of the uniform representing authority is bound to provoke anarchy. No sooner do the tenants learn of the ignominious white blouse than they feel alienated from that upper world with which they commune through the uniform. They resent being socially abandoned and thrown back into the gloominess of their flats and of their souls. All evil lower middle-class instincts are unleashed against the porter. The gossiping housewives maliciously ridicule him; his own relatives turn him out onto the street. He believes himself humiliated by the loss of his uniform, and instead of maturely putting up with his plight, he falls into a self-pity tantamount to self-renunciation.⁵³

As that which simultaneously draws the attention of adoring females and tethers two social classes — the affluent cosmopolitan hotel guests and the lower middle-class community — the “sparkling uniform” becomes effectively, as Elsaesser puts it, “the real star” of the film,⁵⁴ and

⁵³ Kracauer, *From Caligari to Hitler*, 100.

⁵⁴ While Elsaesser's landmark work seeks to break from Kracauer and Eisner by re-assessing aesthetic and cultural trends in Weimar Germany without reference to some clairvoyant premonition of post-1933 society, his analysis

its loss thus initiates the dreadful metamorphosis of the doorman and the collapse of a unified society. Much like Kracauer, Eisner too views the uniform as the pivot of the entire plot, so much so that all other characters exist to express the lofty status of the uniformed porter:

Denn im Grunde bleiben die anderen Figuren um den Portier herum ohne Relief, wirken konturlos. [...] Die Nachbarn des letzten Mannes sind ebenso wie die anonymen Gäste des Hotels Schablonenwesen. Sie beginnen nur zu existieren, wenn sie ihren großen Mann im Hinterhof erwarten können, sie agieren nur, wenn er in seinem Glanz erscheint. Ist der Portier die Treppe hinaufgestiegen, so kann hier das Gaslicht gelöst werden. Und wenn alle diese Schattenkreaturen sich des Morgens an Fenstern und auf Balkonen zu schaffen machen, um Plumeaus zu klopfen und Laken lüften, so geschieht dies gewissermaßen nur als recht bescheidene Begleiterscheinung für die feierliche Hauptaktion: das Bürsten der sakrosankten Livree.⁵⁵

Then, with the demotion of the porter to the washroom, the loss of the uniform, as in Kracauer's analysis, amounts to a terrible transformation from the image of "einen zaristischen General oder einen fetten Kapitalisten" — often captured by the camera from below — to its opposite: "Im Gegensatz dazu wird der seiner Pracht Beraubte von oben her aufgenommen — erscheint in seinem Niedergang erbärmlich klein, hinfällig."⁵⁶ Bearing the opening caption in mind, which hints at the fall of a general or prince, Murnau seemingly sees the removal of the uniform as the confirmation of the warning. Almost two decades later Eisner reaffirms her position:

After he becomes stripped of his uniform, he becomes a poor wretched thing with bandy legs, crumpled trousers, a worn-out jacket. Murnau shows him, with his livery gone, bewildered, looking up at the hotel in a curiously diagonal position, splayed like an Expressionist actor across the screen, in front of the same wall which he used to pass each morning, in the splendour of his pride.⁵⁷

Remembering the societal impact, this reflects the collapse of utmost authority, which Eisner backs up with the convenient claim: "Diese kleinbürgerliche Tragödie ist im Ausland kaum mehr verständlich; sie kommt aus einem Land, in dem die Uniform zuzeiten leider gottähnlich war."⁵⁸ Having observed a guiding aesthetic principle of transformation in the "entfesselte Kamera" and the *Drehtür*, the uniform and its loss with the demotion of the doorman is thus the plot point that ushers in the expected metamorphosis, which not only profoundly alters the man but also the proclaimed societal unity at the beginning of the film.

of *Der letzte Mann* likewise is one of a sudden change prompted by the loss of uniform. For Elsaesser, the uniform is not necessarily a symbol of authority, but also an embodiment of proud employment in Weimar Germany's increasingly capitalist and materialistic social structure. Elsaesser, *Weimar Cinema and After*, 231f.

⁵⁵ Eisner, *Die dämonische Leinwand*, 207f.

⁵⁶ *Ibid.*, 210.

⁵⁷ Eisner, *Murnau*, 155.

⁵⁸ Eisner, *Die dämonische Leinwand*, 207. Some two decades later, Eisner doubles down on this assertion, noting "The petty tragedy [...] could only be a German film. For it could only happen in a country where the uniform (as it was at the time the film was made) was more than God." Eisner, *Murnau*, 154.

Now, there are of course aspects of these analyses that weather critique. Kracauer's portrayal of the demotion as less of a change than the porter makes it out to be for himself is a sentiment that is shared here, and Eisner's description of the visual change of the porter, guided by an awareness of Freund's use of camera angles, certainly matches how things are made to *look* in the film. Both assessments do, however, appear quite confusing upon a closer inspection. Beyond Kracauer's rather unfortunate tone when it comes to the discussion of gender, his outline of *Der letzte Mann* contains several glaring inconsistencies: if the uniform is such a potent symbol of authority that it can connect social spheres, then is the removal of the uniform from the porter merely a "humane administrative measure" that he exaggerates to himself? And in turn, if the demotion is really a menial one that the porter has somewhat overblown in his mind, then why do the neighbours "resent being socially abandoned and thrown back into the gloominess of their flats and their souls"? On top of this, several claims made here seem to warrant further reflection, for there is nothing in the film to necessarily suggest that the uniform somehow bridges and creates "strong ties" between the two social classes of the film. Likewise, one might wonder whether the reaction of the neighbours to the discovery of the doorman's demotion (and loss of uniform) is one of resentment or even alienation "from the upper world with which they commune" at all, as opposed to simply finding the doorman in his attempt to keep up appearances with a stolen uniform rather ridiculous. As for Eisner, it seems that uniforms take on a different meaning when one crosses the German border — an unsubstantiated suggestion that would strike any reader aware of the cultural-political histories of just about any industrial, militarised nation as peculiar.

In their readings of *Der letzte Mann*, Kracauer and Eisner have thus perhaps become too reliant on the uniform as the vehicle for a collapse in authority, for the crippling metamorphosis of the porter. In many ways, this is indeed understandable (if ultimately flawed). As Katharina Loew writes of her predecessors in her analysis of German silent film:

Both authors worked as film critics during the Weimar Republic and survived the Holocaust in exile. Writing in the immediate aftermath of World War II, each in their own way grappled with the question of whether the most heinous crimes in human history might have been presaged in cinema. [...] Although their approaches and rhetoric differed, Kracauer and Eisner both sought to distil from Weimar films characteristics that might elucidate the rise of National Socialism. Indeed, this objective, whether pursued implicitly or explicitly, may also explain why, compared to other national contexts, socio-political history continues to play a major role in German film scholarship.⁵⁹

This critique is somewhat redolent of Gray's assessment of Mehrrens in *Plato's Ghost*, cited in the introduction. Having predetermined the conclusion of their studies of German modernist

⁵⁹ Loew, *Special Effects in German Silent Film*, 10f.

cinema, namely a clear pathway from Weimar culture to the horrors that followed from 1933, Kracauer and Eisner have thus neglected interpretations that do not necessarily fit this trajectory. Given this, Loew positions her own work as building on more recent scholarship that has “played an important role in shifting the focus away from Kracauer’s and Eisner’s grand narratives,” such as Thomas Elsaesser’s influential monograph of 2000. Although her critique of Kracauer’s and Eisner’s canonical studies is rooted in the lack of attention paid to technical effects and the contemporary cinema industry, the identification of inflexible “grand narratives” may help explain the overreliance on the notion of the uniform as a quasi-militaristic embodiment of authority that so beguiles the specifically German (often female) *Seele*. If all roads lead to Hitler, then it is unsurprising that Kracauer and Eisner pin so much of the plot on the *Livree* as the symbol of supreme authority.

As something of a course correction, I suggest here that another discussion of uniforms helps to engender a more nuanced understanding of their effects — not, however, in existing scholarship but in a moment of intertextuality. The structural and thematic parallels with Kafka’s own “kleinbürgerliche Tragödie” in *Die Verwandlung* have already been noted, but a quiet nod in its direction can be observed when it comes to the supposedly “gottähnlich[e]” uniform. Introduced at a key moment to provide the starkest contrast with Gregor’s new, debased form, the narrator remarks, once the bedroom door opens for the first time to the stunned and appalled reactions of the immediate family and the intrusive Prokurist, upon “eine Photographie Gregors aus seiner Militärzeit, die ihn als Leutnant darstellte, wie er, die Hand am Degen, sorglos lächelnd, Respekt für seine Haltung und Uniform verlangte.”⁶⁰ At this critical juncture in the story, the military uniform is set up as that which ought to effortlessly garner respect for its wearer, stressing the scale of difference between the two states of Gregor Samsa — the former military man and the creepy-crawly. From the outset, the uniform, quite like Kracauer and Eisner would have it for Murnau’s film, seems to underline a moment of catastrophic change.

This association of the uniform with *Verwandlung* is then given room to grow. While by no means a military *Livree*, one might recall the opening of that decisive apple-bombardment scene, in which the elder Herr Samsa proudly dons a uniform following his reluctant return to the workforce. The narrator, externalising Gregor’s disbelief at the father’s appearance, lingers on the apparently transformational effects of his uniform:

Gregor zog den Kopf von der Tür zurück und hob ihn gegen den Vater. So hatte er sich den Vater wirklich nicht vorgestellt, wie er jetzt dastand; allerdings hatte er in der letzten Zeit über dem neuartigen Herumkriechen versäumt, sich so wie früher um die Vorgänge in der übrigen

⁶⁰ Franz Kafka, *Die Verwandlung*, in *Die Erzählungen*, ed. Roger Hermes (Frankfurt am Main: Suhrkamp, 112010), 111.

Wohnung zu kümmern, und hätte eigentlich darauf gefaßt sein müssen, veränderte Verhältnisse anzutreffen. Trotzdem, trotzdem, war das noch der Vater? Der gleiche Mann, der müde im Bett vergraben lag, wenn früher Gregor zu einer Geschäftsreise ausgerückt war; der ihn an Abenden der Heimkehr im Schlafrock im Lehnstuhl empfangen hatte; gar nicht recht imstande war, aufzustehen, sondern zum Zeichen der Freude nur die Arme gehoben hatte, und der bei den seltenen gemeinsamen Spaziergängen an ein paar Sonntagen im Jahr und an den höchsten Feiertagen zwischen Gregor und der Mutter, die schon an und für sich langsam gingen, immer noch ein wenig langsamer, in seinen alten Mantel eingepackt, mit stets vorsichtig aufgesetztem Krückstock sich vorwärts arbeitete und, wenn er etwas sagen wollte, fast immer stillstand und seine Begleitung um sich versammelte? Nun aber war er doch gut aufgerichtet; in eine straffe blaue Uniform mit Goldknöpfen gekleidet, wie sie Diener der Bankinstitute tragen; über dem hohen steifen Kragen des Rockes entwickelte sich sein starkes Doppelkinn; unter den buschigen Augenbrauen drang der Blick der schwarzen Augen frisch und aufmerksam hervor; das sonst zerzauste weiße Haar war zu einer peinlich genauen, leuchtenden Scheitelfrisur niedergekämmt. Er warf seine Mütze, auf der ein Goldmonogramm, wahrscheinlich das einer Bank, angebracht war, über das ganze Zimmer im Bogen auf das Kanapee hin und ging, die Enden seines langen Uniformrockes zurückgeschlagen, die Hände in den Hosentaschen, mit verbissenem Gesicht auf Gregor zu. Er wußte wohl selbst nicht, was er vorhatte; immerhin hob er die Füße ungewöhnlich hoch, und Gregor staunte über die Riesengröße seiner Stiefelsohlen.⁶¹

From this drawn-out passage, it would seem that the father's new work guise has triggered a remarkable metamorphosis that serves as an inverse to Gregor's own. The physical descriptions of Herr Samsa resemble (in reverse order) the discordant states of Murnau's hotel porter, imagined around a decade later: he shapeshifts from a scruffy, wizened, old man to an upright, well-groomed and caparisoned member of the *Kleinbürgertum's* labour force. The reader notes that the usual image of Herr Samsa, to which Gregor is more accustomed, is a projection of lethargy, inertia and diminutiveness, who wheezes his way "immer noch ein wenig langsamer" through the local park a few times per year and — in a noteworthy formulation that makes Herr Samsa the grammatical object in a description of his attire — is "eingepackt" into his own old, dusty overcoat. Herr Samsa, in this recollected state, is worn by his own clothing. Now, faced with a fresh-eyed, sprightly and foreboding figure who clearly wears his own clothes, Gregor's perception of his father stresses both authority and size, his gigantic boots ready to squash any lowly insect. Like the aforementioned use of low, upward-facing camera angles in *Der letzte Mann* to unnaturally inflate the proud, uniformed doorman at the beginning, Gregor's unelevated perspective stretches his father to monstrous proportions. Moreover, he now *moves* with determination towards Gregor, with the renewed sense of *Bewegung* complemented by the projectile of his gold-labelled hat, neatly foreshadowing the deadly barrage of fruit that would soon ensue. In short, by isolating this passage of *Die Verwandlung*, the uniform is identified as a trigger for a transformation so complete that readers are almost left to wonder whether Gregor's fortunes could change if he could only get his insectile hands on his old lieutenant's uniform.

⁶¹ Ibid., 136f.

As is to be expected with Kafka's slippery prose, however, the interpretation is rarely that simple, for it is not long before the illusion begins to shatter. In the third and final section of the novella, the uniform comes into focus once again, but this manifestation is challenging to reconcile with passage cited above:

Mit einer Art Eigensinn weigerte sich der Vater, auch zu Hause seine Dieneruniform abzulegen; und während der Schlafrock nutzlos am Kleiderhaken hing, schlummerte der Vater vollständig angezogen auf seinem Platz, als sei er immer zu seinem Dienste bereit und warte auch hier auf die Stimme des Vorgesetzten. Infolgedessen verlor die gleich anfangs nicht neue Uniform trotz aller Sorgfalt von Mutter und Schwester an Reinlichkeit, und Gregor sah oft ganze Abende lang auf dieses über und über fleckige, mit seinen stets geputzten Goldknöpfen leuchtende Kleid, in dem der alte Mann höchst unbequem und doch ruhig schlief.⁶²

Difficult to overlook is the shift in tone when indicating the uniform itself, for that which was once associated with patriarchal authority is but a "Dieneruniform" or a mottled yet humorously overcleaned "Kleid" — two references that serve to simultaneously disempower the father by drawing attention to his position of servitude at work and to (potentially) emasculate him. In a final blow to any attempt to continue associating the uniform with gainful work and productivity, the father wears it in the state that is least conducive to the demands of the capitalist world of work, namely in his sleep — a neat parallel to Gregor's somnolent state as he awakens, late for work, to find himself "in seinem Bett zu einem ungeheueren Ungeziefer verwandelt."⁶³ While its deployment in the second section of the novella does indeed register a change for Gregor, it is ultimately a fleeting and relatively superficial one, and, if anything, it draws attention to those enduring characteristics of the father figure in *Die Verwandlung* (and indeed those in several other of Kafka's prose works) that manifest with or without uniform:⁶⁴ he is somewhat frail and aging but nonetheless capable of great malevolence, and a change of clothing — though it may accentuate it — does not profoundly alter this innate characteristic.

Moreover, it is worth emphasising that this deeper sense of invariance throughout change is paralleled on a level of the reader's shifting interpretations. Drawn at first into the terror of Gregor's vulnerable position at the hands of a dreadfully enlarged and aggressive Herr Samsa, this initial understanding of the uniform and its transformational consequences is then itself made to transform. What begins as a static interpretation of change is made mobile, and just like Gregor is forced back into the room, the reader is logically backed into the only possible corner: the transformation was a sham, and the object in question has remained largely *unchanged*. In the case of Herr Samsa, therefore, old habits die hard, and we as readers have

⁶² Ibid., 140.

⁶³ Ibid., 96.

⁶⁴ One could also consider Georg's bedridden but despotic father in Kafka's *Das Urteil*, who exhibits a no less than lethal level of malice clothed only in his unwashed dressing gown.

been hoodwinked: the all-important uniform has been something of a misdirection, but one that is calculated and rather revealing. The necessary metamorphosis of the reader's interpretation of the uniform confirms that the metamorphosis triggered by the uniform, in the end, exposes that which was actually unaffected by said metamorphosis: the invariant essence of the aggressive and hostile father. This is no doubt a counterintuitive outcome, but it is perhaps to be expected from "the ultimate topological author"⁶⁵ if topology is, as Hausdorff explains, the area in which "das Plausible falsch und das Richtige paradox ist."⁶⁶

Similarly, *In der Strafkolonie* showcases a comparable shift in the portrayal of military uniforms. Awaiting the extensive description of the ghastly machine, the Reisende notices how the Offizier "hatte zwei zarte Damentaschentücher hinter den Uniformkragen gezwängt"⁶⁷ and remarks on their unsuitability for the tropical climate, with the latter replying: "sie bedeuten die Heimat; wir wollen nicht die Heimat verlieren."⁶⁸ The two ladies' handkerchiefs seem to indicate a similar, overtly gendered admiration of the masculine uniform, a symbol of male authority and colonial prowess. Then, as the dejected Offizier later subjects himself to the wrath of the machine, the uniform is quickly cast aside, and in a humorous twist, it turns out that the handkerchiefs were not bestowed by admiring females upon the uniformed Offizier after all: "Hiebei fielen ihm zunächst die zwei Damentaschentücher, die er hinter den Kragen gezwängt hatte, in die Hände. 'Hier hast du deine Taschentücher,' sagte er und warf sie dem Verurteilten zu. Und zum Reisenden sagte er erklärend: 'Geschenke der Damen.'"⁶⁹ Given instead in a probable act of pity to the unfortunate Verurteilten, the Offizier had merely pilfered them to use in the sweltering heat. Again, the reader's association of the uniform with a mystical sense of authority is likewise forced to retreat.

Returning to *Der letzte Mann*, upon a more careful examination of the uniform, one that is not steered by a desired explanation for the rise of National Socialism in the 1930s, a similar phenomenon can surely be observed. The earlier scenes described by Kracauer and Eisner, in which the porter staunchly mans the entrance to the hotel in his "sparkling uniform" and in which the neighbour comically brushes the rising dust that she had battered out of her carpet from the uniform as the porter heads to work, mirror the initial characterisations of the mysterious power of uniforms in Kafka's two stories. Subsequently, just as in *Die Verwandlung*

⁶⁵ Fletcher, *The Topological Imagination*, 154.

⁶⁶ Hausdorff, *Grundzüge der Mengenlehre*, 97.

⁶⁷ Franz Kafka, *In der Strafkolonie*, in *Die Erzählungen*, ed. Roger Hermes (Frankfurt am Main: Suhrkamp, 112010), 165.

⁶⁸ Ibid.

⁶⁹ Ibid., 192.

and *In der Strafkolonie*, this rather obvious association of the uniform with masculine authority is swiftly undercut as the film progresses. Let us recall Eisner's aforementioned discussion, in which she notes that "Murnau shows [the porter], with his livery gone, bewildered, looking up at the hotel in a curiously diagonal position [...] in front of the same wall which he used to pass each morning, in the splendour of his pride."⁷⁰ Eisner (and seemingly Kracauer) overlook the detail that the uniform is not retired from the film once it is taken from the porter; rather the uniform lives on by virtue of the fact that he steals it from the manager's office. This observation is more than mere pedantry, for the following scene showcases the very same porter after the demotion, not "with his livery *gone*" but with his stolen livery *on*, in front of that same wall once more, and as is made apparent by Emil Jannings' expressive acting, the porter is equally wretched, equally bewildered (Fig. 2.7 and 2.8). Still unable to mask the kaleidoscope of fear, anxiety and horror following his demotion, the porter's recovery of the uniform is shown to fail on this visual level — the powerful, upright stature and vain preening in the pocket mirror do not accompany the uniform when it is retrieved. The viewer has been led to believe, therefore, that the porter is transformed into a "Nichts" when deprived of the uniform, but now it is clear that he remains so even after he is reunited with it, which undeniably casts a shadow over that initial interpretation.

At this juncture, a glance at the lesser-known studies of Weimar film is useful, for film analyst Jo Leslie Collier, writing in 1988, does not fall under the spell of the uniform like her more canonical predecessors. Viewing the uniform much more as a cover for the doorman's inherent lack of a meaningful identity, she explains: "This concern with his external image, particularly his external image as male, embodied in the uniform, is indicative of his lack of any real self-image, of his insecurity. He is, he believes, nothing without the uniform."⁷¹ It is thus the doorman himself who places such value in the uniform as means to fix a positive self-image in place, not the film as a whole, and as a corollary, it takes Collier to state what should really have been the obvious:

The doorman, of course, fails to see the fallaciousness of these connotations he ascribes to the uniform. He sees it as the outward form of the active, forceful, decisive, self-determined military man. [...] It is an anachronistic and empty holdover from a time when the keeper of the gate was indeed a soldier, not, as now, a menial whose function is mostly decorative. Ironically, the old man is unaware that the uniform in which he takes so much pride actually connotes passive servility. The uniform, like the madonna, is a false image, seemingly a mark of honor, in fact a degradation.⁷²

⁷⁰ Eisner, *Murnau*, 155.

⁷¹ Jo Leslie Collier, *From Wagner to Murnau: The Transposition of Romanticism from Stage to Screen* (Ann Arbor: UMI Research Press, 1988), 117f.

⁷² *Ibid.*



Figure 2.7: The porter and the stolen uniform (I)⁷³



Figure 2.8: The porter and the stolen uniform (II)⁷⁴

⁷³ *Der letzte Mann*, 00:34:20.

⁷⁴ *Ibid.*, 00:47:46.

The opening scenes described above, which suggest the uniform as the mark of superiority and respect, are, from this perspective, merely the self-deceptions of the old porter, because uniforms are a relatively futile way of establishing a stable individual identity, precisely because they achieve dull uniformity and homogeneity, *not* uniqueness. Indeed, the viewer may be reminded that the porter has never even been the only man in uniform, as he is replaced by another younger man with an identical uniform at that door, and the many younger porters who dart across the hotel lobby also boast neat uniforms. Therefore, while the doorman sneaks through the hotel at night to rescue his uniform, he is unwittingly reclaiming that which tethers him to the hotel's class of servants, a lowly collective, not to some individual greatness.

Moreover, in a very considered use of staging and shadows, a final blow to the supposed power of the uniform is delivered, and two moments of stylistic invariance across Murnau's filmography become most apparent. On the two occasions in which the protagonist attempts to maintain the illusion that he is still the doorman at the front of Hotel Atlantic by collecting his stolen uniform from the train station's cloakroom and returning home in it, visual parallels are to be found with the climax of *Nosferatu*, when Max Schreck's nightmarish vampire is finally lured into Ellen's chamber in her pure-hearted sacrifice. Crucially, it is not the courageous Ellen to whom the porter corresponds — it is the antagonist Count Orlok. At *Nosferatu*'s climax, when night falls, Ellen tears open the window that looks across to derelict mansion acquired by Orlok in Wismar, hoping to draw him out. Then, the dilapidated doorway judders open to reveal the vampire on the move. Similarly, the porter hobbles back to his neighbourhood, under the cover of darkness, his stature hunched following his exposure in the hotel bathroom, and he appears under a gated archway to the housing block, with the right-hand wing sitting ajar. The staging of the latter scene is almost a replica of the former, with the porter in the vampire's position, as is shown below in Fig. 2.9. Then, as Orlok ascends to Ellen's room, his angular shadow forms that spine-chilling image that has become not just a widely recognised shot from *Nosferatu* but indeed an iconic moment of cinema history as whole. Likewise, in *Der letzte Mann*, when the porter returns home for the first time in the stolen attire, Murnau's expressionistic use of shadows in the staircase re-emerges. With one outstretched hand pointing up the stairs and the other behind his back, the porter's shadowy ascent to the domestic space, also linked here to the presence of females, echoes most clearly that of Orlok two years previously, reproduced here in Fig. 2.10. While the porter desperately dons his stolen uniform, apparently the arbiter of all change, he is *still* the monster at the door, the creepy shadow in the hallway, poised to invade the respectable familial household. Two years on from the horror of Count Orlok, cinemagoers encounter a more sympathetic monster, but he is cast as a monster nonetheless:



Figure 2.9: Orlok and the porter at the gates⁷⁵

⁷⁵ *Nosferatu: Eine Symphonie des Grauens*, directed by F.W. Murnau (Prana, 1922), 01:28:04 and *Der letzte Mann*, 01:04:50.



Figure 2.10: Shadows on the stairs⁷⁶

⁷⁶ *Nosferatu: Eine Symphonie des Grauens*, 01:29:08 and *Der letzte Mann*, 00:34:42.

The “sakrosankte Livree,” it seems, does very little to alter this. The images above, which Eisner and Kracauer ignore by mistakenly writing the uniform off when the porter is demoted a mere 25 minutes into the film, really do speak for themselves in this regard. Ultimately, seizing back the uniform does not trigger a change in fortune or a return to the apparent heights of the film’s opening sequence, simply because they were illusory to begin with. The porter, who performs a sacrifice of his own and returns the uniform with help of his only steady companion, the night watchman, thus seems to learn the lesson that his livery is, as Collier notes, much more the confirmation of his servility than his power — a lesson that Kracauer and Eisner fail to grasp in their assessments above. Much like in Kafka’s novella, the uniform is set up at the beginning of the film to symbolise more than it turns out to. Of course, as with *Die Verwandlung*, there *has* been a change involving the uniform, for the hotel manager’s administrative adjustment sees the uniform change hands (several times), and, of course, this leads to the resultant change in how the female neighbours treat the doorman. Yet, as Collier points out, these neighbours have merely been as “equally guilty” as the protagonist in “worshipping the uniform,” and ultimately, they just learn the lesson a little faster and more easily than the doorman.⁷⁷ The heightened vigour, dynamism and power that the uniform appears to bestow upon Herr Samsa turned out to be rather fleeting and superficial, and so too does the adoration of the uniformed doorman in *Der letzte Mann*, which Kracauer and Eisner ascribe to the female neighbours, turn out to be rather fragile and insincere. In a neat repetition of that Kafkaesque topology, these rapid changes serve to expose that which has not changed: the lowly, servile status of the porter that had merely been concealed by his vanity and self-deception. This is to say, he is simply, as the title suggests, “der letzte Mann” who never was “der Erste.”

Stepping back to take stock, it has been shown that Kracauer and Eisner’s reliance on the uniform as the catalyst for an unyielding metamorphosis, on the back of their predetermined interpretation of change based on the aesthetic features of the “entfesselte Kamera” and the *Drehtür*, loses credibility upon a closer look. This was, however, a necessary step, for it has much more clearly brought into view the concealed invariant that this more topological analysis seeks, namely a continuity in the status of the old doorman despite the apparent changes that seem to bewilder and demoralize him so profoundly. The task ahead has become much clearer. In the following it will thus be argued that the close re-reading of several key scenes after the porter’s demotion in the office allows us to concretise this invariance within processes of change, rendering *Der letzte Mann* much more than a story of “Bewegung, Veränderung und Verwandlung.” In a neat example of topological thinking, movement, change and

⁷⁷ Collier, *From Wagner to Murnau*, 118.

transformation are *utilised* to disclose this much deeper, unchanging essence therein. This close reading will proceed chronologically, dwelling on the dizzying drunken dream sequence, the porter's exposure in the male bathroom and the rapid spread of the news amongst his female neighbours, and finally the jarring epilogue. Then, it will be shown how all these scenes encourage the viewer to think counter-chronologically and re-assess that misleading caption, which announces an imminent metamorphosis, at the beginning of the film. As was noted at the beginning of this chapter, this analysis will draw on the two aesthetic elements that Kracauer and Eisner linked — erroneously, I argue — to unremitting change: the portable camera and the revolving door, with all of its topological properties in tow. Moreover, this counter-reading of Kracauer's assessment in particular sets up another potential invariant that will be addressed in the following, namely his questionable contention that the social classes of the film are in some way united “by strong ties,” i.e., by the uniform, at the film's outset — a unity that then disintegrates like the doorman himself upon the change of costume. In annexation to the above argument concerning the status of the doorman, I also contest that the societal architecture that envelops the apparent fall of the protagonist is equally robust and remains invariant throughout, not in such a way that fosters unity but rather forceful separation. The sudden alienation of the lower classes decried by Kracauer, as will be shown, has in fact always been in place.

Drink-Dreaming

Turning to the first, and most significant, of the scenes in question, unlike for the rotational, cyclical structure of the *Drehtür*, one might suspect that it is much more difficult to reconcile the notion of invariance within transformation to a freely moving camera perspective. Yet, for all the sense of *Bewegung* that is achieved by the technique in *Der letzte Mann*, the “entfesselte Kamera” finds its most interesting application in the quintessentially modernist moment of revealing the inner perspective of the protagonist. As Elsaesser notes, its “eloquent command of the character's hidden feeling make[s] the space it traverses so effortlessly into a wholly interiorised landscape of the doorman's psyche,”⁷⁸ which is no doubt best rendered in a now famous scene that, as critics have noted, showcases Murnau's pioneering capabilities as a director. Upon returning home in his stolen uniform (for the first time), the doorman finds himself in the middle of a family celebration to mark his niece's marriage, and his tenement apartment is stocked with a generous ratio of alcoholic beverages to guests. Unsurprisingly, this soon descends into a boisterous drinking session by the end of which the doorman struggles to stay upright. As the gathering dissipates, the camera-eye suddenly adopts his wobbly perspective

⁷⁸ Elsaesser, *Weimar Cinema and After*, 232.

and begins to rotate sharply, clockwise, anti-clockwise and back again, capturing the spinning sensation that plagues the inebriated brain.⁷⁹ Now some 40 minutes in, the viewer is well-positioned to find the movement somewhat familiar: the porter's point of view is beginning to mimic the motion of the revolving door, with the doorman himself as the fixed central axis. Then, just as the revolving door eloquently communicates Bachelard's "cosmos of the Half-open," the ensuing scene confirms, for the porter at least, Bachelard's related contention that "man is a half-open being"⁸⁰ (Fig. 2.11). As the background of the apartment dissolves, the dreamscape comes into view, and the door takes centre-stage once again. Now with its frame "ungeheuer langgestreckt," it splits open the sleeping mind of the old porter,⁸¹ while a statuesque, re-uniformed dream version of him emerges at the bottom. Keeping the militaristic connotations of the uniform in play, he breaks into a sharp salute and descends upon a quintet of eerily identical old servants, who are struggling with the enormous trunk of a recent arrival. With a well-timed blast of triumphant orchestral accompaniment, the old porter hauls the heavy case above his head and marches back towards the door, defying gravity and leaving his miniature co-workers awestruck (Fig. 2.12).



Figure 2.11: Transition to the porter's dream⁸²

⁷⁹ Cf. Eisner, *Die dämonische Leinwand*, 213.

⁸⁰ Bachelard, *The Poetics of Space*, 222.

⁸¹ Eisner, *Die dämonische Leinwand*, 212.

⁸² *Der letzte Mann*, 00:40:39.



Figure 2.12: The porter's feat of heavy lifting⁸³

Passing through the *Drehtür* once more, which now sits askew and blurs the scene with its sharp rotations (Fig. 2.13), the doorman enters a contourless, ill-defined space that is full of spectators who applaud him as he throws the coffer, as if weightless, into the air. He salutes and bows to his audience, and he catches it effortlessly as it falls (Fig. 2.14). As Eisner correctly notes, “die entfesselte Kamera beherrscht den trunkenen Traum in vollendeter Weise,”⁸⁴ for it encircles (like the door) the dazzling display of the doorman, sweeping through the space and capturing reactions of the spellbound dinner guests, creating a Kafkaesque “Schwindel” that breaks the fourth wall and “auch uns erfasst und wir uns mit in den Wirbel gerissen fühlen.”⁸⁵ Then, this dual deployment of the *Drehtür* and the “entfesselte Kamera” intensifies “den Eindruck von sinnloser Hast, [...] von unaufhörlichem Wechsel, von Vorübergehen, das keine Spur hinterlässt.”⁸⁶ As something of an attempt to reverse the traumatic demotion of the previous day, the drunken dream thus confirms, according to Eisner, a relentless transformation that has left no discernible aspects of the doorman intact.

⁸³ *Der letzte Mann*, 00:41:21.

⁸⁴ Eisner, *Die dämonische Leinwand*, 213.

⁸⁵ *Ibid.*

⁸⁶ *Ibid.*



Figure 2.13: The wonky *Drehtür* of the dream⁸⁷



Figure 2.14: The doorman's show of triumph⁸⁸

⁸⁷ *Der letzte Mann*, 00:41:41.

⁸⁸ *Ibid.*, 00:42:35.

It is worth noting that, upon close inspection, the imagined setting is an indeterminate amalgam of the hotel and the tenement neighbourhood of the porter. Firstly, the car in Fig. 2.12 has not pulled over on the shiny metropolitan streetscape that fronts the hotel but into a corner of the dreary working-class locality, confusing the two distinct locations. Then, the space of the porter's absurd performance with the flying luggage case is but another violation of this separation and, likewise, that of inner and outer worlds: in Fig. 2.13, through the wing of the revolving door is a view of the familiar *Wohnblock* in place of the hotel's interior. Nonetheless, the lobby's elevator rises as a blurry block of light in the upper right-hand corner. Furthermore, as the camera orbits the doorman, the streetlamps of the porter's district are fixed to the walls behind the guests, who are seated at circular dining tables as if they were in the hotel restaurant. This fusion of spaces would thus seem to corroborate Kracauer's earlier assertion that the social spheres (and therefore classes) in *Der letzte Mann* were indeed bridged by the uniformed porter after all, and he dreams of undoing the disintegration that has separated them. Taking Eisner and Kracauer's views together once more, therefore, the dream sequence seems to present itself as a rather undisguised Freudian *Wunscherfüllung* that undoes the catastrophic "Vorübergehen" of the preceding day, restoring that sense of societal unity that was contingent, according to Kracauer, on the uniform.⁸⁹ The drunken dream is, in short, about rewinding an unrelenting metamorphosis on both a personal and societal level. However, if such an interpretation were allowed to stand, it would do so rather awkwardly alongside the previous re-assessments of the revolving door and the beguiling uniform, which, as is argued in here, serve much more to expose the omnipresence of invariance, all the while utilising change and metamorphosis to stress this. If the *Drehtür* is as aesthetically essential to the dream sequence as certainly seems to be the case, then so too, surely, is its unique structure of change *and preservation*.

Here, it is worth highlighting the real (rather than the imagined) location of this bibulous fantasy. While the porter has been confined to the basement of the hotel, he lives (along with relatives) in one of the uppermost apartments of his tenement block, towering over the other residents in an architectural sense as well as in the aforementioned physical sense, and it is here that the dream takes place. In *The Poetics of Space*, Bachelard opens with an exploration of the common house, "from the garret to the cellar," where he stresses: "A house is imagined as a vertical being. It rises upward. It differentiates itself in terms of its verticality."⁹⁰ Like Murnau's *Drehtür*, this is ensured by the presence of a fixed, vertical axis — "the polarity of cellar and attic, the

⁸⁹ Collier seems to share this interpretation of the dream, referring to it on several occasions as the "wish fulfilment dream." Collier, *From Wagner to Murnau*, 117.

⁹⁰ Bachelard, *The Poetics of Space*, 17.

marks of which are so deep that, in a way, they open up two very different perspectives for a phenomenology of the imagination.”⁹¹ With the upper floors of a tenement block contrasting a hotel cellar, *Der letzte Mann* bears a slightly different topology to the kind imagined by Bachelard above, but certain aspects are still of relevance. Fundamentally, Bachelard associates this vertical polarity with dreaming, with the garret as the site of rational dreams and the cellar the locus of irrational fears. Discussing the former, he writes:

We ‘understand’ the slant of a roof. Even a dreamer dreams rationally; for him, a pointed roof averts rain clouds. Up near the roof all our thoughts are clear. In the attic it is a pleasure to see the bare rafters of the strong framework. Here we participate in the carpenter’s solid geometry. [...] The dreamer constructs and reconstructs the upper stories and the attic until they are well constructed. And, as I said before, when we dream of the heights we are in the rational zone of intellectualized projects.⁹²

The dreams of the upper levels are thus rooted in specifically rational concerns. Significantly, Bachelard leans on the forward-looking Jungian approach to dreams in his work, as opposed to the latter’s former mentor Freud’s rigid reduction of all somnolent imaginings to *Wunscherfüllung* in relation to an event in the recent past.⁹³ In *The Poetics of Space*, they are cast here as inherently aspirational, as incomplete “intellectualized projects” that need to be constructed. Just as the aging porter is seen to labour up the stairs to his bedsit, in Bachelard’s lofty dreams, “we always *go up* the attic stairs, which are steeper and more primitive. For they bear the mark of ascension to a more tranquil solitude.”⁹⁴ Dreams of the attic do not go backwards, down the stairs; they are longings for an unrealised and *unobtained* future. Bachelard’s musings are rather enlightening here, for it is notable that the doorman does not daydream in the space where one might expect, namely his new subterranean domain. It is worth remembering that, as viewers, we have never really seen the doorman in the form he imagines in the dream — inordinately strong, sprightly and the object of adoration among the upper-class visitors. Rather, the very first image of the aging doorman is as someone who — largely ignored by the guests he greets — can no longer compete with the physical demands of his job, soaking wet and collapsing onto a bench in the lobby (Fig. 2.15). Any expressions of dominance at the beginning are merely his own delusions of grandeur, as he vainly preens his moustache in a pocket mirror while failing to notice that nobody has taken any notice of him. If anything, he has only ever appeared as the opposite to what is imagined in this dream, a show of failure in the manager’s office when he attempts to prove his worth by lifting another heavy box, only to buckle into a heap on the floor.

⁹¹ Ibid.

⁹² Ibid., 18.

⁹³ Cf. Carl Jung, *The Quotable Jung*, ed. Judith R. Harris (Princeton: Princeton University Press, 2016), xi.

⁹⁴ Bachelard, *The Poetics of Space*, 26.



Figure 2.15: The exhausted porter at the beginning⁹⁵

As is the case with the doorman, whom the viewer observes from the outset as an increasingly incapable worker who struggles — like Gregor — to cope with a draining, burdensome job, the reader first encounters Gregor *after* his transformation. While some change has undoubtedly occurred, any insights into the protagonist's life *before* the decisive shift are filtered entirely through his own perspective — the very perspective soon diagnosed as unreliable as the story progresses. From this angle, the porter is not dreaming of a return to how things were before his unforeseen demotion, and it is in this light that the foundations of Eisner and Kracauer's arguments start to fracture. What seems like a nostalgic longing for a former state of glory is, as most nostalgic longings are, a desire to “return” to something that never really existed in the first place, at least not in the narrative space of the film. The doorman, therefore, is stuck in the mud and dreaming of a changed future. His various militaristic salutes in the dream thus recall that opening caption: “Heute bist Du der Erste, geachtet von Allen, ein Minister, ein General, vielleicht sogar ein Fürst — weisst Du, was du morgen bist?” Yet now it is clear that, although he is dreaming of what he could be tomorrow, his starting point was not a “General” or indeed any position of universal respect — he just thought it was. In reality, he is dreaming of becoming “der Erste” *für das erste Mal*, because he is and was *invariably* “der letzte Mann.”

Consequently, the porter has not really been the object of a sudden, forceful transfiguration that has left him dreaming of a return to a previous, more successful and more socially unified time.

⁹⁵ *Der letzte Mann*, 00:04:17.

Rather, the demotion just confirms that he has always been a stationary cog in a machine that does not change, and that the social classes were never positively unified in the first place. The two posited invariant properties, the personal and the societal, are therefore uncovered by these fluctuations around them. The viewer is encouraged to mentally rewind to the supposedly cataclysmic event in the manager's office and recall that the protagonist is being moved to replace the washroom attendant, who is in turn being moved to a retirement home, and that the doorman is likewise replaced by a younger version of himself, who will no doubt follow in his footsteps down the line. These variations simply keep the wheel in motion — a cyclical process of change that ultimately changes nothing, like the all too familiar *Wiederkehr des Gleichen* that so intrigued the young Hausdorff. The lower classes that populate these shifting positions of servitude remain, therefore, the expendable workforce for the upper classes who populate the hotel's luxurious spaces. As significant as this scene proves to be, it comes to an end less than half-way through the span of *Der letzte Mann*. It is necessary therefore to show how the dream sequence has set up the trajectory of the remainder of the film, i.e. how invariance through change becomes the dominant principle of the plot.

Clopen Doors

With the tragedy of Gregor Samsa still in mind, it is worth remembering the recurring role played by doors in *Die Verwandlung*. Aside from Gregor's laborious and somewhat gruesome attempt to open the door to his concerned family and the invasive Prokurist early in the novella, the reader learns through the mention of the various doors to Gregor's abode that he is positioned rather curiously in a room that connects to most other rooms of the apartment. His position at the centre of his financially dependent family members is thus paralleled by the internal architecture of the Samsa household. A brief reflection on the opening and closing of these doors to his room later on becomes rather revealing, for it is written:

Einmal während des langen Abends wurde die eine Seitentüre und einmal die andere bis zu einer kleinen Spalte geöffnet und rasch wieder geschlossen; jemand hatte wohl das Bedürfnis hereinzukommen, aber auch wieder zu viele Bedenken. Gregor machte nun unmittelbar bei der Wohnzimmertür Halt, entschlossen, den zögernden Besucher doch irgendwie hereinzubringen oder doch wenigstens zu erfahren, wer es sei; aber nun wurde die Tür nicht mehr geöffnet und Gregor wartete vergebens. Früh, als die Türen versperrt waren, hatten alle zu ihm hereinkommen wollen, jetzt, da er die eine Tür geöffnet hatte und die anderen offenbar während des Tages geöffnet worden waren, kam keiner mehr, und die Schlüssel steckten nun auch von außen.⁹⁶

⁹⁶ Kafka, *Die Verwandlung*, 118.

Someone, having belatedly thought better of opening the door, swiftly closes it again to avoid the re-release of the family secret, underlining an apparent change in Gregor's position from integral to the family network to spatially central but now fully isolated. Yet, following the dreadful transformation and Gregor's subsequent enclosure in his room, the reader learns that Gregor has always had a curious habit of locking the doors *prior* to his transformation, and this perception of a change thus begins to dissolve. In turn, a clear continuity, an invariance, comes into view: the central-yet-alienated position of the protagonist. The keys may change hands, but ultimately it is the same solitary Gregor who is imprisoned, paradoxically, in the centre of the Samsa household. True to topological brand, these changes involving doors in Kafka's text serve to expose that which has proved resistant to change throughout.

In a differing but nonetheless related way, the doors of *Der letzte Mann*, when coupled with the roving camera, can be seen to bolster the invariant status of the doorman that was exposed by the dream sequence. In the groggy aftermath of the previous night's drinking, the bleary-eyed porter sets off for work again, swapping out his stolen uniform for the white blouse before he arrives. Some way into the working day, his adoring relative⁹⁷ tries to surprise him with a packed lunch at the hotel door, only to be confronted with the younger replacement doorman. Creeping through the hotel, she soon discovers the porter in his new job, marking his first exposure following the demotion, and the camera and the door to the bathroom are put to full use here. Sensing someone, the doorman slowly pushes the door ajar and peers outwards up the stairs, and then in a sharp tracking shot, the camera reverses its view and is propelled up towards the onlooker and her horrified scream (Fig. 2.16). In her recent analysis of the technical achievements in *Der letzte Mann*, Loew astutely unpicks this key scene to conclude how the portable camera manages to embody something immaterial:

As if the movement of the bathroom door sets the camera in motion, the following shot swiftly tracks from a slightly low-angle medium close-up of the aunt to an extreme close up of her eyes. She stands directly behind the glass doors at the top of the stairs, looking downward towards the right, which establishes a double eyeline match with the former doorman. As the camera moves towards her, she begins to scream, her nose pressed against the glass pane of the door, which steams up from her breath. [...] The tracking shot, which originates approximately at *his* optical point of view, captures *her* dismay at the discovery. At the same time, the shot's expressive scope goes beyond the aunt. It is equally shaped by the former doorman: The camera movement is initiated by *his* opening of the bathroom door, is a response to *his* secret getting out, and is mirrored in *his* recoiling. It is as if the moving camera embodies the awful truth escaping through the bathroom door as the former doorman opens it.⁹⁸

⁹⁷ The relationship of this relative to the doorman is never made clear. Loew deems her to be the "aunt" of the family, but as the doorman is suggested as the uncle to the young woman who gets married, she is possibly his sister. Loew, *Special Effects and German Silent Film*, 242. Collier, conversely, suggests she is perhaps a neighbour or another in-law. Collier, *From Wagner to Murnau*, 118.

⁹⁸ Loew, *Special Effects and German Silent Film*, 242.



Figure 2.16: Tracking shot during the porter's exposure⁹⁹

More than just an external view of the protagonist's perspective, the camera here, according to Loew, is ingeniously used to depict the motion of the exposure itself, echoing with striking similarity the Bachelardian take on doors when he writes: "when so many doors are closed, there

⁹⁹ *Der letzte Mann*, 00:56:29 – 00:56:31.

is one that is just barely ajar. We have only to give it a very slight push! The hinges have been well oiled. And our fate becomes visible.”¹⁰⁰ With that “slight push” of the door, breaking the hermetic seal of the cellar of secrets, this scene thus become an act of *secretion*: the content of the secret, “the awful truth” concerning the doorman’s fate, slips out into the open, its pathway mapped out by the motion of the portable camera.

Loew’s interpretation is certainly a convincing one, and it will encounter no resistance in this analysis. Instead, I simply suggest that the above phenomenon is not only repeated later but is pushed to an extreme, for the exposure is by no means a singular event. With the dramatic flight of the appalled relative, the news of the porter’s humiliating new guise is soon carried home and relayed to his immediate family, and in the tenement housing block it mounts something of a great escape (Fig. 2.17). In a scene once again constructed around doorways that serve remarkably poorly as boundaries, the secret seeps effortlessly through a closed apartment door into the ears of the eavesdropping neighbour, who passes it to another neighbour, who has emerged from behind her own front door. From this point, the portable camera gets to work once again and demarcates the path of the now ambulatory piece of gossip by zooming swiftly from one resident’s mouth to the next resident’s ear — while they appear on the courtyard balconies from behind their doors — as though it were a ball being thrown from one nosy neighbour to the next. Triggering the dreaded exposure of the porter on his home turf, this scene with its dynamic cinematography serves to literalise the often-cited Freudian metaphor that ‘der Mensch,’ in this case the porter, ‘ist nicht Herr im eigenen Haus.’ The real technical feat concerning the unchained camera is thus perhaps in articulating the devastating effect of *words* in the very wordless medium of silent film. Now, the doors have become nothing less than a parody of themselves, and despite appearances, they all function like the revolving one. With Bachelardian “half-openness” in full swing, the binary of insides and outsides ruptures, and the horrible secret soars freely in space. In their *failure*, however, the doors serve to explicate, to linger with Freudian influences, the underlying structure of secrecy itself. With the hair-raising Count Orlok and his spooky surroundings, Murnau is of course no stranger to uncanny interventions, but with this exposure sequence, the less obvious connotations of Freud’s somewhat overused (and often truncated) theory of the *Unheimliche* are at work in *Der letzte Mann*. For all the talk of graveyards and ghouls, the true nature of the uncanny lies, as the German etymology indicates, in leakage of a secret, or in Freud’s own memorable words: “Unheimlich sei alles, was ein Geheimnis, im Verborgenen bleiben sollte und hervorgetreten ist.”¹⁰¹

¹⁰⁰ Bachelard, *The Poetics of Space*, 222f.

¹⁰¹ Sigmund Freud, *Das Unheimliche*, ed. Oliver Jahraus (Stuttgart: Reclam, 2020), 14.



Figure 2.17: The motion of the exposed secret in the tenements¹⁰²

The uncanny is engendered, therefore, when the secret gets out the door. It is also impossible to discount the overt gendering of these *unheimlich* exposures. With blunt Freudian overtones, the female relative catches the porter in the humiliating act, so to speak, by peering down the stairs into the exclusive space of the male: the men's bathroom. Then, perpetuating the clumsy trope of the gossiping housewives, the pitiable old man becomes the object of ridicule amongst the opposite sex, which sets up most clearly the element that is showcased in the title of the film's English version, namely laughter. In short, the old porter has been confronted with that which, in Margaret Atwood's eyes, is *invariably* the greatest fear of the male of the species,

¹⁰² *Der letzte Mann*, 1:00:51–1:02:35.

expressed with such universality that a mathematically minded reader would be tempted to christen it “Atwood’s Theorem”: whereas “women are afraid that men will kill them,” conversely, “men are afraid that women will laugh at them.”¹⁰³ And while, for the former, it is in Murnau’s *Nosferatu* that an innocent woman is sacrificed to the predatory Count Orlok to save the day, *Der letzte Mann* showcases the latter fear with little subtlety, and the chorus of laughing women blur into one monstrous image of humiliation for the male.



Figure 2.18: Atwood’s Theorem¹⁰⁴

While an initial reading would suggest that the content of the *Geheimnis* is the metamorphosis of the porter, the previous re-assessment of the alcohol-fuelled dream sequence would render this very unlikely. If the innermost aspirations of the porter are to become that which he at no point really was, then the secret that gets out is surely his *stationary* reality, i.e. that he has never been the “Erste” at all. The content of the secret then begins to mirror the way it operates: whirring around, from neighbour to neighbour, the *Geheimnis* encircles a fixed central axis in the form of the porter himself. In congruence with the dream sequence, the fluid motion of the camera synchronises with the permeability of the many doors, functioning again like the all-important *Drehtür*. Ultimately, this confirms the unyielding presence of a *lack* of motion, a stasis,

¹⁰³ Jess Hill discusses the origin of the quote (which is not associated with any particular text) in her work. It seemingly arose from a survey Atwood herself conducted amongst friends and students regarding gendered fears. Jess Hill, *See What You Made Me Do: Power, Control and Domestic Abuse* (Carlton, Australia: Black Inc., 2019), 57.

¹⁰⁴ *Der letzte Mann*, 01:06:07.

that should have been kept in the dark behind closed doors but was drawn out into the light. In line with this topological way of thinking, the secret is subjected to repeated processes of motion and transition, which serve to draw attention all the more to their own counterpoise: the concealed invariance within. With the uniform failing to shield the former doorman from ridicule amongst his fellow residents, he then returns to the hotel, places the useless *Livree* in the hands of the watchman, and retreats to the bathroom in shame. In what seems like the close of the narrative, the porter is found slumped against the wall, a devastated ghost of a man (Fig. 2.19). He is cared for only by another lowly member of the hotel staff, the watchman — “two human wrecks,” as Kracauer notes, who at best enjoy “a moving gesture of solidarity.”¹⁰⁵



Figure 2.19: The death-like porter in the bathroom¹⁰⁶

In short, this solemn scene confirms the status of the porter as “der letzte Mann,” admired by nobody and at most the object of (self-)pity, but unlike Kracauer and Eisner assert, the changes that brought him to this point were really so profound. In fact, they have served, like the rotating door, to highlight underlying continuities in the porter’s life. The status of “der letzte Mann” is by no means a new one; it has merely been exposed to the world around the doorman and perhaps to himself as well. As this display comes to a close, fading into black, however, the viewer soon discovers that endings need not be singular events after all.

¹⁰⁵ Kracauer, *From Caligari to Hitler*, 100.

¹⁰⁶ *Der letzte Mann*, 01:13:23.

Turning Point

In a sudden break from the commitment to visual storytelling, a textual intervention is staged in the form of the second (and last) caption of the film, which wastes little time in announcing a change of fortunes for the “von Allen Verlassenen” (Fig. 2.20). As the caption lifts, the spectator is brought back to the hotel’s interior, where wealthy guests howl with laughter at the headline newspaper story: a travelling Mexican millionaire died suddenly in the washroom of the hotel, and his last will and testament stipulated that his wealth was to be bequeathed to the person in whose arms he died. Moving into the hotel restaurant, the camera swoops alongside a table of gastronomical delights and converges on the seated protagonist, now dressed in a regal dinner suit, who is revealed to be the surprise beneficiary of the businessman’s fortune. Attended to by two waiters, the former washroom assistant, joined by the somewhat overwhelmed night watchman, indulges in his pre-established habit of immoderate drinking (now with a fine champagne from Reims), delves greedily into all manner of deluxe dishes, and generously tips each and every staff member as he exits the hotel onto the street.



Figure 2.20: The “Autors” caption¹⁰⁷

¹⁰⁷ *Der letzte Mann*, 01:14:24 – 01:15:10. Adapted from several frames to one image.

The film closes, as has been noted, where it begins, as the protagonist and his friend are carted away on a private carriage, with the familiar *Drehtür* lingering in the background. Of course, everything about this improbable “Nachspiel” points towards its inauthenticity. The sudden turn is marked by one of only two captions in the film, implying that the aperture between the two narrative spaces (before and after the caption) is such that it cannot be bridged diegetically, i.e. within the story world alone. A sympathetic but manipulative “Autor” asserts his presence and admits his sleight of hand. Likewise, the chasm between the two versions of the protagonist is manifest on a visual level: on the one hand, there is the ghostly “human wreck,” a hunched-over and dejected washroom attendant, and on the other hand, there is the sprightly, well-groomed millionaire in the hotel restaurant. If the two manifestations of Emil Jannings’ character are juxtaposed, say by comparing the two figures 2.21 and 2.19 above, the spectators might unsurprisingly suspect that they are being misled once again. The “Nachspiel,” in short, registers primarily as a charade.



Figure 2.21: The old doorman’s luxury banquet after his twist of fate¹⁰⁸

This judgement is, of course, one that has been proposed before; as Kracauer writes: “Mayer grafts upon this natural conclusion an ingenious second one [...]. What follows is a nice farce jeering at the happy ending typical of the American film.”¹⁰⁹ The second ending is thus a cheap

¹⁰⁸ *Der letzte Mann*, 01:17:21.

¹⁰⁹ Kracauer, *From Caligari to Hitler*, 100f.

crowd-pleaser for the American release of the film, and Murnau, it would seem, has his own last laugh by pushing this “happy end” to an almost absurd level, thus allowing it to better ground the much gloomier first ending, or in Kracauer’s words:

The farcical character of this concluding sequence corroborates its introductory caption in that it expresses the author’s disbelief in a happy ending involving such categories as chance and good luck. If there should exist a way out for hotel porters degraded to lavatory attendants, it is certainly not identical with any solution rooted in the superficial concepts of Western civilization. Through its second ending the film underscores the significance of its first one, and moreover rejects the idea that the ‘decline of the West’ could be remedied by the blessings of the West.¹¹⁰

By *grafting* on this “fairy tale”¹¹¹ epilogue, as Kracauer says, Murnau and his screenwriter Mayer have thus triggered a metamorphosis that violates the now well-known criteria of topological equivalence — cutting and sticking do not preserve neighbourhood relationships — creating two narrative spaces with no preserved, invariant essence. This “farcical character” of the second corroborates this irreconcilability of the two disjointed conclusions, cementing, as Kracauer eloquently explains, a deeply held scepticism of what Einstein calls the shallow “accumulation of worldly goods” in his aforementioned obituary of Noether, i.e. the allure of Western capitalism. This assessment would no doubt accord to the political leanings of the director and the *Kammerspielfilm* as a genre. The happy twist, it seems, is one metamorphosis too far for any notion of invariance and preservation to endure.

Yet, if there is a lesson to be learned from the spatial insights of Hausdorff and Noether — and from the re-assessment of the previous parts of the film — it is that even the most monstrous of deformations can be honeycombed by subtle invariant properties. Despite the sense of *change* that is emblazoned on the doorman’s improbable leap from the “Stätte seiner Schmach” to ludicrous wealth, can threads of *continuity* be drawn that are not severed in the transition? In other words, can the invariant axis in the constant rotation be identified once again? Answering this question, it would seem, calls for what is perhaps Noether’s most transferable skill: seeking the common ground, even, or perhaps especially, when it is well hidden and far from obvious. Such a task, which reads the final scene somewhat against the grain, necessitates not just another departure from Kracauer’s assessment, but indeed it also demands that the viewer pay a little less attention to that invasive “Autor” in the caption that marks the final transformation. As is argued in the following, this more suspicious approach can be seen to unearth a lingering *Invarianz* in what seems like a seismic, all-encompassing (if ironic) shift, which in turn has unavoidable consequences for the interpretation of *Der letzte Mann* as a whole.

¹¹⁰ Ibid., 101.

¹¹¹ Ibid.

In her own analysis of the film, Collier breaks from Kracauer's view by relating the closing shot of the film, the porter and the watchman departing in a carriage in front of the hotel, to the earlier images of the porter surrounded by admiring neighbours:

Without the epilogue, the doorman is seen to fully accept that he has no identity without the uniform, as objectified by the black empty space of the lavatory. With the epilogue, he is seen to have traded one uniform, one external image of self, for another — from doorman to grand bourgeois. The regal wave he gives as he pulls away in the carriage in the film's final shot is exactly the same as the one he gave his adoring neighbors.¹¹²

Spotting a scene that is set up in the exact same way as before, just with different actors and costumes, Collier's finding implies that the epilogue may in fact be a repetition, pre-empting perhaps another fall amongst onlookers who will be no less ruthless than the previous. While Collier's perspective is one that this analysis echoes in sentiment, there is more to rely upon than the *potential* idea of another collapse to make this point. Fundamentally, in a way that sharply undermines the supposed transition, this final scene thematically begins more or less where the previous sequence ended: laughter. The spectators, witnessing first the riant guests in the hotel lobby at the scene's opening, are then led to enjoy the extended "last laugh" of the doorman, chuckling at his overloaded table of food. This gleeful "nice farce" is, however, cratered with another type of laughter, one that does not paint the old porter as the object of some well-meaning humour. Despite a new guise, the brash and uncouth mannerisms of the protagonist — unbecoming of a refined, upper-class establishment — lead to him making something of a scene: he boisterously greets, as one would in the local *Kneipe*, his only friend, the watchman, who looks ludicrously out of place, drowning in a new overcoat and struggling to carry an absurd pile of gifts. Then, he noisily summons the waiters back and forth with demands for more extravagant dishes but proceeds to clumsily serve himself and his companion — an endearing but nonetheless jarring display in an otherwise sophisticated environment. While the porter raucously showers the somewhat overwhelmed night watchman with caviar and expensive booze, the surrounding guests, as can be seen in figures 2.22 and 2.23 below, begin to enjoy what has become a spectacle of sorts. Clearly, the giggling guests, craning their necks to get a better view of the chaotic display, are not taking some well-intended pleasure in the newfound fortune of the doorman, thereby welcoming him with a mirthful embrace into their ranks. They are not laughing *with* the former doorman; rather, they are laughing *at* him.

¹¹² Collier, *From Wagner to Murnau*, 119.



Figure 2.22: A spectacle in the restaurant (I)¹¹³



Figure 2.23: A spectacle in the restaurant (II)¹¹⁴

¹¹³ *Der letzte Mann*, 01:19:31.

¹¹⁴ *Der letzte Mann*, 01:21:47.

Recalling the revealing drunken dream of the doorman in the wake of his demotion, his desire was always to be appreciated, admired and respected by the hotel clients he so proudly served, which is to say, to feel a part of that well-heeled class of cosmopolitans from whom he was economically and materially separated. Now, in this discordant “Nachspiel,” the protagonist enjoys a financial proximity to those very clients that was hitherto unthinkable; it would seem that the wish of aspirational dream has partly been granted. Yet, the gulf that separates the social classes in *Der letzte Mann* has not really been bridged, for his uncultured, boorish nature has turned him into nothing more than a clown. In short, he is *still* entirely out of place. We as spectators are not alone in noticing this irreconcilability of the two social spheres in the film, for the two waiters who are summoned repeatedly between the kitchen and the table share a telling glance (Fig. 2.24), that underscores the sneering laughter of the other guests:



Figure 2.24: A telling look¹¹⁵

For all the surface-level changes, this dubious epilogue thus communicates a sense of invariance just as much as it does swift transformation. Much like the revolving door is fixed around one unchanging axis, the wheel of fortune that supposedly propels the protagonist to great riches encounters inertia in the mocking laughter of just about every character who surrounds and observes him. In this sense, this whole scene is not as different as its gloomy predecessor in the

¹¹⁵ *Der letzte Mann*, 01:18:33. Likewise, when the watchman arrives in his formalwear, the two young staffers at the entrance share similar mocking glances and struggle to hold back laughter as he mistakes for theft their attempts to take his coat and many parcels off him to check them into the cloakroom.

hotel's underbelly as Kracauer would maintain: the pointed laughter here just supplements the chorus of laughter in the tenement block, conveying yet another humiliation in a sequence of them. Far from a grafted "Nachspiel," we just have a continuation of the *Spiel*, a discernible *ewige Wiederkehr des Gleichen* that is revealed by the utilisation of change and transformation. This scene is, therefore, a turning point, but merely a turn in a never-ending circle, and the fact that the doorman seemingly fails to notice this widening gap between himself and those he now thinks of as his peers is merely the final twist of the knife, for we as spectators *do* notice it, and we are invited to also enjoy a (slightly guilty) laugh at the buffoonish doorman's expense. The supposed tale of a crushing downward trajectory followed by a swift ascent to glorious heights is now somewhat doubtful. Ushered into something of an analytical *Drehtür*, the viewer is encouraged, therefore, circle back once again to the beginning of the film and view the opening marker of transformation, the title card reproduced above (Fig. 2.2), with a revitalised degree of scepticism. The doorman never really experienced a fall, for he was already at the bottom, and now, in this final scene, a sudden, meteoric rise is made just as dubious. To twist Kracauer's assessment, the "farical character" of the second ending does not underscore the "significance of the first"; rather, it exposes, upon closer inspection, the false premise and farcicality of the first.

As for the second invariance, if Kracauer's suggestion that the social spheres of the film are bridged at the beginning was questionable, it is certainly questionable here too, even though it ostensibly seems to be the case. Allowing for one final Kafkaesque consultation, in the penal colony, where uniforms can change hands, commandants and officers can perish and fearsome instruments of torture can malfunction and disintegrate, the societal structure of the *Strafkolonie* itself nevertheless endures. That supposedly enlightened traveller with so-called humanist values, who could be most expected to challenge the oppressive social architecture of the colony, ends up being one of its fiercest protectors: as the soldier and the condemned man try to follow him onto the departing ship, he hangs back and "hob ein schweres geknotetes Tau vom Boden, drohte ihnen damit und hielt sie dadurch von dem Sprunge ab."¹¹⁶ Well poised on the vessel's stern to beat back any escapees, the traveller guarantees the invariance of the wider system that governs the terrifying outpost: the "Nachbarschaftsbeziehungen" that govern the structural integrity of the spaces remain intact. Similarly, in *Der letzte Mann*, the workers are moved around, uniforms are taken and re-taken, the suddenly destitute come by incredible wealth, but the revolving door figuratively and literally just keeps spinning, and the chasm that separates the servant class and monied elite remains insuperable.

¹¹⁶ Kafka, *In der Strafkolonie*, 198.

Summary, or: *Invariante Variationsprobleme*

Taking Günzel's proclaimed topological turn, a mathematization of the spatial turn in the humanities, as a springboard for an aesthetic analysis of German modernism, this chapter attempted a re-reading of F.W. Murnau's *Der letzte Mann* of 1924, one of Weimar cinema's most memorable outputs. Guided by the topological principle of invariance throughout metamorphosis and the imaginings of Franz Kafka, it was suggested that the canonical readings of the film in scholarship to date too complacently characterise the film as a visualisation of absolute transformation, an unyielding metamorphosis into the titular last man. By reconceiving of the central aesthetic aspects of the film — a constantly turning *Drehtür* and the innovative "entfesselte Kamera" — as means to unearthing concealed invariances within processes of change, a corresponding re-reading of the film was proposed. Despite all the changes and fluctuations — perceived and real — that occur in the porter's life, he is the invariant point in his own metamorphosis: he never was "der Erste," the admiration he enjoyed in his community proved to be as shallow as a quick costume change, and he never really gets the last laugh promised by the Hollywood re-branding, regardless of the status of the jarring twist of fate in the final minutes of the film. The original German title is ultimately the most truthful, for the hotel porter was and remains "der letzte Mann," a pitiable object of derision, who resorts to playing dress-up to feel better about himself. Invariance, it may be said, to borrow and lightly adjust Noether's remark cited at the beginning of this chapter, "ist jetzt hier Trumpf."

3

“Null mit Null multiplizieren”

Transformation, Emptiness and “die neue Frau” in Mela Hartwig’s *Das Weib ist ein Nichts* (1929) and *Bin ich ein überflüssiger Mensch?* (1931)

“Das ideale Drama zu n Personen muss enthalten: n Persönlichkeiten, $\frac{n(n-1)}{2}$ dialogische Beziehungen, $\frac{n(n-1)(n-2)}{6}$ ‘dreieckige’ Verhältnisse und so fort, oder, wie man in der Arithmetik sagt, Unionen, Binionen, Ternionen in der überhaupt möglichen Anzahl. Also innere Vollständigkeit und Erschöpfung aller denkbaren Combinationen; keiner der Handelnden soll nur einseitig wirken oder einseitig empfangen — zwischen den vorhandenen Punkten sind alle Linien, Ebenen usw. wirklich zu zeichnen. [...] Man sieht, wie sehr der ernsthafte Dramatiker bemüht sein wird, sein n zu verkleinern!”¹

— Paul Mongré, *Sant’Ilario*

“In Wien stellen sich die Nullen vor den Einser,” quips Austrian satirist Karl Kraus in just one of his many biting aphorisms comparing the two German-speaking metropolises of Berlin and Vienna in *Pro domo et mundo* of 1912.² Both “Zentren der Moderne”³ are subjected to Kraus’ acidic wit, when he opines in a mocking defence of Berlin, for example, that “ein Kulturmensch wird lieber in einer Stadt leben, in der keine Individualitäten sind, als in einer Stadt, in der jeder Trottel eine Individualität ist.”⁴ Nonetheless, it is the dysfunctional Austro-Hungarian capital, awash with mediocre nothings, “wo die Automaten Sonntagsruhe haben und unter der Woche nicht funktionieren,”⁵ that is met with the most derision. Yet of course, for all its proclivity for *Null*-ness, Vienna occupies a unique position not just as a site for the proliferation of modern art and literature but as a unique nexus for an array of cross-disciplinary expressions of modernity. Alongside Karl Kraus’ erratically published periodical *Die Fackel*, turn-of-the-century Vienna accommodated Sigmund Freud’s landmark publication of *Die Traumdeutung* in 1900 and the plumbing of the mind on his chaise longue, the simultaneous centring of the individual

¹ Paul Mongré, “Sant’Ilario,” 247.

² Karl Kraus, *Ausgewählte Schriften Band IV: Pro domo et mundo* (Munich: Albert Langen, 1912), 119.

³ Gottfried Willems, *Die Geschichte der deutschen Literatur, Band V: Moderne* (Vienna, Cologne and Weimar: Böhlau Verlag, 2015), 122.

⁴ Kraus, *Pro domo et mundo*, 119.

⁵ *Ibid.*, 125.

perspective in literary narrators, like in Arthur Schnitzler's stream-of-consciousness novella *Leutnant Gustl*, and intense erotic symbolism in Gustav Klimt's visual art. This pseudoscientific "objective" study of the subject, then, co-existed with Adolf Loos' multipurpose and utilitarian architecture following his turn away from the Wiener Secession in 1896 and Moritz Schlick's formation of the resolutely objective and scientific Wiener Kreis in the university's *Mathematisches Seminar* on the Bolzmannngasse. The *Wiener Moderne*, therefore, both naturally transcends disciplinary divides and interweaves various cultures and approaches.

To pull on the thread of modern mathematics, it is thus perhaps unsurprising that some attention has been paid to the context of Vienna in existing scholarship. In his aforementioned essay on the utility of the term "modernism" in the history of mathematics, Leo Corry critiques the insular focus on German institutions and cities in Mehrrens' *Moderne-Sprache-Mathematik*. Curiously, in one of his own initial attempts in the article to "look for ideas relevant to a possible discussion of modernism in mathematics,"⁶ Corry unwittingly demonstrates an inability to follow his own advice, for he soon turns to advocating for a renewed focus on the academic culture of not just one nation, but one particular city, namely this turn-of-the-century Vienna. Heaping praise onto Allan Janik and Stephen Toulmin's landmark *Wittgenstein's Vienna* of 1973,⁷ Corry casts turn-of-the-century Vienna as a network of cross-disciplinary links enveloping an array of well-known and indeed less well-known modern actors. To the usual writers with mathematical training, i.e. Robert Musil, Hermann Broch, Corry adds the less canonical Leo Perutz, a Prague-born Versicherungsmathematiker, who briefly worked in the Trieste office of Assicurazioni Generali — the same insurance firm for whom Franz Kafka worked in their Prague division — and whose fantastical mystery-crime novels set in Imperial Vienna were described by Friedrich Torberg as the literary offspring of an illicit encounter between Kafka and Agatha Christie.⁸ Then, alongside these mathematical cognoscenti, Corry ponders whether the simultaneous mathematical work underway at Universität Wien, such as the further development of topology and knot theory by Kurt Reidemeister (who was appointed in 1922

⁶ Corry, "How Useful is the Term 'Modernism,'" 29.

⁷ Corry recites their question: "Was it an absolute coincidence that the beginnings of twelve-tone music, 'modern' architecture, legal and logical positivism, nonrepresentational painting and psychoanalysis — not to mention the revival of interest in Schopenhauer and Kierkegaard — were all taking place simultaneously and were largely concentrated in Vienna?" Allan Janik and Stephen Edelston Toulmin, *Wittgenstein's Vienna* (New York: Simon and Schuster, 1973), 18. Cited in Corry, "How Useful is the Term 'Modernism,'" 31.

⁸ While a discussion of Perutz will not be taken forward in this thesis, his 1918 novel *Zwischen neun und neun* could meaningfully be brought into a conversation with the insights of the subchapter on Mauthner, Nietzsche and Mongré's "Sprachkritik," especially with regards to the creative potential that ensues from the death of language and its referential capacity. For an insightful assessment of the novel and its engagement with the philosophy of language in the intellectual circles of modern Vienna, see Gary Schmidt, "Performing in Handcuffs: Leo Perutz's *Zwischen neun und neun*," *Modern Austrian Literature* 43, no. 1 (2010): 1-22.

and became well acquainted with key figures of the Wiener Kreis), could also be seen as the result of Janik and Toulmin's "broad historical processes that underlie all other manifestations of Viennese modernism."⁹ While ultimately leaving a full exploration of it to future scholars, Corry emphasises one such underlying shift identified in *Wittgenstein's Vienna*, namely the "processes leading from Mauthner to Wittgenstein," as a means to positing a new proximity not only between Reidemeister and these aforementioned writers, but key actors of a broader Viennese scientific culture, like Ernst Mach and his phenomenalist philosophy of physics and the Wiener Kreis itself.¹⁰ Taken together, Corry suggests that these modern expressions variably interact the central task of constructing through "the logical articulation and empirical application of systematic theories [...] a direct *bildliche Darstellung* of the world."¹¹ Now, this short outline is enough to indicate a fundamental divergence with the approach taken in this thesis, which has positioned Mongré's language critique as an explicit breakaway from Mauthner's own and would argue that a "*bildliche Darstellung* of the world" has bearing on the disciplinary space of physics, as opposed to modern mathematics.¹² What, then, is the way forward?

In the introduction to this thesis, Nina Engelhardt's similar blend of methodological sympathy for Corry's "underlying fields" and a measure of reservation when it comes to taking them forward was discussed. As such, noting how most appeals in existing research into modernism and mathematics principally address historians, Engelhardt proceeds with an astute literary analysis that involves two of the figures mentioned by Corry, namely Musil and Broch, which primarily elucidates the thematization of mathematical enigmas and mindsets in *Der Mann ohne Eigenschaften* and *Die Schlafwandler*. Yet, as has been the methodological thrust of this thesis, if modern mathematics is to be more meaningfully "added" to modernism, then it is necessary to extend beyond the analyses of writers with mathematical training, lest we accept an unnecessarily narrow category of (principally male) writers with access to elite educational institutions in which to examine disciplinary cross-over. Briefly taking stock, Chapter 1 examined a common instance of philosophical influence in Friedrich Nietzsche, who was seen to guide Felix Hausdorff's proto-topological *Transformationsprinzip* and his turn towards mathematical formalism as the

⁹ Corry, "How Useful is the Term 'Modernism,'" 30.

¹⁰ Ibid.

¹¹ Janik and Toulmin, *Wittgenstein's Vienna*, 166, cited Corry, "How Useful is the Term 'Modernism,'" 31.

¹² It is argued in the next chapter by way of its associations with Bauhaus that the Wiener Kreis and logical positivism are in fact more aligned to one of formalism's competitors, namely logicism. It is necessary to stress, however, that neither the Wiener Kreis nor Bauhaus (a pairing that has been assessed by various scholars; see next chapter) are to be imagined as wholly uniform and consistent in their working philosophies, and the former did of course accommodate philosophers (like Rudolph Carnap) who were directly impacted by David Hilbert's programme.

“Spielraum des Denkens” in the early 1900s. This fairly localized but nonetheless impactful *Einflussgeschichte* serves to ground a more transferable conception of space in mathematical modernism that is two-pronged: (i) a shifting understanding of the concept of space, i.e. as a nuanced relationship between transformation and invariance, that (ii) is interwoven with a reappraisal of the remit of mathematical language itself. To begin the task of mapping out a corresponding *Raumproblem* in German-language cultural modernism, Chapter 2 grappled with the former aspect with respect to Murnau’s *Der letzte Mann*. How, then, might the latter aspect — the loss (or emancipation from) a clear sense of spatial *content*, of foundational material — be accounted for? While the next chapter will address this question in its own right, this chapter forms a necessary intermediate step. Here, I ask if and where these two spatial tenets can be seen to work *in tandem* in German-language modernism. In short, situated between two modernist echoes of mathematical thinking, the task of this chapter is to listen out for how these two reverberations — the transformation-invariance dynamic and de-ontologisation in language — are in fact entangled. In search of perceptive ears, it turns out that Vienna’s cultural scene, apparently overrun with *Nullen*, is a fitting place to start after all, albeit not in that famous Boltzmannngasse lecture theatre. The focus of this chapter will lie with someone with no direct mathematical training or engagement with mathematical discourse, namely the Viennese writer Mela Hartwig.

An example of the so-called “vergessene” generation of female writers, whose marginalization was compounded by a forced exile following the rise of German Nazism, Hartwig by no means sits alongside figures like Murnau, Kafka, Musil and Broch as part of the German-language canon of literary and cinematic modernism, but her early works did attract some notable attention in Vienna’s literary circles in the late 1920s, and they have enjoyed a belated (and albeit relatively modest) renaissance since her death in 1967. Born in Vienna in 1893 to a Jewish family that converted to Catholicism, Hartwig briefly began to train as a teacher following her Matura, before joining the Wiener Konservatorium in 1917, where she studied singing and acting until 1921. Following her marriage to Jewish lawyer Robert Spira in 1923, Hartwig moved to Graz, where she took to writing for the first time, publishing a disturbing short story entitled “Das Verbrechen” in 1927, in which an archotypically “hysterische” young woman develops an incestuous relationship with her psychoanalyst father. With the text attracting the praise of Alfred Döblin and Stefan Zweig, Hartwig was soon able to re-release it as part of a collection of stories, *Ekstasen*, in 1927.¹³ Building on this small breakthrough, Hartwig soon published her

¹³ This volume was published anew in 1992 by Ullstein, and then a larger volume containing these texts and further short stories was published by Droschl as *Das Verbrechen* in 2004.

first novel-length work *Das Weib ist ein Nichts* in 1929, whose content certainly lives up to its provocative title, and which is one of the two focal texts of this chapter.



Figure 3.1: Mela Hartwig

Opening with the 16-year-old Bibiana inspecting her naked body in her bedroom mirror, the fast-paced third-person narration follows how she repeatedly falls into the hands of several men who fundamentally reshape her character each time — from imparted traits to new names. Swept away by the unnamed “Abenteurer,” a domineering and manipulative conman, Bibiana is drawn into an elaborate heist and sculpted into Nastasja, an underage Russian noblewoman, only for the charade to crumble and the conman to commit suicide as the police arrive. Spared punishment by some Germanic “Excellenz,” who houses her in his palace, Bibiana is placed under the tutelage of a bumbling but brilliant musician and soon leaves her palatial surroundings to become his frustrated lover in a squalid two-room tenement house. She then abandons the musician and secures secretarial work under a cold, severe bank manager, with whom she begins another secret affair and enjoys a life of extravagance at his behest. When a financial collapse triggers the banker’s ruin and he disappears, Bibiana’s search for him soon leads her to a politically engaged factory worker, who becomes her final companion before her untimely demise at a workers’ protest when she is trampled by police on horseback. With each change in circumstance accompanied by a transformation in Bibiana’s body and lifestyle — from the upper echelons of society to dull housework and relative starvation, then once more to

fantastical luxury in a Biarritz villa and finally back to poverty — *Das Weib ist ein Nichts* reads, at first, like a kaleidoscopic whirr of metamorphoses at the hands of a series of male lovers.

Met with a mixture of acclaim and disconcertment,¹⁴ *Das Weib ist ein Nichts* would be the final text published in Hartwig's lifetime. Submitted for publication in 1931, Hartwig's second novel bearing yet another unambiguous title *Bin ich ein überflüssiger Mensch?* showcases, according to Zsolnay publishing house, a refinement of Hartwig's "bisherigen Stil zu größerer Klarheit und Reife," but that the increasingly tense political climate would render its publication "einen sicheren Misserfolg."¹⁵ From this point on, Hartwig would largely move away from writing. Fleeing Austria for England with her Jewish husband, Robert Spira, following the Anschluss in 1938, Hartwig enjoyed moderate success as a painter in London's creative circles, where she rubbed shoulders with none other than Virginia Woolf.¹⁶ Many decades after her death, this second novel was finally published in 2001 following the rediscovery of Hartwig's manuscripts, which has prompted a welcome but nonetheless moderate degree of critical and scholarly engagement with Hartwig's literary output,¹⁷ with an English translation even catching the attention of celebrated English contemporary novelist Zadie Smith.¹⁸ If *Das Weib ist ein Nichts* showcases the allure of a beautiful protagonist, *Bin ich ein überflüssiger Mensch?* opts for unyielding mediocrity with Aloisia Schmidt, who describes herself — physically, intellectually and in terms of personality — as inflexibly "überflüssig." Moreover, whereas the 1929 novel saw the typical

¹⁴ In her afterword to the 2002 Droschl edition, Bettina Fraisl maps out the critical response to the novel. Interestingly, talks for a film adaptation were initiated in January 1931 via correspondence by Gertrude Grunwaldt at Metro-Goldwyn-Mayer. She imagined an adaptation of the text with the title *WOMAN IS NOTHING* as prime material for a Greta Garbo film, and with a curious parallel to the pressures put on Murnau for *Der letzte Mann*, Grunwaldt noted that a "happy ending" would be needed for a Hollywood success. Unfortunately, no agreement was reached between the production company and Zsolnay-Verlag, and the project fell by the wayside. Bettina Fraisl, afterword to *Das Weib ist ein Nichts* (Graz: Literaturverlag Droschl, 2002), 187f. See Appendix A for correspondence from Grunwaldt.

¹⁵ Cited here from Bettina Fraisl, afterword to *Bin ich ein überflüssiger Mensch?* (Graz: Droschl, 2001), 160. See Appendix B for the document in question.

¹⁶ See Lisa Silverman's study of Austrian interwar culture and the effect of emigration in the late 1930s for a detailed history of Hartwig's life and publishing career (contextualised alongside numerous other emigrées). Lisa Silverman, *Becoming Austrians: Jews and Culture Between the World Wars* (Oxford: Oxford University Press, 2012).

¹⁷ Building on the infrequent studies into Hartwig's works that were published before 1930, Bettina Fraisl initiated this new wave of scholarly attention with *Körper und Text: (De-)Konstruktionen von Weiblichkeit und Leiblichkeit bei Mela Hartwig* (Vienna: Passagen Verlag, 2002). See also: Walter Fähnders' comparative discussion of the 1931 novel's case of pre-publication censorship "Über zwei Romane, die 1933 nicht erscheinen durften. Mela Hartwigs *Bin ich ein überflüssiger Mensch?* und Ruth Landshoff-Yorcks *Roman einer Tänzerin*," in *Regionaler Kulturraum und intellektuelle Kommunikation vom Humanismus bis ins Zeitalter des Internet*, ed. Axel E. Walter (Amsterdam and Atlanta: Rodopi, 2004), pp. 161-190; Ulrike Stamm, "Die Nullität der Frau und der Einspruch gegen das autonome Subjekt. Mela Hartwigs Roman *Das Weib ist ein Nichts*," in *City Girls. Bubiköpfe und Blaustrümpfe in den 1920er Jahren*, ed. Alexandra Tacke and Julia Freytag (Cologne, Weimar and Vienna: Böhlau, 2011), pp. 55- 69. Most recently, an entire volume of articles was dedicated to Mela Hartwig's prose in *Text + Kritik*, which was edited by Marijke Box and Vojin Saša Vukadinovic and published in July 2023.

¹⁸ The English translation *Am I a Redundant Human Being?* by Kerri Pierce (Funks Grove, London and Dublin: Dalkey Archive Press, 2010) features alongside a critique of Thomas Bernhard in Smith's essay "The Harper's Columns" in her creative non-fiction collection *Feel Free*, where she notes how the novel "works like a life buoy, alerting us to a writer drowning in obscurity." Zadie Smith, *Feel Free* (London: Penguin, 2018), 289.

“rags to riches” tale twice repeated and reversed, *Bin ich ein überflüssiger Mensch?* is a supposedly more mundane *Büroroman*: the novel is entirely composed of the intense retrospective self-analysis of Aloisia, a Viennese “Stenotypistin” and wannabe stage actress. In less overblown prose, Aloisia, in an attempt to answer the titular question over the course of 150 pages, describes how she falls in and out of jobs at various legal, financial and architectural firms just as she does fleeting relationships, all the while relying upon others to supply her with any meaningful characteristics and purpose, i.e. to shape her inner world and self.

From these brief outlines, it is clear that both *Das Weib ist ein Nichts* of 1929 and *Bin ich ein überflüssiger Mensch* of 1931 engage with this pervasive modernist theme of metamorphosis and transformation: much like with Murnau’s *Der letzte Mann*, readers are confronted with protagonists who are subjected, it seems, to relentless processes of change. Furthermore, these changes in personhood and circumstance are likewise enveloped by wider, societal fluctuations in work and power relations; the doorman’s sudden arrival into immense wealth is experienced (albeit in different ways) by Bibiana, and in Hartwig’s novels, especially the latter, the position of the *Arbeiterklasse* is adjoined by a reflection on the shifting status of women in the world of work and leisure. At this point, it is appropriate to ask whether *Das Weib ist ein Nichts* and *Bin ich ein überflüssiger Mensch* also invite a more topologically cognisant examination that can see past surface-level change and through to potential invariances concealed therein. If connections between modern mathematics and aesthetic modernism can be uncovered by re-reading German-language modernism through the prism of the *Raumproblem*, then Hartwig’s novels seem well placed to assist on this level. Yet, this chapter seeks to do more than replicate the spatial analysis of *Der letzte Mann* in a new context, which is to say, merely follow the trajectory of that first “Echo” of invariance within transformation as it bounces off in several directions. Here, I argue that the second “Echo,” that of operating (anxiously or enthusiastically) in the absence of *Grundlagen*, is also at work in Hartwig’s novels: her engagement with transformation not only accompanies but is in fact intimately interwoven with the troubling characterisation of the modern woman as fundamentally foundationless — as *Nichts*, as *Überflüssigkeit*.

While it is clear that Hartwig’s novels do — even at this cursory glance at their contents — suggest themselves for an analysis through the main conceptual prism of this thesis, it may prove fruitful to first take a closer look at the aforementioned scholarship linking modern mathematics to Viennese modernist literature, for a more robust connection between the epistemological challenges that informed mathematical modernism and the specifically gendered questions that are grappled with by Hartwig needs to be established. In the following subsection, existing examinations of Musil’s essayistic work on mathematics and fiction will serve as a springboard

into the broader cultural discourse on precarious selfhood(s) in the *Wiener Moderne*, from some iconic *Maschinenmenschen* to Otto Weininger's troublesome (and strangely) pseudomathematical *Geschlecht und Charakter*. In short, by better grounding the gendered deployment of *Nichtigkeit* within a wider discourse, a more solid theoretical bridge between key developments in modern mathematics and the works of Mela Hartwig can then be constructed.

Running on Empty: The Void, the Machine and the *Frau*

With its focus on a writer with no formal training in mathematics beyond the basics of early school years, this chapter seeks to reach beyond writers like Musil and Broch. As such, it builds upon the valuable groundwork of scholars like Engelhardt by stretching the intended scope of its central questions to cover more territory — even if that territory is still in Vienna. To round off her assessment of the titular man without qualities, the mathematician Ulrich,¹⁹ Engelhardt draws attention to another of Musil's mathematical texts, namely a wry essay entitled “Der mathematische Mensch” of 1913, which “explores relations between maths, fiction and literature in a humorous and exaggerated tone.”²⁰ The essay moves nimbly between a focus on the discourse of mathematics and the position of the mathematician in such a way that reaches outwards and, as is argued in the following, comes to bear upon the non-mathematician and the conception of the modern Self more broadly, offering therefore this necessary bridging point in the analysis of figures like Hartwig and her unsettling protagonists.

Denkmaschinen und denkende Maschinen

In his essay, Musil first probes the role of mathematics, ostensibly “eine äußerste Ökonomie des Denkens,” and sets up the familiar duality of pure and applied mathematics.²¹ With the help of this “umständliche Apparat,” Musil notes, “ist unsere ganze Zivilisation entstanden,” for its inherent “Nutzbrauch” undergirds almost all functional processes imaginable, from those of everyday simplicity, for which “der gewöhnliche Mensch nicht viel mehr von ihr braucht als er in der Elementarschule lernt,” to the complex workings of theoretical physics that rely upon

¹⁹ In her contribution to the volume *Being Modern*, Engelhardt reiterates this dynamic between Musil's essay and his prose works, this time retrospectively with focus on Musil's earlier novella *Die Verwirrungen des Zöglings Törleß* of 1906, and compares it to a similar essay-prose relationship between Russian writer Yevgeny Zamyatin's essay “On Literature, Revolution, Entropy, and Other Matters” (1923) and his novel *We* (1920). Nina Engelhardt, “Modern by numbers: modern mathematics as a model for literary modernism,” in *Being Modern: The Cultural Impact of Science in the Early Twentieth Century*, ed. Robert Bud, Paul Greenhalgh, Frank James and Morag Shiach (London: UCL Press, 2018), pp. 169-187.

²⁰ Engelhardt, *Modernism, Fiction and Mathematics*, 113.

²¹ Robert Musil, “Der mathematische Mensch,” in *Robert Musil: Gesammelte Werke, Band VIII*, ed. Adolf Frise (Hamburg: Rowohlt, 1978), 1005.

“wenig differenzierten mathematischen Mitteln.”²² Yet, this unrivalled capacity for application in the real world is not just a part of mathematics; it is a lesser part at that: “Nur wenn man nicht auf den Nutzen nach außen sieht, sondern in der Mathematik selbst auf das Verhältnis der unbenutzten Teile, bemerkt man das andere und eigentliche Gesicht dieser Wissenschaft.”²³ Less interested in these “Adaptierungsarbeiten” that are directed *outwards* into the world, “[i]rgendwo *innen* arbeitet der einzelne Mathematiker,” and, much like the doors of Gregor Samsa’s claustrophobic Zwischenraum, “seine Fenster gehen nicht nach außen, sondern auf die Nachbarräume.”²⁴ The specialist mathematician is spurred on not by the “praktisch liquidierbaren Nutzen” that may arise from her or his work: “er dient der Wahrheit, das heißt seinem Schicksal und nicht dessen Zweck.”²⁵ Underlining that modernist relocation of mathematical “Wahrheit” from its external applicability to something internal, Musil’s speaker then describes something of a hierarchical trajectory from the abstract workings of mathematics to the rise of all kinds of machinery, from bread ovens to the modern automobile:

Wir backen unser Brot, bauen unsre Häuser und treiben unsre Fuhrwerke durch [diese Wissenschaft]. Mit Ausnahme der paar von Hand gefertigten Möbel, Kleider, Schuhe und der Kinder erhalten wir alles unter Einschaltung mathematischer Berechnungen. Dieses ganze Dasein, das um uns läuft, rennt, steht, ist nicht nur für seine Einsehbarkeit von der Mathematik abhängig, sondern ist effektiv durch sie entstanden, ruht in seiner so und so bestimmten Existenz auf ihr. Denn die Pioniere der Mathematik hatten sich von gewissen Grundlagen brauchbare Vorstellungen gemacht, aus denen sich Schlüsse, Rechnungsarten, Resultate ergaben, deren bemächtigen sich die Physiker, um neue Ergebnisse zu erhalten, und endlich kamen die Techniker, nahmen oft bloß die Resultate, setzten neue Rechnungen darauf und es entstanden die Maschinen.²⁶

For all this passage’s exaggerated tone, none of this is particularly startling. In line with the thrust of Enlightenment rationalism, mathematical knowledge begins abstractly in the mind and is then applied across the spectrum of natural sciences and mechanics, and the resultant machines are thus indebted to mathematics for their very existence. Then, in this moment of calm cohesion, the storm strikes in the familiar form of the *Grundlagenkrise* of mathematics:

Und plötzlich, nachdem alles in schönste Existenz gebracht war, kamen die Mathematiker — jene, die ganz innen herumgrübeln, — darauf, daß etwas in den Grundlagen der ganzen Sache absolut nicht in Ordnung zu bringen sei; tatsächlich, sie sahen zuunterst nach und fanden, daß das ganze Gebäude in der Luft stehe. Aber die Maschinen liefen! Man muß daraufhin annehmen, daß unser Dasein bleicher Spuk ist; wir leben es, aber eigentlich nur auf Grund eines Irrtums, ohne den es nicht entstanden wäre. Es gibt heute keine zweite Möglichkeit so phantastischen Gefühls wie die des Mathematikers.²⁷

²² Ibid.

²³ Ibid.

²⁴ Ibid.

²⁵ Ibid., 1006.

²⁶ Ibid., 1005f.

²⁷ Robert Musil, “Der Mathematische Mensch,” 1006.

Continuing the quasi-architectural metaphor, the mathematician's conceptual digging in the innermost chamber with no outwards facing windows unearths not a solid foundation but a void, rendering the many "Maschinen" of modern life contingent upon and emerging from what is now an archetypal *Luftschloss*. And yet, perhaps with the notable exception of Karl Kraus' perpetually dysfunctional Viennese "Automaten," the mathematically dependent machines in Musil's vividly rendered assessment continue to run despite the emergence of a chasmic *Grundlagenproblem* in mathematics itself.

This "Grundlagenwitz," as Andrea Albrecht notes in her 2008 article "Mathematische und ästhetische Moderne," offers a number of "Deutungsmöglichkeiten" in the context of modern mathematics and its relation to the real world. While the mathematician's focused "[H]erumgrübeln" registers as the "belächelnswerte Schrulle weltfremder Spezialisten," the butt of the joke is surely the empiricist, who constructs models and machinery "im blinden Vertrauen auf die Anwendungstauglichkeit mathematischer Erkenntnisse."²⁸ On top of the plausible interpretations suggested by Albrecht here, let us consider again that declaration of improbable success despite the foundational rupture: "Aber die Maschinen liefen!" There is more to the mention of machines, it could be argued, than has already been noted, for the joke can, in a sense, be folded in on itself. Beyond the worldly machines that function according to the laws and insights of a field without solid footing, there is another machine whose cogs continue to turn in spite of the fact that mathematics now stands "in der Luft," namely the free-floating "Gebäude" of mathematics itself — the *Denkmaschine* of Hilbert's programme²⁹ — that is self-supporting and autonomous. On the back of Chapter 1, Musil's "Grundlagenwitz" can certainly be read along these lines, and in fact, this interpretation can be pushed a little further. As Albrecht, Engelhardt and others have rightly indicated, it not just mathematics as a discourse or "Spielraum des Denkens" that emerges as uniquely victorious in the face of a foundational crisis; the "working mathematician," as the title would indicate, is the true subject of Musil's praise. "Diesen intellektuellen Skandal," writes Musil following his pronouncement of the *Grundlagenkrise*, "trägt der Mathematiker in vorbildlicher Weise, das heißt mit Zuversicht und Stolz auf die verteuflte Gefährlichkeit seines Verstandes."³⁰ In other words, it is "die Mathematiker selbst [...], die ihr Tun in Frage stellen,"³¹ as Albrecht explains, and who want to

²⁸ Andrea Albrecht, "Mathematische und ästhetische Moderne: Zu Robert Musil's Essay 'Der mathematische Mensch,'" *Scientia Poetica* 12 (2008): 218-251, here 236.

²⁹ Mehrtens explores the use of this term in detail throughout his discourse analysis, noting how it was first used in critical response to Hilbert's self-reflexive and self-contained formalism, which, unlike intuitionism, theoretically does away with the personhood of the mathematician in the process of creating mathematical knowledge. It then became intertwined with the development of the Turing Machine. Mehrtens, *Moderne-Sprache-Mathematik*, 304ff.

³⁰ Musil, "Der mathematische Mensch," 1006.

³¹ Albrecht, "Mathematische und ästhetische Moderne," 239.

“penetrate the foundations of their own science and the rational worldview even at the risk of undermining their own foundations.”³² This conception of the modern mathematician aligns with the modernist variety of what Nicolas Michel calls “mathematical selves,” which is to say “different normative accounts of what being a mathematician entails”³³ in response to the modernist “absence of outward reference for mathematical discourse and the growing anxiety among practitioners after the emergence of new standards of rigor.”³⁴ Significantly, the advent of such mathematical selves, as Michel stresses, was “shaped against the decisive backdrop of various cultural trends and intellectual debates beyond mathematics,” and as such, any conception of mathematical modernism articulated via mathematical selves is to be imagined “as a composite phenomenon, inseparable from cultural history at large.”³⁵ In a similar vein, Musil insists that the way in which modern mathematicians carry on with remarkable enthusiasm despite the lack of firm foundations renders them “eine *Analogie* für den geistigen Mensch, der kommen wird.”³⁶ Musil’s sketch of a “mathematical self,” a mathematical spin on the overtly Nietzschean *Übermensch*, thus emerges as a radical *Vorbild* in a precarious modern world where “Gott ist tot,” whose ethical and epistemological foundations have been revealed to be just as illusory and naïve as those in mathematics, and which has allegedly borne witness to a cultural decay: “Wir haben damit unsre Dichtkunst schon so weit ruiniert, daß man nach je zwei hintereinander gelesenen deutschen Romanen ein Integral auflösen muß, um abzumagern.”³⁷

It is with this sense of *Vorbildlichkeit* in mind that Engelhardt approaches anew Musil’s subsequent magnum opus *Der Mann ohne Eigenschaften*, demonstrating how the ideas of the essay map onto the landmark novel: as something of a “literary implementation of the mathematical model developed in ‘The Mathematical Man,’” Musil’s unfinished text becomes a “negotiation of foundational and pragmatist orientations [...] in various responses to the absence of central ideas in Kakania and Ulrich’s personal life.”³⁸ As for the satirised setting of the dissolved Austro-

³² Cornelia Blasber, “A City ‘Under Glass’: Vienna in Robert Musil’s The Man without Qualities,” in *Vienna: The World of Yesterday*, ed. Stephen Erich Bronner and F. Peter Wagner (New York: Humanity Books, 1999), 153, cited in Engelhardt, *Modernism, Fiction and Mathematics*, 116. In a sense, Blasber’s description is somewhat understated here: It is not only that mathematicians risk undermining their own foundations; rather they have actively eradicated them outright. Drawing on from her reading of Mehrtens’ *Moderne-Sprache-Mathematik*, Albrecht briefly gestures towards Hausdorff as a fitting example here, isolating his opening remarks in *Grundzüge der Mengenlehre* that reveal an urge to embrace the ambiguities of foundations and carry on nonetheless. Albrecht, “Mathematische und ästhetische Moderne,” 238.

³³ Nicolas Michel, “Mathematical Selves and the Shaping of Mathematical Modernism: Conflicting Epistemic Ideals in the Emergence of Enumerative Geometry (1864–1893),” *Isis: Journal of the History of Science Society* 112, no. 1 (2021): 68.

³⁴ *Ibid.*, 72.

³⁵ *Ibid.*

³⁶ Musil, “Der mathematische Mensch,” 1007. Emphasis added.

³⁷ *Ibid.*

³⁸ Engelhardt, *Modernism, Fiction and Mathematics*, 117.

Hungarian Empire, just like the mathematician in Musil's essay looks *downwards* into a paradoxical void, in the often-cited eighth chapter of *Der Mann ohne Eigenschaften*, which opens with the hum of manmade machinery no less, the narrator looks *backwards* at the humorous inconsistencies at the bedrock of "dieses versunkene Kakanien."³⁹ As for the personhood of Ulrich, it is Walter, similarly decrying to Clarisse in the 17th chapter that "Heute ist alles Zerfall! Ein bodenloser Abgrund von Intelligenz," who brands his friend "ein Mann ohne Eigenschaften" in a rant about his job as a mathematician: "Ein Mathematiker sieht nach gar nichts aus; das heißt, er wird so allgemein intelligent aussehen, daß es keinen einzigen bestimmten Inhalt hat! [...] Nichts ist für ihn fest. Alles ist verwandlungsfähig [...]."⁴⁰ Ulrich (as Engelhardt indicates), is thus something of a "mathematischer Mensch" with respect to two gaping chasms, namely the societal one that surrounds him in the form of Kakanien and the one within himself. As the figure who carries out this "negotiation" between a lack of foundations (both externally and internally) and some form of pragmatism, which manifests as a "critical trust"⁴¹ in necessary fictions at the bases of society and selfhood, Ulrich is able to *function* despite — like the essay's mathematician — having gazed around himself and inside himself, only to find the abyss. Focussing on this second void in particular, i.e. that of the modern self, to be the "mathematischer Mensch" is, in a sense, to be able to *run on empty*.

Returning again to the "Grundlagenwitz," Musil's declaration "Aber die Maschinen liefern!" can be folded in on itself for a second time, because there is yet *another* machine at play here. As the person who is able to operate, to continue "working" after the erasure of discernible *Grundlagen* in his discipline, Musil's "Mathematiker" — the role model for that Nietzschean "Mensch, der kommen wird" — functions just like the very machines that "liefern" despite their indebtedness to a now foundationless body of knowledge. Now, it seems, pathways outwards from the case of Musil alone have come into view. While the machine-like capacity (and the connotation is a distinctly *positive* one) to operate on the basis of this negotiation between foundational emptiness and pragmatism, to use Engelhardt's terms, maps well onto the "mathematischer Mensch"

³⁹ Robert Musil, *Der Mann ohne Eigenschaften* (Cologne: Anaconda Verlag, 2013), 36. He continues: "Es nannte sich schriftlich Österreichisch-Ungarische Monarchie und ließ sich mündlich Österreich rufen; mit einem Namen also, den es mit feierlichem Staatsschwur abgelegt hatte, aber in allen Gefühlsangelegenheiten beibehielt, zum Zeichen, daß Gefühle ebenso wichtig sind wie Staatsrecht und Vorschriften nicht den wirklichen Lebensernst bedeuten. Es war nach seiner Verfassung liberal, aber es wurde klerikal regiert. Es wurde klerikal regiert, aber man lebte freisinnig. Vor dem Gesetz waren alle Bürger gleich, aber nicht alle waren eben Bürger. Man hatte ein Parlament, welches so gewaltigen Gebrauch von seiner Freiheit machte, daß man es gewöhnlich geschlossen hielt; aber man hatte auch einen Notstandsparagraphen, mit dessen Hilfe man ohne das Parlament auskam, und jedesmal, wenn alles sich schon über den Absolutismus freute, ordnete die Krone an, daß nun doch wieder parlamentarisch regiert werden müsse." Ibid.

⁴⁰ Ibid., 65.

⁴¹ Engelhardt, *Modernism, Fiction and Mathematics*, 116.

Ulrich, who *is* a mathematician, the *Grundlagenproblem* is one that is manifest not just in his field of work, but also around *and* within himself. Much like Michel casts the “mathematical self” as fundamentally fused to an extra-mathematical cultural backdrop, the inherent *Vorbildlichkeit* of Musil’s figure with respect to the uncertain foundations of the Self need not be confined to mathematicians, and of course Musil did not intend it to be this way either: “und [die Mathematiker] tun auf ihrem Gebiet das, was wir auf unsrem tun sollten.”⁴² Likewise (and somewhat ironically), it is none other than Clarisse — only half listening to Walter’s pompous diatribe and more interested in her dinner — who cannot quite see what Walter’s description of Ulrich has to do with his being a *mathematician* in particular. To move forwards, therefore, we must look for more machines.

Stepping back for a broader survey, the Self as a machine is, of course, nothing new in European modernism. To remain even with Viennese connections, Freud’s landmark 1919 essay “Das Unheimliche” was indeed informed by the closing revelation in E.T.A. Hoffmann’s *Der Sandmann* that Olympia is in fact a well-disguised automaton, whose displaced artificial eyes propel Nathanael into insanity. Likewise, there is the iconic robot of Fritz Lang’s milestone UFA production *Metropolis* in 1927, in which the spiteful Rotwang, in many ways the stock “mad scientist” character, fashions a bionic version of his deceased love interest, Hel, who left him for Joh Frederson, the city’s master. Much like Olympia is the uncanny Doppelgänger of Clara in *Der Sandmann*, the mechanical Hel is soon reworked to impersonate the messianic Maria, and she too becomes an agent for chaos and destruction: driving Freder into temporary delirium and the city’s Arbeiter into a destructive revolt, the false Maria is stopped only when she is burnt at the stake by the crazed masses and the uncanny “Geheimnis” of her true nature is revealed by the flames. Her creator, Rotwang, spirals (further) into madness and falls to his death from a high cathedral roof. With these culturally impactful imaginings of the machine selves, it cannot be overlooked that these “Maschinenmenschen” are first and foremost “Maschinenfrauen,” equipped with a devastating, destructive potential that threatens Man — be it Nathanael (“the gift of God”) or the Freder the peaceful mediator — and social cohesion at large. This is not that surprising; as Janik and Toulmin spend much time deliberating, the question of characterizing the (Viennese) modern self in machine-like terms, i.e. as a hollow vessel, absent of foundations or fundamental essence, and under the control of external forces is primarily a gendered one.

⁴² Musil, “Der mathematische Mensch,” 1007.

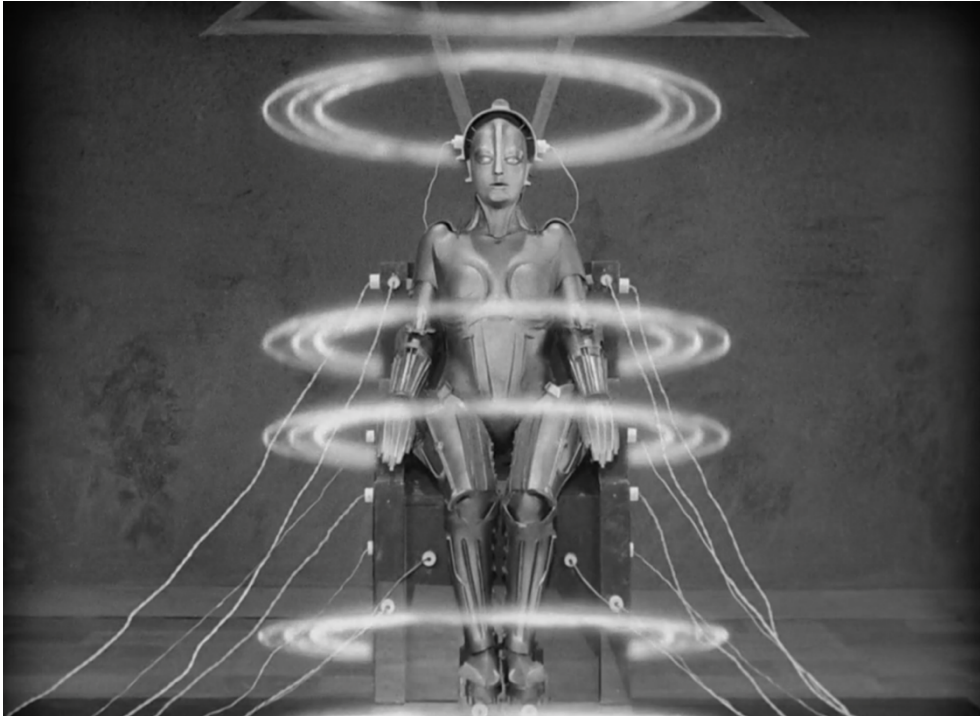


Figure 3.2: The activation of Rotwang’s bionic Hel⁴³

To better unpack this suggestion (and move off from the explicitly mechanical aspects of feminine machine selves), let us return briefly to Karl Kraus and his satirising of Viennese cultural life. While Janik and Toulmin, for example, emphasise his vocal support for suppressed minorities, notably sex workers and homosexuals,⁴⁴ the first section of Kraus’ *Pro domo et mundo*, entitled “Vom Weib, von der Moral,” showcases an array of biting “frauenfeindliche Aphorismen” that reflect, as Austrian art historian Hilde Schmölzer suggests, his “seltsam gespaltene” position with respect to women’s emancipation and the early *Frauenbewegung*.⁴⁵ Next to some belligerent one-liners like “Interessante Frauen haben vor den Frauen voraus, daß sie denken können, was uninteressante Männer vor ihnen gedacht haben,”⁴⁶ one of these misogynistic aphorisms takes the form of a mathematical formula that would undoubtedly trigger a traumatic *Wiederkehr* in those for whom secondary-school algebra was a form of slow torture:

⁴³ *Metropolis*, directed by Fritz Lang (UFA, 1927), 01:24:39.

⁴⁴ They suggest that Kraus held articular contempt for the hypocrisy of the Judeo-Christian state, which simultaneously criminalised and protected (at a price) sex workers, marking a turn from private immorality to the theatre of public immorality. Janik and Toulmin, *Wittgenstein’s Vienna*, 70.

⁴⁵ Hilde Schmölzer, *Frauen um Karl Kraus* (Klagenfurt: Kitab, 2015), 8. Schmölzer in particular tries to reconcile Kraus’ openly misogynistic writing with his noted support (in his capacity as founder, editor and sole funder of *Die Fackel*) of several female writers, such as Annie Kalmar, Mechthilde Lichnowsky and Else Lasker-Schüler.

⁴⁶ Kraus, *Pro domo et mundo*, 4.

$$\text{Die Frauenseele} = \frac{x^2 + \sqrt{31.4 - 20 + 46} - (4 \times 2) + y^2 + 2xy}{(x + y)^2 - 3.8 + 6 - 6.2} - (0.53 + 0.47). \quad 47$$

While those who, perhaps like young Törleß, enter the mathematics classroom with more enthusiasm might be tempted to try simplifying Kraus' inelegant expression, or ask what quantities x and y represent, or indeed wonder whether the "Frauenseele" is not a constant but yet another variable, the mathematical illiteracy unmasked by the equation is of course quite purposeful and *should* engender nothing but further *Verwirrung*. The joke, in a sense, is that it takes a certain degree of mathematical knowledge to know that the equation is absurd in the first place. While this impenetrable expression could be understood along the lines of Kraus' well-known scepticism of (and outright disdain for) Freud's psychoanalytic programme and its pseudoscientific methods,⁴⁸ the ironic deployment of mathematical notation surely gestures to his nuanced position with respect to the troubling and reactionary philosophy of Otto Weininger, the self-avowed Nietzschean whose works were likewise subsumed into Nazi propaganda in the 1930s in spite of (or, in a sense, *because of*) his Jewish heritage.⁴⁹

Vom Nutzen und Nachteil der Mathematik für das Leben

"Auf den verrückten Gedanken, die Liebe auf eine mathematische Formel zu bringen, wird doch niemals ein Mensch verfallen," writes Viennese teacher and philosopher Ferdinand Ebner in his 1921 collection *Das Wort und die geistigen Realitäten*.⁵⁰ With no small measure of mirth, he continues: "Versucht wurde es ja von Otto Weininger."⁵¹ Here, of course, Ebner is referring to Weininger's infamous 1903 treatise *Geschlecht und Charakter*, in which he tries to render credible his unbending misogyny (and indeed his troubling self-hatred and internalized antisemitism)⁵² by way of some mathematical language — a facet of his approach that has been widely remarked

⁴⁷ Ibid.

⁴⁸ As Janik and Toulmin explain, for Kraus, "the new myth [of psychoanalysis] was no better than the one it sought to displace and was itself one more manifestation of the illness it sought to cure. Psychoanalysis was in fact a further complication, rather than a solution, of the psychological problems that afflicted the Viennese middle class." Janik and Toulmin, *Wittgenstein's Vienna*, 76. Other aphorisms in this collection could equally be read alongside Kraus' disdain for Freud's tendency to read what he wanted in a female patient, e.g. "Die Augen der Frau sollen nicht ihre, sondern meine Gedanken spiegeln." Kraus, *Pro domo et mundo*, 5.

⁴⁹ Cf. Janik and Toulmin, *Wittgenstein's Vienna*, 71f.

⁵⁰ Ferdinand Ebner, *Das Wort und die geistigen Realitäten* (Innsbruck: Brenner-Verlag, 1921), 144.

⁵¹ Ibid.

⁵² In a way that renders Ebner's term "auf den verrückten Gedanken" darkly accurate, Weininger's disturbing and discriminatory work must of course be assessed as such with a more up-to-date awareness of mental illness that a contemporary perspective enables, as was the case with the later works of Nietzsche. As is well known, Weininger took his own life in the very year the text was published following a severe depressive spell at the age of just 23. While the undeniably dangerous ideas in *Geschlecht und Charakter* are rightly critiqued — both morally and conceptually — in this chapter, I endeavour to remain cognisant of Weininger's psychological state throughout.

upon by scholars ever since.⁵³ Although regularly dismissed as desperate pseudomathematics in service of morally unjustifiable goals, Weininger’s fraught mathematisation of gender and relationships is rather interesting for the purposes of this thesis, not just because of his deployment of mathematical language in general, but rather because its limitations help to pin down precisely what makes Mela Hartwig an intriguing and fruitful case study for this thesis.

With this in mind, let us explore Weininger’s misguided lesson in applied mathematics. Deliberating on the so-called “Gesetze” of opposite-sex attraction, Weininger pens:

Das Gesetz lautet: ‘Zur sexuellen Vereinigung trachten immer ein ganzer Mann (M) und ein ganzes Weib (W) zusammen zu kommen, wenn auch auf die zwei verschiedenen Individuen in jedem einzelnen Falle in verschiedenem Verhältnisse verteilt.’

Anders ausgedrückt: Wenn m_μ das Männliche, w_μ das Weibliche ist in irgend einem von der gewöhnlichen Auffassung einfach als ‘Mann’ bezeichneten Individuum μ und w_ω das Weibliche, m_ω das Männliche dem Grade nach ausdrückt in irgend einer sonst oberflächlich schlechtweg als ‘Weib’ gekennzeichneten Person ω , so ist bei jeder vollkommenen Affinität, d.h. im Falle der stärksten sexuellen Attraktion:

- (Ia) $m_\mu + m_\omega = C(\text{onstans})_1 = M = \text{dem idealen Manne}$
 und darum natürlich gleichzeitig auch
 (Ib) $w_\mu + w_\omega = C_2 = W = \text{dem idealen Weibe.}$ ⁵⁴

In other words, no real human male, denoted here as μ , can fully embody masculinity in a way that is absolute, and is thus composed of a (dominant) masculine component, here m_μ , and some latent feminine component, w_μ , and conversely for the female ω .⁵⁵ The ideal union, therefore, is the one that yields a complete masculine M and feminine W, which occurs when the respective masculine and feminine components of the real man and woman in question counterbalance one another; for example, when

the male “ $\mu \left\{ \begin{array}{l} \frac{3}{4} M \\ \text{also} \\ \frac{1}{4} W \end{array} \right\}$ ” is met with “sein bestes sexuelles Komplement [...] $\omega \left\{ \begin{array}{l} \frac{1}{4} M \\ \text{also} \\ \frac{3}{4} W \end{array} \right\}$.”⁵⁶

⁵³ For thoughts on Weininger’s pseudoscience via the use of mathematical terms, see, for example: Steven Beller, “How Modern was Viennese Modernism? The Historical Context of Otto Weininger’s Critique of Modernity,” *German Politics and Society* 14, no. 4 (1996): pp. 83-98; Susan C. Anderson, “Otto Weininger’s Masculine Utopia,” *German Studies Review* 19, no. 3 (1996): pp. 433-453; Chandak Sengoopta, *Otto Weininger: Sex, Science, and Self in Imperial Vienna* (Chicago and London: University of Chicago Press, 2000); Max Genecov, “The Man Behind the New Man,” *JSTOR Daily*, October 10, 2018, accessed: May 12, 2023.

⁵⁴ Otto Weininger, *Geschlecht und Charakter* (Vienna and Leipzig: Wilhelm Braumüller Verlag, 1920), 33.

⁵⁵ As Janik and Toulmin explain, for Weininger, “All the men and women who actually exist are androgynous, as Aristophanes had argued in Plato’s *Symposium*. In them, the two ideal types are found mixed together in varying proportions, each individual possessing psychological counterparts to the anatomical vestiges of the opposite sex.” Janik and Toulmin, *Wittgenstein’s Vienna*, 72.

⁵⁶ Otto Weininger, *Geschlecht und Charakter*, 34.

Cumbersome though this attempt to underpin the mathematics of heterosexual attraction is,⁵⁷ there remains at least some sense of equilibrium and interdependence between Weininger's two "sexuellen Typen" — in simple mathematical terms, one could rearrange the formulae without any structural consequences. When Weininger's thinking moves (or at least attempts to) from the formulaic to the conceptual, however, the dangerous and disturbing nature of his deliberations is laid bare, for the focus of *Geschlecht und Charakter* soon turns to the void-like absence of character in one *Geschlecht* in particular.

Having cited a particular passage of Norwegian playwright Henrik Ibsen's *Little Eyolf* (1894), in which the mother figure Rita supposedly demonstrates "daß die Frau zur Idee der Unendlichkeit, zur Gottheit, kein Verhältnis hat: weil ihr die Seele fehlt," Weininger wonders to himself: "Das Weib ist nicht Mikrokosmos, es ist nicht nach dem Ebenbilde der Gottheit entstanden. Ist es also noch Mensch? Oder ist es Tier? Oder Pflanze?"⁵⁸ Passing quickly over some sweeping statements that cast the female as "sicherlich"⁵⁹ closer to the natural world and more bestial than the male, Weininger painfully concedes but an inch in order to declare: "Aber die Frauen sind Menschen. Selbst W, die wir ohne jede Spur des intelligiblen Ich denken, ist doch immerhin das Komplement zu M. [...] Die Tiere sind ferner bloß Individuen, die Frauen Personen (wenn auch nicht Persönlichkeiten)."⁶⁰ A "Mensch" but without an "Ich," a person without a personality: it is with this disquieting turn that Weininger begins his polemic, which takes the form of an interlocking series of binary modes of thought. Firstly, Weininger stresses, "Es ist das Verhältnis von Mann und Weib kein anderes als das von *Subjekt* und *Objekt*. *Das Weib sucht seine Vollendung als Objekt*. Es ist die Sache des Mannes, oder die Sache des Kindes, und will, trotz aller Bemäntelung, nicht anders genommen werden denn wie eine Sache."⁶¹ Supposedly, this is because all of the hopes and feeling of the female are part and parcel of her "innere Eigenart" that *desires* to be so:

Die Frau will nicht als Subjekt behandelt werden, sie will stets und in alle Wege — das ist eben ihr Frau-Sein — lediglich passiv bleiben, einen Willen auf sich gerichtet fühlen, sie will nicht gescheut noch geschont, sie will nicht *geachtet* sein. [...] Wie die bloße Empfindung erst Realität gewinnt, indem sie begrifflich, d.h. *Gegenstand* wird, so gelangt das Weib zu seinem Dasein und zu einem Gefühle desselben erst, indem es vom Manne oder vom Kinde, als dem Subjekte, zu dessen *Objekt* erhoben wird, und so eine Existenz geschenkt erhält.⁶²

⁵⁷ Indeed, it is in the violation of the "besprochenen Gesetze der sexuellen Anziehung" that homosexuality arises, according to Weininger, as something of a "Zwischenform" between his algebraic Ms and Ws, i.e., when the male is composed of masculinity/femininity ratio that is weighted towards femininity. *Ibid.*, 51ff.

⁵⁸ *Ibid.*, 384.

⁵⁹ *Ibid.*

⁶⁰ *Ibid.*, 385.

⁶¹ *Ibid.*, 386. Emphasis in original.

⁶² *Ibid.*, 386f. Emphasis in original.

Not only is the female imagined as the passive object of some subject — man or child — but this stage is in fact the *end* of the road, the final iteration in some process of becoming, of obtaining an existence at the behest of the wilful subject. The question as to what the female is before her “Erhebung” to object sidesteps, it seems, into another of Weininger’s binary structures: “Was erkenntnistheoretisch der Gegensatz des Subjekts zum Objekt, das sagt ontologisch die Gegenüberstellung von *Form* und *Materie*.”⁶³ Whereas the difference between subject and object is one of “Existenz” (innate to the male, bestowed upon the female by the former), “bedeutet der Gegensatz von Form und Materie einen Unterschied der *Essenz* (die Materie ist ohne Formung absolut qualitätslos).”⁶⁴ While it is likely apparent to the reader to which gender Weininger will ascribe formless materiality, he is at pains to set up another binary — that of “Etwas” and “Nichts” — before making this explicit, which he does by way of Plato:

Darum konnte Platon die Stofflichkeit, die bildsame Masse, das an sich formlose ἄπειρον, den knetbaren Teig des εκμαγειον, das, worin die Form eingeht, ihren Ort, ihre χωρα, das εν ω, jenes ewig Zweite, Andere, das θατερον, auch *als das Nichtseiende*, als das μη ον bezeichnen. [...] Das Nichtseiende Platons ist gerade das, was dem Philister als das denkbar Realste, als die Summation der Existenzwerte erscheint, es ist nichts anderes als die Materie.⁶⁵

On the one hand to borrow Weininger’s zealous use of mathematical notation, *Subjekt = Form = Etwas*, and on the other hand, *Objekt = Materie = Nichts*. Moreover, with the “knetbaren Teig” of nothingness, there is a deliberate link between the two spatial echoes suggested previously: the question of transformation and an ontological *Leerstelle*. To be infinitely malleable material is to be *nothing*. And as Weininger’s frenzied deliberation reaches its all too terrible climax, this connection, just like the expected alignment along gendered binaries, is made very explicit:

Der Mann ist Form, das Weib Materie. [...] Die Frauen sind die Materie, die jede Form annimmt. Jene Untersuchungen, welche für die Mädchen eine bessere Erinnerung speziell an den Lehrstoff ergeben haben als für die Knaben, können nur so erklärt werden: aus der Inanität und Nullität der Frauen, die mit allem Beliebigen imprägniert werden können, indes der Mann nur behält, was ihn wirklich interessiert, und alles übrige vergißt. Aber vor allem geht das, was die Schmiegsamkeit des Weibes genannt wurde, seine außerordentliche Beeinflußbarkeit durch das fremde Urteil, seine Suggestibilität, seine völlige Umschaffung durch den Mann auf dieses Bloß-Materie-Sein, diesen Mangel jeder ursprünglichen Form zurück. Das Weib *ist* nichts, und darum, *nur* darum kann es *alles werden*; während der Mann stets nur werden kann, was er *ist*. Aus einer Frau kann man machen, was man will; dem Manne höchstens zu dem verhelfen, was er will. Darum hat, in der wahren Bedeutung des Wortes, eigentlich nur Frauen, nicht Männer, zu erziehen einen Sinn. [...] Das Weib mag alles scheinen und alles verleugnen, aber es ist nie irgend etwas in Wahrheit. Die Frauen haben nicht diese oder jene Eigenschaft, sondern ihre Eigenheit beruht darauf, daß sie gar keine Eigenschaften haben [...].⁶⁶

⁶³ Ibid., 387. Emphasis in original.

⁶⁴ Ibid. Emphasis added.

⁶⁵ Ibid.

⁶⁶ Ibid., 389f.

And there we have it. With this final turn, Weininger completes his set of dualities: “Subjekt/Objekt,” “Form/Materie,” “Invarianz/Transformation,” “Etwas/Nichts” are now annexed by “Mann/Weib.” Equating his posited categories with remarkable abandon and forming two groups thereof, Weininger has established the masculine subject of invariant form, very much an “Etwas,” who can only follow that Nietzschean mantra “Du sollst der werden, der du bist!”⁶⁷ Conversely, there is the feminine object of inessential, perpetually transformable material, which is to say a Platonic “Nichts,” for whom nothing — neither quality nor agency — is fixed or enduring. To return to the aesthetic of machines, therefore, Weininger’s philosophical treatise becomes yet another sketch of the woman as the hollow, manipulable vessel that operates at the will of the always male creator.

It is into this very discourse on gender, feminine selfhood and nothingness that Mela Hartwig stages a unique intervention. Before examining precisely how she does so, let us dwell for a moment on this quasi-mathematical format of Weininger’s approach. It became apparent above that Weininger moves progressively from the more *formulaic* — i.e., imaging the laws of sexual attraction as formulae (perhaps satirised most bluntly by Kraus) — towards a more *conceptual*, “begriffliche” approach, in which an array of binary concepts were arranged into something of an overlapping grid. This shift from the formulaic to the conceptual is in fact familiar. As was cited previously, Bartel van der Waerden — Emmy Noether’s most successful tutee — wrote of his mentor after her death in 1935: “Sie konnte nur in *Begriffen*, nicht in *Formeln* denken, und darin lag gerade ihre Stärke.”⁶⁸ Spurning any concern for what given mathematical objects *are* and examining instead the complex structural relationships *between* ontologically empty organising concepts, Noether’s abstract algebra renders vexed the formulaic use of the equation and its $X = Y$ format. In this light, it could be said that Weininger’s “Stärke” does not actually lie in refined conceptual thinking, and although he tries, he never really escapes from a formulaic level of analysis that either places concepts as equal to one another or directly juxtaposes them without restraint. Now, it should be noted that, in the above passage, Weininger indeed connects the two thematic concerns of this chapter, namely the question of transformability and foundational emptiness. From the previous focus on the development of mathematical topology in Chapter 1, it is not difficult, however, to see why Weininger’s gendered separation of transformation and invariance, i.e. with the infinitely malleable woman and the doggedly invariant man, is highly unnuanced. Rather unsurprisingly, this lack of “begriffliche” finesse extends to his other categories. Consider, for example, Weininger’s Ibsen-inspired contention

⁶⁷ Nietzsche, “Die fröhliche Wissenschaft,” 519.

⁶⁸ van der Waerden, “Nachruf auf Emmy Noether,” 469. Emphasis added.

that the Frau has “kein Verhältnis [...] zur Unendlichkeit,” unlike the male, thus setting up his declaration of woman as its opposite, namely “Nichts.” Fundamentally, Weininger’s apparently mathematical methodology is not robust enough to account for the fact that zero and infinity, everything and nothing, are actually more interwoven than they are opposed. In her accessible guide *Beyond Infinity*, mathematician and concert pianist Eugenia Cheng⁶⁹ cleverly dispels several misapprehensions about infinity and zero. Probing the limits of mathematical expression, she ascertains how both are equally calamitous when incorporated into formulae and equations and sit within a conceptual proximity to one another that belies the intuitive perception of them as opposites.⁷⁰ In a more public-facing capacity, Cheng offers the following illustration of this interdependency.⁷¹ Let us imagine a wheel that sits atop a flat surface but that has the unfortunate predicament of being square. Unsurprisingly, its turns will be rather laborious. By increasing the number of sides of the wheel from four to six, for example, the problem is then eased somewhat (albeit still with a bumpy ride ahead). Then, consider a twelve-sided wheel; it is easy to see that the motion, while by no means perfect, becomes significantly more fluid. Rather intuitively, therefore, the greater the number of sides, the smoother the turning motion of the wheel. Yet, it is also not difficult to observe that, as the number of sides stretches towards infinity, the shape approaches the perfect circle. This is to say, the *more* sides of the wheel, let us call this quantity n , the closer it is to having precisely *zero* sides:

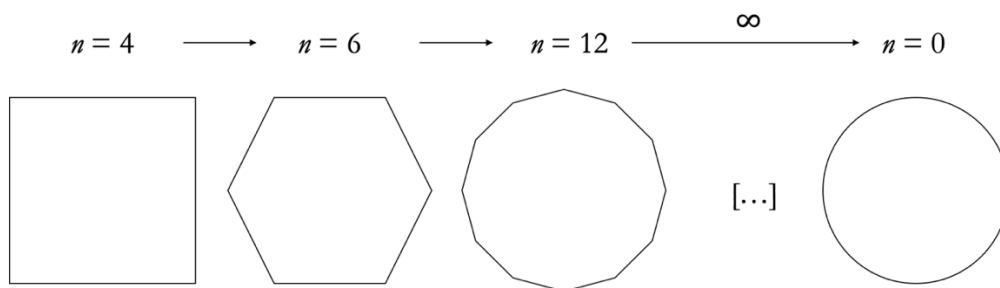


Figure 3.3: Infinity and Nothing

⁶⁹ Cheng’s remarkable ability to communicate complex mathematical ideas to a wide audience is evidenced by her expanding collection of books that relate abstract mathematics to issues ranging from social inequality to baking, as well as her participation across several platforms for public dissemination, from TED talks to documentaries. In a neat inverse to Weininger’s hollow use of mathematical language, in her popular mathematics book $x + y$: *A Mathematician’s Manifesto for Rethinking Gender* (London: Profile Books, 2020), Cheng uses the language of category theory (a mathematical successor to set theory that emerged from algebraic topology — the very field Noether helped devise with Alexandrov, as was discussed previously), to unpick intersecting forms of social marginalization, principally gender, race and class.

⁷⁰ Eugenia Cheng, *Beyond Infinity: An Exploration to the Outer Limits of the Mathematical Universe* (London: Profile Books, 2017).

⁷¹ The following paraphrases her contribution to the independent documentary *A Trip to Infinity*, directed by Jonathan Halperin and Drew Takahashi (Makemake and Room 608, 2022), 00:14:10-00:15:58.

In other words, leaping “zur Unendlichkeit,” a destination with which “die Frau [...] kein Verhältnis hat,” according to Weininger, one lands at what seems to be its exact opposite and precisely the space occupied by the female of the species in *Geschlecht und Charakter*, namely “Nichts.” In a conceptual complexity that Weininger’s unwieldy pseudomathematics fails to articulate, much like the topological notions of transformation and invariance, “Unendlichkeit” and “Nichts,” everything and nothing, are not so easily coerced into a rigid binary after all.⁷² Given enough time, the charge towards the infinite naturally succumbs, in a sense, to the deleterious power of a Krausian Viennese “Null.”

While the task of this chapter, of course, is not to simply discredit Weininger’s mathematization of gender from a loftier perspective, the above is illustrative of what Mela Hartwig achieves in her two novels. In *Körper und Text*, Fraisl concludes that Hartwig’s conceptualisation of gender difference, while explicitly adopting Weininger’s terminology, “läßt sich keineswegs auf eine reine Affirmation etwa der Geschlechterpsychologie Weiningers mit positiver Bewertung reduzieren.” Rather, Hartwig seeks to reform the “strikte” divide between the sexes into “eine gleichsam osmotisch durchlässige *umzudeuten*, ohne damit in einer androgynen Vereinheitlichung zu enden.”⁷³ Then, discussing *Bin ich ein überflüssiger Mensch*, Smith discerns that “despite its sometimes clumsy phrasing and Freudian posturing, it’s not simply an expression of feminine ‘hysteria’ but an arch critique of it, from the inside,”⁷⁴ a subversion that, in the end, “recasts its much-trumpeted ‘redundancy’ as a vital kind of agency.”⁷⁵ Both Fraisl and Smith draw attention, therefore, to an *Umdentung* of pre-existing and overtly gendered categories that never quite fully dispenses with them but *does* serve to render their contours hazy and the divisions between them and other categories somewhat unsound. These assessments, I suggest, have by no means missed the mark, but following the detour through Musil, Kraus and Weininger, they can be rendered more precisely — and in such a way that brings a topological cognisance to bear upon questions of gender, agency, and power in Hartwig’s prose. Ultimately, this positions Mela Hartwig’s *still* rather marginal works as fitting case studies for an examination of the “topological turn” in German-language modernism, and as such, a significant yet unexpected crossing-point of literary modernism and key tenets of modern mathematics.

⁷² A note of caution: This may, at first look like a misreading of Weininger’s claim, for he does of course note that because of the female’s nature as “Nichts” she can “alles werden,” seemingly tethering the infinite with nothingness. As he continues, however, it is clear that he means that the female can *appear* as everything but always remains nothing. As such, there is no particularly nuanced interrelation of the infinite and zero at play in Weininger’s theory.

⁷³ Fraisl, *Körper und Text*, 267. Emphasis added.

⁷⁴ Smith, *Feel Free*, 294.

⁷⁵ *Ibid.* Emphasis added.

Mela Hartwig's "Frauen ohne Eigenschaften"⁷⁶

In a way that will variably harmonise with and depart from the aforementioned studies of Hartwig's works, it will be argued in the following that *Das Weib ist ein Nichts* and *Bin ich ein überflüssiger Mensch?* collectively serve as a multifaceted subversion of Weininger's binary schematics *from within*. This amounts to an interference that uses his gendered categories and, in a thoroughly Nietzschean way, "verwirrt [...] die Rubriken und Zellen der Begriffe"⁷⁷ in such a manner that upends their binary logic and clear-cut configurations. More specifically, Hartwig's texts first break down Weininger's unnuanced opposition of transformation and invariance into something more topologically familiar, i.e. as interdependent concepts in the sense that transformative processes serve to unmask a more integral *resistance* to transformation. This decoupling then serves to further disassemble Weininger's simplistic, binary arrangement neighbouring categories that are necessarily fused to the original opposition, namely the agency differential of "Subjekt/Objekt," the question of discernible content and stable qualities "Etwas/Nichts," and of course the constructed gender binary "Mann/Weib" that supposedly envelops them all.

In slightly more detail, the various processes of change that both Bibiana and Aloisia experience are shown to be entirely contingent upon and subservient to an invariance, which Weininger restricts solely to the "Mann (M)." This topological reworking is expressed slightly differently in each text. If Weininger fails to observe in his own phrase "Das Weib *ist* nichts, und darum, *nur* darum, kann es alles *werden*" that the feminine *Nichtigkeit* is itself an invariance that underpins all change, this is what Hartwig achieves in *Das Weib ist ein Nichts*. Laying bare in Bibiana a mysterious invariance within herself that is inherently structural and quasi-*mechanical*, as opposed to ontological or contentual, namely a flexible framework of different roles, it is within this very structure of *Nichtigkeit* that a rather destructive sense of feminine agency is developed — an ability to shapeshift between forms, taking on and casting off traits with abandon. In *Bin ich ein überflüssiger Mensch?*, the initial topological intervention is a more direct one, in that Hartwig basically short-circuits Weininger's phrase outright: she posits in Aloisia a young woman who, on account of her intransigent *Überflüssigkeit* cannot meaningfully change at all. Aside from this different opening gambit, a very similar ripple-effect through the remainder of the Weiningerian binary framework for gender ensues. In her two novels, Hartwig deploys alongside Weininger's

⁷⁶ To borrow Hartmut Vollmer's term when he discusses Bibiana in particular. Hartmut Vollmer, *Liebes(ver)lust: Existenzsuche und Beziehungen von Männern und Frauen in deutschsprachigen Romanen der zwanziger Jahre* (Oldenburg: Iger Verlag, 1998), 283.

⁷⁷ Nietzsche, "Über Wahrheit und Lüge," 887.

categories a number of literary and artistic tropes and figures common to the culture of modern Vienna, namely the *femme fatale* and the aforementioned machine body — both of which have regularly served as conduits for the all too impactful Freudian image of the “hysterische Frau.”⁷⁸ In terms of structure, the same general argument outlined above pertains to both of Hartwig’s novels collectively. To do justice, however, to the ways in which her prose style matures and to best account for the very different narrative situations in *Das Weib ist ein Nichts* to *Bin ich ein überflüssiger Mensch?* — from the variably focalised heterodiegetic perspective in the former and the intensely autodiegetic, confessional point of view of the latter — the following analysis will proceed chronologically, all the while remaining cognisant of the significant areas of thematic overlap between the two texts.

Mirror, Mirror on the Wall

“Mela Hartwig’s fictional world is full of madwomen,” writes Sarah Painitz in her 2008 analysis of law, madness and the body in Hartwig’s short stories, drawing very clearly on the oppressive, hysterical images of womanhood devised and often invoked by trigger-happy psychoanalysts in the early 20th century.⁷⁹ As Painitz notes, the assortment of “crazy women” across Hartwig’s literary *Werk* did not (and still often does not) “sit well with many critics and reviewers,”⁸⁰ and indeed Hartwig’s first novel *Das Weib ist ein Nichts* prompted at times both perplexed and antagonistic reactions from her contemporaries. Taking stock of these in her afterword to the 2002 Droschl Verlag reprint, Fraisl first cites Friedrich Lorenz’s 1929 contention in the *Neuer Wiener Journal* that the novel amounts to a “Frauenroman gegen die Frau,” in which, through the woman’s “Kapitulation vor dem Mann,” a degree of Hartwig’s apparent “Minderheitsgefühl ihren poetischen Ausdruck findet.”⁸¹ Writing almost 70 years later, Petra Maria Wende, while not disagreeing in principle concerning this portrayal, finds that the novel, a “Melodram um

⁷⁸ Building on much existing scholarship on Kleist’s “Über das Marionettentheater,” Nathan J. Timpano, for example, traces out the myriad interconnections between the hysterical *femme fatale* and the hystero-theatrical gestures articulated via the aesthetics of puppetry in modern Viennese theatre. Nathan J. Timpano, *Constructing the Viennese Modern Body: Art, Hysteria and the Puppet* (New York and London: Routledge, 2017). Likewise, in her recent monograph, Alys X. George comprehensively unpacks the aesthetics of the machine body in modern Vienna, tracing its presence through visual and performance arts in the 1910s and 1920s and demonstrating a long-standing familiarity with the body-as-machine among Viennese audiences by the time Fritz Lang’s *Maschinenmensch* arrived on the scene in 1927. Alys X. George, *The Naked Truth: Viennese Modernism and the Body* (Chicago and London: University of Chicago Press, 2021).

⁷⁹ Sarah Painitz, “Lunacy and the Law: Mela Hartwig’s *The Crime* and *The Fantastical Paragraph*,” in *Crime and Madness in Modern Austria: Myth, Metaphor and Cultural Realities*, ed. Rebecca S. Thomas (Newcastle: Cambridge Scholars Publishing, 2008), 117.

⁸⁰ *Ibid.*

⁸¹ Fraisl, afterword to *Das Weib ist ein Nichts*, 177.

eine Frau [...] in einer männlich dominierten Welt,”⁸² serves as a form of epochal exposure, unveiling the horror of the discourse on gender shaped by figures like Freud and Weininger. On this level of analysis, *Das Weib ist ein Nichts* affirms Weininger’s terms with a view to implicitly condemning them, and it thus “gerinnt damit zum Effekt einer patriarchalen Ordnung, die spezifisch ‘andere’ Seinsweisen eliminiert.”⁸³ While Fraisl suggests that such a perspective is “nicht unplausibel,” as is clear from her work in *Körper und Text*, she is aware that there is more to Hartwig’s novel than holding a mirror up to contemporaneous discourse — however valid that endeavour may be. Fraisl’s observation of some *Umdeutung* of Weininger’s ideological mind map of binary categories most clearly comes into view, I suggest, when Hartwig’s prose is positioned alongside alongside the spatial insights of the Topological Turn, with an eye to observing with Hartwig a modern mathematical way of thinking that far surpasses Weininger’s formulaic mindset. As was the case with *Der letzte Mann*, the task begins therefore with the sequence of *Verwandlungen* to which Bibiana is subjected: is it possible to isolate therein a perhaps veiled but fundamental (non-ontologically speaking) invariance to which the transformative processes are in fact subservient? For reasons of conciseness, more attention will be paid to this first section involving the “Abenteurer” than the subsequent sections with the “Musiker,” “Bankier” and “Arbeiter.” This opening sequence sets up much of what is needed for the purposes of this chapter’s argument, and many relevant aspects in the latter three are structural repetitions of the former. Indeed, several thematic threads from these later sections are also carried over, as Fraisl also notes, into *Bin ich ein überflüssiger Mensch?*,⁸⁴ and attention will be drawn to them where necessary.

Turning to Bibiana’s many transformations, it is made clear early on that these are, rather unsurprisingly and in keeping with the dominant aesthetic portrayals of metamorphosis, *bodily* ones. Moreover, as Hanna De Budt comprehensively argues, the body and self are often “parzelliert” into modular “Körperteile” across much of Hartwig’s *Werk*,⁸⁵ and in *Das Weib ist ein Nichts*, it is in Bibiana’s face (and, to a lesser degree, her hands) that not only the many transformations register but also with respect to which an overarching sense of invariance becomes manifest. Let us consider the first transformation at the hands of the Abenteurer. At the close of a short prologue, Bibiana, instead of returning home one evening, “ließ sich von dem Abenteurer entführen” (*WVN*, 9), triggering the first of her four fraught relationships in the

⁸² Petra Maria Wende, “Eine vergessene Grenzgängerin zwischen den Künsten: Mela Hartwig 1893 Wien – 1967 London,” *Ariadne* 13 (1997): 35. Cited in Fraisl, afterword to *Das Weib ist ein Nichts*, 183.

⁸³ Fraisl, afterword to *Das Weib ist ein Nichts*, 183.

⁸⁴ Fraisl, *Körper und Text*, 274.

⁸⁵ Hanna De Budt, “Polarisierung, Parzellierung und Emotionalität bei der vergessenen Autorin Mela Hartwig Eine genderkritische Motivanalyse” (Thesis, University of Ghent, Belgium, 2016).

text. Following the *Entführung* by the Abenteurer, focus is drawn immediately by the narrator to the transformation that will ensue, in which the “Gesicht” acts metonymically for character of Bibiana as a whole:

Er ahnte hinter der Vielfältigkeit seiner Abenteuer die Einfalt des nackten Lebens. Beides in eins zu verschweißen, erwählte er Bibiana zu Gefährten seines Dämons, beschloss er in ihrem Herzen seßhaft zu werden und es planmäßig zu vergeuden. Ihr ungeprägtes Gesicht, in dem sich die unvereinbarlichen Züge so willkürlich und gefährlich kreuzten, führte ihn zu einem Vertrauen, dem er sich längst schon entwachsen glaubte. [...] In dem Gesicht der Bibiana aber verwirrte und überwand ihn, den erfahrenen, das wunderbare Gleichgewicht der Kräfte, dieses unentschiedene Spiel zwischen der frechen, breiten Sinnlichkeit des Mundes und dem hellen, schmalen Mißtrauen ihrer schrägen Augen. In einer einzigen Nacht meißelten seine zärtlichen Hände diesen zuckenden Körper zu seinem willenslosen Geschöpf (*WN*, 10f.).

In many ways a retelling of *Pygmalion*,⁸⁶ having found in Bibiana’s “ungeprägtes” face the potential of infinite malleability, the Abenteurer transforms the Weiningerian “Materie” of Bibiana, and glancing ahead, the subsequent three episodes depict the relationships between Bibiana and each male counterpart in similar terms.⁸⁷ Then, accompanying this transformative process is swift process of nominalization, for the “willenlose[s] Geschöpf” is given a new name by the Schöpfer:

Einen Haufen Rechnungen vor sich, ließ er Bibiana am siebenten Tag rufen, befahl: ‘Du heißt Nastasja. Du bist die natürliche Tochter des...’, er flüsterte ihr einen feudalen Namen aus dem russischen Hochadel ins Ohr.
[...] Sie weinte leise in sich hinein.
‘Nastasja’, begann er nach einer Weile behutsam. Sie zuckte zusammen und weinte nur noch heftiger. ‘Nastasja’, wiederholte er unbarmherzig, um sie an den fremden Klang des Namens zu gewöhnen. ‘Warum bist du so traurig, kleine, süße Nastasja?’ (*WN*, 12f.).

While the function of names and naming, an important facet of Hilbert’s nominalistic formalism, will be discussed in more detail in Chapter 4, the procurement of names is a significant and recurring aspect throughout Hartwig’s novel as well. Looking briefly ahead at subsequent reiterations, alongside the emergence of Nastasja in the first section, the following episode with the Musiker sees what looks initially like the return of “Bibiana” but which has the effect of being equally new; when she reveals her previous name, the protagonist “fühlte, daß sich erst in diesem Augenblick das Grab über dem Abenteurer schloß,ühlte, daß sie selbst in diesem Namen in ein neues Leben einging” (*WN*, 53f.). Then, in the final two sections, her

⁸⁶ The clear allusions to the Pygmalion myth from Ancient Greece has been pointed out by Evelyn Polt-Heinzl in “Mela Hartwigs Fallgeschichten. Korrekturen zum Thema Hysterie,” in *Literatur und Kultur im Österreich der Zwanziger Jahre*, ed. Primus-Heinz Kucher (Bielefeld: Aisthesis Verlag, 2007), 225. Cf. De Budt, “Polarisierung, Parzellierung und Emotionalität,” 37.

⁸⁷ From the Musiker, who tells her “Ich werde mein Blut in dich hinein ausschütten, zuckende Ströme des Zweifels, [...] das Chaos der Töne, das mich erstickt, aber du wirst mir Ton um Ton jeden Tropfen in Blut verwandeln und geläutert, durch dein Herz filtriert zurückgeben müssen” (*WN*, 55), to the closing Arbeiter who explains: “Ich liebe dich nicht gar nicht so, wie du bist, begreifst du das nicht? Ich werde dein Herz, wenn es erst nur mir gehört, um und um kneten” (*WN*, 154). Once again, with the emphasis on “kneten,” the references to *Pygmalion* are apparent.

name is partitioned into two new ones when she becomes the secret love affair “Bibi” of the Bankier, her employer, and the suffering companion “Anna” to the socialist Arbeiter. As is already evident, the male characters, for all their apparent dominance, control and creativity, are never actually referred to by name at all — this point is significant and will be developed later.

Returning to the first act, for the new creation of Nastasja to be fully operable, she must master the very language of the “russischen Hochedel,” a task for which a young student is enlisted under duress — succeeding guarantees him a coveted ticket to America, and failure results in his death. Managing “Bibiana zwanzig Stunden von vierundzwanzig abzulisten” (*WN*, 16), the student’s desperate efforts to keep an exhausted Bibiana on track soon descend into a sexual encounter of questionable consent: falling asleep, she stirs as he removes her clothes and absentmindedly “lallte ein russisches Wort” (*WN*, 16). Marking a turning point in her assumption of a new identity, Bibiana’s body is now operating in a way that is almost mechanical, producing language in the absence of clear thought — a connotation that is heightened as the narration proceeds.⁸⁸ With a taxonomy similar to Musil’s essay, in which the “Ökonomie des Denkens” characterises the mathematical *Denkmaschine*, Bibiana’s impossible task becomes “[v]on diesem Tag an [...] nurmehr eine Frage äußerster Disziplin und pedantischer *Ökonomie der Kräfte*” (*WN*, 16),⁸⁹ and the narrator is quick to shape an image of the Bibiana, now rapidly acquiring a new language and identity, as a *Maschine* and *Gefäß*. Hartwig writes: “Wenn sich das übermüdete Gehirn [...] wie eine heiß gelaufene Maschine je versagte, ließ er ihren gehorsamen Gaumen russische Gerichte versuchen, bezwang er ihre willigen Ohren mit russischer Musik, ließ er ihr aus seinen Fingerspitzen Vokabeln ins Blut sickern” (*WN*, 16f.). Carrying on an overtly sexualised tone from the preceding encounter with the student, Bibiana, it seems, is to be imagined as a mechanical being into which language, as an *Eigenschaft*, is secreted — from his fingertips into her blood system — and this undergirds a metamorphic process that registers on Bibiana’s face:

Halten ihr nur die krampfhaften Spannungen ihres unfreien Willens und die schlaflosen Nächte, die Wangen oder sprangen ihr die Backenknochen unter der gewalttätigen nationalen Wandlung ihres Gehirns slavisch hervor? Unmerklich von Tag zu Tag vollzog sich der Sieg ihrer asiatischen Herkunft in ihrem Gesicht. Vor dem Spiegel glaubte sie manchmal selbst schon daran (*WN*, 17).

⁸⁸ One might be reminded here of Olympia’s mechanical “Ach – ach – ach,” in *Der Sandmann* which Nathanael mistakes for sighing. E.T.A. Hoffmann, *Der Sandmann* (Stuttgart: Reclam, 2003), 32.

⁸⁹ Emphasis added. Reflecting upon allusions to *Pygmalion*, one might at this point consider the ways in which language itself is being cast as the feminine. In George Bernard Shaw’s theatrical retelling of the myth, which serendipitously premiered in Vienna in 1913, Eliza Doolittle becomes the muse of competing linguists Colonel Pickering and Henry Higgins, who bet on whether she can pass as a duchess once she is taught to *speak* like one.

An inversion of the usual phrase, the text has now put a face to the name. Just like the bionic vessel Hal is literally pumped with the alchemic mixture that has been bubbling on Rotwang's laboratory table to create the image of Maria, the face of Nastasja seemingly manifests when Bibiana serves as a receptacle for a new liquid identity. With her new name, new language and new face, it soon transpires that the Abenteurer was well aware of Bibiana's brief affair with the student; serving as a test for his real intentions, he soon deploys Nastasja as an agent to seduce key officials in the local administration, all the while orchestrating a media sensation around the fabricated young Russian noblewoman. Here, as scholars rightly point out, is where *Das Weib ist ein Nichts* — or rather the first iteration of Bibiana's storyline — becomes a typical "Kolportageroman."⁹⁰

At this stage, Wende's interpretation of *Das Weib ist ein Nichts* as a frightful mirroring of society, an insight into a perverse, exploitative and authoritarian imbalance between the sexes, is certainly still valid.⁹¹ Keen to go further than this, Fraisl follows the plotline of the first act in particular and finds therein the emergence of the *femme fatale* in line with pre-existing literary templates of the "über den Plan des Schöpfers hinaus *sich selbstverständigen Geschöpf*s."⁹² Given the episode's end, in which the Abenteurer's charade collapses and he takes his own life, the suggestion is of course a fitting one, but it becomes clear that Fraisl's conceptualisation of the *femme fatale* in *Das Weib ist ein Nichts* is not without some limitations — limitations that are nonetheless useful in charting an alternative way forwards here. Let us consider this decisive scene, which acts as a notable turning point in the dynamic between the Abenteurer and Bibiana. As the Abenteurer's machinations bore further into what might now be called the "deep state," the bodies of various agents begin to pile up, and Bibiana comes to realise her own engrossment, which is expressed no less in terms of *names*. The realisation comes as she speaks: "Ich habe nur dir ihre Namen veraten, nur dir.' Er schwieg, er lächelte nicht einmal mehr. 'Ich habe nur dir...?', wiederholte sie immer noch fassungslos. Mitten im Satz brach sie bestürzt ab, begann langsam zu begreifen: 'Du hast ihre Namen verkauft, du?'" (WN, 35). Despite her horror at the depths to which the Abenteurer is willing to descend in his schemes, Bibiana cannot help herself fall deeper again into his clutches: "Ich will immer noch mehr für dich tun. Warum, warum?"

⁹⁰ Cf. Vollmer, *Liebes(ver)lust*, 283.

⁹¹ While quite a leap, Fraisl links this discussion to fellow Austrian poet Ingeborg Bachmann's *Malina*, which she cites at some length for its similar probing as to whether "es gute Liebhaber unter den Männern gebe." Fraisl, *Körper und Text*, 261. Given Bachmann's contention that "der Faschismus ist das erste in der Beziehung zwischen Mann und Frau," this line of thinking is at least understandable. Ingeborg Bachmann, *Wir müssen wahre Sätze finden. Gespräche und Interviews* (Munich: Piper Verlag, 1983), 144. Indeed, it is echoed by late Viennese writer and academic Ruth Klüger's uncompromising assertion that fascism "reine Männersache ist." Ruth Klüger, *Weiter leben: Eine Jugend* (Munich: Deutscher Taschenbuchverlag, 1992), 12.

⁹² Fraisl, *Körper und Text*, 253. Emphasis in original.

(*WN*, 36). Quick to capitalise on the moment, the Abenteurer muses aloud on whether he really loves Bibiana, which the latter correctly deciphers as the coded lead-in to yet another more difficult and dangerous mission for her to undertake to win his approval — so risky, in fact, that the Abenteurer is reluctant to elaborate “weiter als bis zu Andeutungen” (*WN*, 37). In a stunning reversal, it is Bibiana who suddenly takes the lead:

Er war selber nicht ganz entschlossen, ihr dieses heikelste Geschäft bereits jetzt anzuvertrauen. Er zögerte noch, er wollte noch zuwarten. Bibiana sprach das Wort zuerst aus: ‘Aufmarschplan’. In ihrer Stimme, als sie es aussprach, schwankte ein verzückter Laut. Das Wort traf ihn wie ein Schlag mitten ins Gesicht. Sie stahl ihm ja, von seinem Willen besessen, seine geheimsten Gedanken. Sie entglitt ihm mitten in die Rasereien seiner eigensten Pläne hinein. Sie verwandelte sich unmerklich in seinen lebendigen Dämon. Sie lebte wahrhaftig sein Leben. Er sagte verdrossen: ‘Haben wir unsere Rasereien ausgetauscht, Nastasja? Hat dein süßes Herz sich in Gehirnschubstanz verwandelt und frönt dem männlichen Laster, der frigidischen Lust zeugender Vernunft?’ Sie lächelte nur verklärt, fühlte, jetzt mußte er sie lieben, mußte (*WN*, 37).

Now, it seems that the *Geschöpf* of Nastasja has begun to exceed her own pre-configured boundaries, and what follows is the Abenteurer’s realisation of what might be called a Kleistian moment, in which the puppet begins to operate without the puppet master:

Er erschrak vor ihrem verzückten Gesicht, rief sie an: ‘Bibiana!’, rief in diesem Namen ihr verschüttetes Selbst an. Sie aber lächelte nur. Da wick er vor ihr zurück, vor diesem seinem Geschöpf, das sich mit einmal und lächelnd seinen Lebenswillen aneignete, murmelte betroffen: ‘Eine Figurine in meinem Spiel ist lebendig geworden, ein Schattenriß, eine Federzeichnung von einem Menschen, von meinem Gehirn ausgedacht, ist lebendig geworden. Das ist das einzige, was ich nicht vorgesehen habe.’ Von diesem Tage an hatte er trübe Ahnungen (*WN*, 37).

Now disrupting the *Pygmalion* myth somewhat, the sudden animation of the “Figurine,” as if granted by Aphrodite, is a frightful occurrence. Keeping in mind the subsequent demise of the Abenteurer, who shoots himself when the powers that be of the “deutsche Kleinstaat” catch up with the couple, it is only natural that Fraisl identifies here as the point at which the creation surpasses the creator. This, in turn, sets up the near-future emergence of an almost accidental *femme fatale*. Accordingly, the transformation into the media sensation/socialite/secret agent Nastasja must have been so complete that she has *acquired* some sort of lethal potential, annihilating the adventurer and the elaborate charade to boot. With his own acts of creation spiralling out of hand, the potential subversion of the Weiningerian hypothesis that Fraisl tries to discern is simply that Man, in a sense, becomes his own undoing, and the agency that the woman acquires is at most inadvertent and indirect. Having noted the potentially rebellious presence of this long-standing literary motif, Fraisl concedes — with palpable disappointment — that the “Konzeption einer ‘femme fatale’ allerdings bleibt in Hartwigs Roman auf die erste Bibiana aufoktroierte Rolle beschränkt, während Wedekind sie bei Lulu bis zuletzt

durchspielt.”⁹³ As such, in a way that mirrors the partial sense of agency it uncovers, the analytical category itself — the trope of the *femme fatale* — only seems to be partially effective when it comes to *Das Weib ist ein Nichts*.

In looking for ways in which Hartwig begins to upset and befuddle Weininger’s modular structure of binaries, with the *femme fatale* there is now a hurdle. In need of a course-correction, it is argued in the following that Fraisl’s suggestion is not, however, a non-starter and that this hurdle is not in fact an inevitable one. The working understanding of the the *femme fatale* and its application here need only be recalibrated somewhat. The problem, as becomes clear, is two-fold: firstly, Fraisl’s understanding of the concept is unnecessary literal, i.e. in that a literal fatality is involved, and secondly, it is slightly misplaced, not in the sense of its general relevance, but in the simple sense that she attributes it to the wrong character, or more precisely, the wrong *manifestation* of a certain character. As will be shown, a more careful consideration of the scene above (and the scenes that bookend it) serves to extend the pertinence of the *femme fatale* beyond the “erste Bibiana aufoktroyierte Rolle” in *Das Weib ist ein Nichts* and expose a breakdown of Weininger’s pseudomathematical system that far exceeds the comparatively moderate result above. Drawing now on the more topologically cognisant understanding of transformation that has been built throughout this thesis so far, it is by rethinking the very metamorphosis into Nastasja, which elicited Fraisl’s discussion of the “über den Plan des Schöpfers hinaus sich selbstverständigen Geschöpf,” that enables this.

Recalling from above, throughout the transformation of Bibiana into Nastasja, it is in the “Gesicht” that the processes of change leave their mark, and, as will be touched upon later, the subsequent transformations involving the Musiker, Bankier and Arbeiter do so as well. What seems to be missing, however, from the scholarly and critical responses to Hartwig’s 1929 novel is that these various facial transformations cannot be separated from the short introductory scene that takes place the day before the episode with the Abenteurer begins. Although Fraisl and De Budt rightly identify and reflect upon this scene as the sole moment in *Das Weib ist ein Nichts* in which another female character comes into focus, Bibiana’s aggressive mother,⁹⁴ it is in fact more significant again, for a closer look forces the reader to re-evaluate the ways in which the four *Verwandlungen* of Bibiana are articulated by the narrator. While keen to move off from Wende’s characterisation of *Das Weib ist ein Nichts* as something of a disturbing “Spiegelung” of an equally disturbing society, it is perhaps ironic that the very first sentences of the novel foreground above all else the presence of a mirror: “Ihrem Spiegelbilde zugeneigt prüft die süße

⁹³ Ibid., 256.

⁹⁴ Fraisl, *Körper und Text*, 247. See also De Budt, “Polarisierung, Parzellierung und Emotionalität,” 32.

Bibiana Zug um Zug ihr kindliches Gesicht, spürte neugierig hinter dem zuversichtlichem Lächeln um ihren schmalen Mund und die frühen Schatten um ihre gelben Augen ihr unentrinnbares Schicksal auf" (*WN*, 7). It continues to detail each of Bibiana's features, from her lips — "dunn, rot und ein wenig zu breit" — to her dimpled cheeks and a chin that is "weich gerundet" (*WN*, 7). As the fitting title to this prologue, "Bildnis," suggests, a virtual *portrait* of Bibiana is put on display.

The period in which Hartwig wrote (and indeed her conscious, if ambivalent, engagement with contemporary psychoanalytic theories)⁹⁵ would perhaps encourage us to consult the usual discussions of mirrors from Freud through to Lacan's "mirror stage" for theoretical inspiration. A later assessment of the mirror by Michel Foucault in his essay "Des Espaces Autres" in 1984, however, ultimately offers a more useful perspective on the matter. Perhaps one of the French philosopher's more memorable contributions to the Spatial Turn, Foucault's essay, which was based on a lecture given in 1967, uses the object of a mirror to illustrate not only the differences between the utopia and the heterotopia but also their fundamental interconnectivity. Detailing first the utopic function of the mirror, he writes: "I see myself there where I am not, in an unreal, virtual space that opens up behind the surface; I am over there, there where I am not, a sort of shadow that gives my own visibility to myself, that enables me to see myself there where I am absent [...]"⁹⁶ In a way that is all quite self-explanatory, the initial function of the mirror is one that establishes an image of the Self in the archetypal *ideal* space, i.e. a space that is strictly not real. Yet, the mirror offers up a second spatiality, one that is in fact generated from first:

But it is also a heterotopia in so far as the mirror does exist in reality, where it exerts a sort of counteraction on the position that I occupy. From the standpoint of the mirror I discover my absence from the place where I am since I see myself over there. Starting from this gaze that is, as it were, directed toward me, from the ground of this virtual space that is on the other side of the glass, I come back toward myself; I begin again to direct my eyes toward myself and to reconstitute myself there where I am. The mirror functions as a heterotopia in this respect: it makes this place that I occupy at the moment when I look at myself in the glass at once absolutely real, connected with all the space that surrounds it, and absolutely unreal, since in order to be perceived it has to pass through this virtual point which is over there.⁹⁷

In other words, it is precisely *through* the unreal, utopic space that the image of the Self is recontextualised into something real and extant in its surroundings — real from unreal, presence from absence. While a certain distancing from the term "real" in an ontological sense is necessary (in favour of something like "operational"), a similar phenomenon to Musil's "Grundlagenwitz" is surely at work here, in which the worldly machines *function* according to a

⁹⁵ Cf. Fraisl, afterword to *Das Weib ist ein Nichts*, 180.

⁹⁶ Michel Foucault, "Of Other Spaces," translated by Jan Miskowiec, *Diacritics* 16, no. 1 (1986): 24.

⁹⁷ *Ibid.*, 24f.

system of knowledge that rests upon entirely unreal, absent foundations. The mathematician, inside the building that keeps expanding, in the machine whose cogs keeps turning, peers downwards to find that the whole edifice rests on an absence, just as the gazing subject in front of the mirror first encounters “reality” once it has “pass[ed] through this virtual point which over there.” This conception of the spatiality of mirrors thus complements the phenomenon of operability based upon, to use Englehardt’s phrase, “necessary fictions.” The expression is so apt, because Foucault’s spatiality of the *Spiegel* does not describe a presence that usurps its opposite, namely absence, rather it describes how the former *necessarily* arises from the latter, that is contingent upon the latter.

Gazing into her own mirror, something similar happens with Bibiana in a way that is decisive for the purposes of this chapter, for what Bibiana finds therein corresponds to this sense of utopic absence noted above in that she discovers *not* a unity of features to form one distinct, identifying face, but rather a discordant multiplicity: “Mein Gesicht ist abenteuerlich vielfältig, dachte Bibiana. [...] Wie soll ich je die geheimnisvollen Augen, den frechen Mund und die schwermütigen Konturen meiner Wangen zu einem einzigen Gesicht zusammenzwingen” (*WN*, 7). Devoid of anything that is *essential*, Bibiana observes in her face the capacity to actually be multiple faces as opposed to one of her own. If for Foucault, the first function of the mirror is that of a spatiality with no foundations, Hartwig’s prologue pushes this further, with Bibiana’s likeness itself a whirr of features that possess no *Grundlage* and come to no *Einheit*. Soon disrobing and observing herself naked in the mirror, Bibiana is struck, in a typical mind-body separation, with the related sense of “Körper” being a mere container, and an empty one at that, for there is no stable self to speak of: “Er ist das Maß meiner Laster und Leidenschaften. [...] Ihm wird man glauben, nicht mir. [...] Die Konturen meines Körpers sind die Grenzen meines Herzens” (*WN*, 8). Bibiana’s Self is *just* her body, which itself serves as a vessel but with nothing integral or fundamental contained therein, and this is a lack of essence matched by her amorphous, undefinable face, which she reiterates in language as obscure as it is plain once her hostile mother bursts into the scene: “Ich habe so viele Gesichter in meinem Gesicht” (*WN*, 9). The protagonist’s initial reaction to her findings in the mirror is understandably negative: Bibiana wonders sullenly how “sie [ihren Körper] bezwingen könnte, daß er ein willigeres Instrument werde für das Spiel, das ihr Herz verantworten mußte” (*WN*, 8). How indeed could the inessential and formless be put to use?

Here, it may seem like Hartwig is writing faithfully to Weininger’s blueprint, for there is an apparent confirmation of a feminine “Nichts,” an empty “Gefäß” that can “alles werden” (at the hands of a dominant male) as well as Bibiana’s own apparent realisation of her lack of agency

over own body — an “Instrument [...] für das Spiel” over which she possesses no control, an “Objekt” for which Bibiana is not the “Subjekt.” Indeed, much in line with her own analysis, Wende thus deems the mirror in this scene to be a “Symbol der eigenen hassenswert-unzulänglichen Existenz” that glumly confirms the status of the protagonist in Weininger’s terms, i.e. as the passive, malleable “Nichts” that finds form only at the hands of Man.⁹⁸ Yet, grappling firstly with the question of transformation, this is surely an erroneous suggestion, for is there not a more nuanced topological interconnection of transformation and invariance here, which is so lacking in Weininger’s binary system? Bibiana’s reflection in this passage reveals that the protagonist is to be imagined from the outset as something of an accumulation of “Gesichter,” a set of possible manifestations, in a way that is almost machine-like. Though it is first in the Grimm fairy tale *Sneewittchen* of 1854 that the jealous Queen repeatedly inquires: “Spieglein, Spieglein an der Wand, wer ist die Schönste im ganzen Land?,”⁹⁹ the English-language rendition of the phrase was of course made iconic by the breakthrough Walt Disney film *Snow White and the Seven Dwarfs* (1937), in which the magic mirror, when summoned by the Queen, has a “Gesicht” of its own: a theatrical mask (see Fig. 3.4 below). This is curiously fitting, because while Bibiana’s “mirror, mirror on the wall” is not interested in telling her who exactly is the fairest one of all, it does frame her as something of an automated masquerade. Both anticipating and, more importantly, *undercutting* the metamorphoses that will ensue and seem so all-encompassing, this short scene incites the reader to re-evaluate them as mere transitions between forms, “parzelliert” as faces, that are part and parcel of a wider invariance that is *not* of fixed content but is structural and systematic. To stress this, none of these faces are essential or inherent, and indeed that is precisely the point: this structure depends on the very emptiness, the very absence of foundations, that Bibiana ascertains above. In a way that both chimes with Günzel’s topological turn and identifies Hartwig as a much more nuanced conceptual thinker than Weininger — perhaps even an “untaught” topologist, to appropriate Jenkins’ helpful category¹⁰⁰ — this mirror scene has pre-emptively reconfigured the very idea of transformation in terms of a structural, not ontological, “Gleichbleibendes.”¹⁰¹

⁹⁸ Wende, “Eine vergessene Grenzgängerin,” 34.

⁹⁹ “Sneewittchen, nach Grimm,” in *Das Buch Der Schönsten Kinder- und Volksmärchen, Sagen und Schwänke*, ed. Ernst Lausch (Leipzig: Otto Spamer, 1891), 10.

¹⁰⁰ Jenkins, “Non-Normative Euclidean,” 81.

¹⁰¹ Günzel, “Spatial Turn—Topographical Turn—Topological Turn,” 222. It should also be noted that the encounter with the mother can also be read in such a way that undermines the apparent transformation that sees Bibiana act essentially as a prostitute in the Abenteuerer game. Her mother roars at her “Mußt du wirklich jeden Abend herumtrieben?” (*WN*, 9), which can of course be understood in an overtly sexual manner. Indeed, Bibiana responds with a laugh: “Ich kann nicht über Arbeitslosigkeit klagen” (*WN*, 9). In this light, the actions of Nastasja in the first section would corroborate a sense of invariance throughout transformation, by which she metamorphoses into a figure that is already a part of some pre-existing repertoire.



Figure 3.4: The Mirror and the Mask¹⁰²

Before jumping to a possible counterargument that these transformations are still fully at the *behest* of the four men to come, thus leaving Weininger's framework of binaries largely intact and only forced to concede a little ground to topological pedantry, the question of feminine agency does not go unaddressed by the end of this scene. In a way that marks De Budt out as entirely right-headed to criticise Wende's interpretation as much too "eingeschränkt" for its neglect to consider how the mirror is also connoted positively in the text,¹⁰³ once her mother hurries out of the room (marking the last time she will see her daughter alive), Bibiana dresses

¹⁰² *Snow White and the Seven Dwarfs*, directed by David Hand *et al* (Walt Disney, 1937), 00:02:33-54.

¹⁰³ De Budt, "Polarisierung, Parzellierung und Emotionalität," 74.

herself and returns to the mirror once more, ostensibly “nur um zu sehen, ob das Kleid ordentlich saß” but soon observing a very different facet of the mirror’s expression of spatiality than she morosely noted before: she “erkannte vergnügt, daß ihr Körper auch seine ganz besonderen Vorzüge hatte, [...] daß er seine schwächliche Glieder [...] recht gut und verheißend zu gebrauchen wußte” (*WN*, 9). Now, it seems, this body, the apparently useless “Instrument,” is fit for *Gebrauch* after all.¹⁰⁴ Attributing an operational knowledge to the body itself — “er [...] wußte” — and not some external force, this accumulation of faces with no elemental *Grundlage* can function in such a way that appears to be of its own accord. In short, if Bibiana is something of a (literally) multifaceted machine, she is one that is now independently “denkend.” This is indeed a characterisation that complements “frequent parallels between body and machine” in modern Viennese culture, which “hinge not on a dualistic, mechanistic conception of mind and body,” as George notes, “but point far more to a sometimes ambivalent interdependence between the two.”¹⁰⁵ Echoing now the Foucault’s conception of the mirror and the previous interpretation of Musil’s “Der mathematische Mensch” in full, in which the Real/operational/present is based on the void-like Unreal and absent, the “Nichts” itself serves as a foundation *in absentia* for the possibility of functionality. Much like Engelhardt frames the real mathematical impulse behind *Der Mann ohne Eigenschaften* as a “critical trust” in necessary fictions,¹⁰⁶ Bibiana, now bearing witness to this new-found nature of her “Körper,” immediately resolves “ihm maßlos zu vertrauen” (*WN*, 9).

With her body now accorded some sense of agency before any encounter with the four men of the novel, gendered division between “Subjekt” and “Objekt” upon which Weininger insists is no longer on solid footing — an interpretation that forces a re-reading of suggestive pieces of text against the grain of the obvious. Perhaps unsurprisingly, the closing sentence of this opening scene is the most fitting example: “An diesem Abend kehrte sie nicht mehr nach Hause zurück, ließ sich von dem Abenteurer entführen” (*WN*, 9). While a rather simple grammatical observation, the use of the *Hilfsverb* “lassen” leaves ample space for ambiguity when it comes to the agency inherent to the action of “entführen”: the Abenteurer does not explicitly abduct Bibiana, like Rotwang does Maria. Rather, she *has herself* abducted by him, which allows for the retention of Bibiana as the grammatical subject in the sentence. With this delicate yet revealing

¹⁰⁴ De Budt argues instead that the mirror is in fact “ein ambivalentes Motiv” in *Das Weib ist ein Nichts*, in that the negative description runs against an eventual positive one. With the interpretation of this chapter, one might nuance her claim somewhat to say that real ambivalence comes not only from a juxtaposition of positive and negative aspects of the mirror function, but rather that the positive (here a *functionality*) is in fact rooted in that which is presented initially as negative (the embodied *Nichtigkeit*). Ibid.

¹⁰⁵ George, *The Naked Truth*, 61.

¹⁰⁶ Engelhardt, *Modernism, Fiction and Mathematics*, 117.

choice of phrase, the notion that *only* the men are pulling the strings is rendered dubious on the level of language from the outset. Keeping an eye on the argument of this chapter, the *Umdeutung* of Weininger's clunky division between transformation and invariance into something much more topological now seems in place to threaten the integrity of the "Subjekt/Objekt" binary as well. Let us now return with fresh eyes to the above scene in which Fraisl located the beginnings of the *femme fatale* in *Nastasja*, cited again below:

Er erschrak vor ihrem verzückten Gesicht, rief sie an: 'Bibiana!', rief in diesem Namen ihr verschüttetes Selbst an. Sie aber lächelte nur.
Da wick er vor ihr zurück, vor diesem seinem Geschöpf, das sich mit einmal und lächelnd seinen Lebenswillen aneignete, murmelte betroffen: 'Eine Figurine in meinem Spiel ist lebendig geworden, ein Schattenriß, eine Federzeichnung von einem Menschen, von meinem Gehirn ausgedacht, ist lebendig geworden. Das ist das einzige, was ich nicht vorgesehen habe.'
Von diesem Tage an hatte er trübe Ahnungen (*WN*, 37).

Reflecting upon the significance of the opening mirror scene prior to the creation of the Russian "Hochadel," it is surely *not* really the fabricated *Nastasja* who becomes the formidable threat to the man with the plan; it is Bibiana, and the Abenteurer *knows* this — perhaps even subconsciously. If names are as important to the text as they appear, then the fact that he shouts "Bibiana!" in his moment of peril — a name he has hitherto *never* used — is rather informative. The name *Nastasja* is now "verkauft," and as much as the narrator insists that *his* "Geschöpf" has seized control, there is a tension within this passage that encourages the reader to suspect a misdirection. Is it not the case, therefore, that the apparent changes yielding *Nastasja* — the sculpting purportedly the hands of the Abenteurer — are but a shift into just one permutation in the polygonal structure that predates him? Bibiana, with an agency that is not acquired but pre-existing and contingent upon her very *Nichtigkeit*, is simply moving between faces. The reader knows, of course, that she has many of them. Further, in a way that demonstrates that the invariant system is in fact an open-ended one, she is surely now just acquiring a *new* face when "sie verwandelte sich unmerklich in seinen lebendigen Dämon": that of the Abenteurer himself.¹⁰⁷ Much like for the audience in *Metropolis*, the reader's positionality is crucial in reaching this alternative conclusion. The climactic reveal that Maria 2.0, when burning at the stake, is actually a man-made machine comes as a shock to the riled-up crowd of workers, but surely not to the viewer, who witnessed the empty aluminium shell take on content and the guise of Maria in Rotwang's cavernous laboratory some 55 minutes earlier.

¹⁰⁷ This capacity to collect faces is indeed alluded to when Bibiana looks into yet another mirror, unsure whether she is dreaming or not: "Trübte ihr Atem das Glas? Das Gesicht im Spiegel, immer noch ihr Gesicht, überzog sich auf einmal mit einem fahlen Niederschlag aus Rasereien, fremde Züge mischten sich, sah sie, unter die eigenen, eckig schob das Kinn sich vor, die Stirn wölbte sich, heftig strafften sich die Lippen und die Augen vereisten, bis [...] sie taumelnd vor Entzücken in ihrem Spiegelbild den Toten erkannte" (*WN*, 46).



Figure 3.5: The creation of Maria 2.0¹⁰⁸



Figure 3.6: The Big Reveal¹⁰⁹

¹⁰⁸ *Metropolis*, 01:25:48.

¹⁰⁹ *Metropolis*, 02:19:02.

Likewise, the mirror scene and everything it establishes about the protagonist suggests that the transformation into Nastasja is not so complete or enduring, as it melts away in an instant like the imitation covering of Maria on the stake. Moreover, the transformative process has not, in fact, been as orchestrated by the Abenteurer as initially seems to be the case — ironically a finding that places a limitation on the use of *Metropolis* as a point of comparison here, for the robot was only ever the desperate Rotwang's invention.¹¹⁰ Indeed, there is more to rely upon here than the Abenteurer's instinctive use of the name "Bibiana" and the mirror scene (telling as they are) to determine who the real *femme fatale* is, for the ending of the first story is not that ambiguous. Following directly on from Bibiana's sudden and unnerving act of mind-reading with the "Aufmarschplan," said plan is put into action, albeit to calamitous ends:

Bibiana ertrug, ihren Plan zu gutem Ende zu bringen [...]. Aber sie widerstand nicht der Versuchung, sich einen vermeintlichen Festungsplan anzueignen, der sehr verlockend, viel zu verlockend auf dem Schreibtisch des Chefs der Spionageabteilung lag, gerade so, als hätte man ihn mit Absicht für sie hingelegt. Aber Bibiana war zu sehr darauf gedrillt, mit menschlicher Dummheit zu rechnen, vergaß ein einziges Mal, vorsichtig zu sein. Hastig nahm sie den Plan an sich, während ihre Finger auf der präparierten Platte Abdrücke zurückließen, während die unsichtbaren photographischen Apparate sich von allen Seiten zugleich filmten, während die automatische Klingel, die sie berühren musste, wenn sie den Plan berührte, aus allen ihren Drähten unhörbar zu singen begann und die Horchenden alarmierte. Sie wurde nicht aufgehalten, als sie das Haus verließ, aber irgendein Mensch folgte ihr hart auf den Fersen. Er war jung und sah nicht gefährlich aus, irgendein verliebtes Bürschchen vermutlich. Aber der entwendete Plan, dieser Kostbarkeit, wie sie vermeinte, entpuppte sich, als sie ihn dem Abenteurer übergab, *als ein leeres weißes Papier* (WN, 37f.).¹¹¹

The Abenteurer's carefully woven web of secrecy and lies is severed, then, by a blank sheet of paper, *not* one that has been marked with content. It is thus an emptiness with the arbitrary *potential* for content that proves fatal(e) for the elaborate con and for the Abenteurer himself. The alignment of the "leeres weißes Papier" and Bibiana, the empty, "Frau ohne Eigenschaften," is difficult to overlook, but Hartwig is keen to labour the point. When the entire charade collapses and the arrival of the police is imminent, the Abenteurer plays his final card, ostensibly to save himself from the wrath of the authorities:

Ich besitze ein Geheimdokument, Bibiana, das mich, will ich, überleben soll. Ich werde es dir anvertrauen, aber nicht deinen Händen, ich will es keiner Leibesvisitation aussetzen. Ich werde es deinem Körper anvertrauen, Bibiana, ich werde es unsichtbar auf deine weiße Haut schreiben, und du wirst es mit deinem Körper diesem Päderasten überliefern, der dich nicht berühren wird (WN, 41).

¹¹⁰ Which is to say, the case of *Metropolis* resembles Fraisl's conception of the *femme fatale* that has been shown to be inadequate for the analysis of Hartwig's novel.

¹¹¹ Emphasis added. Bearing in mind Shaw's *Pygmalion* and the feminisation of language, there is here something similar to the ending of the play, when Eliza begins to realise that she has a power over Higgins that is connected to language. At the climax, she threatens to become the assistant to Higgins' rival, Nepommuck, and teach phonetics herself.

Bibiana, “dieses süße Nichts,” that can be literally and figuratively written on, is indeed the “leeres weißes Papier,” and it was Bibiana, not Nastasja, that proved to be the destroyer of the dangerous game.

Having modified the pitfall in Fraisl’s conception of the *femme fatale* concerning its incorrect attribution to Nastasja, the issue as to its applicability beyond the first episode of *Das Weib ist ein Nichts* still remains, for the Abenteurer is the only one of the four men who meets his demise in the novel. Thankfully, however, this hurdle is easily overcome when depart from a strictly “wortwörtliche” reading of term “fatale” but maintain a grasp on its nonetheless destructive possibilities. Curiously enough, it is firstly with the doomed Abenteurer that benefits of widening scope can be gleaned. Let us return once more to the critical moment where the Abenteurer yells “Bibiana” and recognises that “die Figurine in [s]einem Spiel ist lebendig geworden” (WN, 37). As was explained previously, Fraisl sees this as the emergence of the creation that will — at a *future* moment — overpower the creator, which is to say, the announcement of the imminent arrival of the *femme fatale*. Yet, there is another fatality that occurs as a result of Bibiana (*not* Nastasja) exercising terrible agency, and it strikes not later but immediately. With the *Spiegelszene* setting up the *potential* for the multifaceted machine-body of Bibiana to disrupt the “Subjekt/Objekt” binary, this is surely the moment at which the devastating potential is realised, occasioning not the cracking of the mirror but rather the audible shattering of Weininger’s edifice of binary categories.

Furthermore, to complete the cycle of discombobulation, the result of this breakage is that Man — who for Weininger is only ever a stubbornly invariant entity, who can only ever be the “Etwas” he always has been — becomes subjected to nothing less than a process of *change*. The scene in which the Abenteurer subconsciously recognises Bibiana as the terrible presence before him is an *immediate* turning point in every sense, including for the Abenteurer, who “[v]on diesem Tage an hatte [...] trübe Ahnungen” (WN, 37). This remarkably simple “von ... an” structure designates, in short, a change that begins the moment it is written, and what a change there is: the cold, calculating and uncaring Abenteurer is, in his final moments, shown to be surprisingly vulnerable and ultimately concerned with Bibiana’s survival above all else, not his own. The fatality brought about by the *femme fatale* is thus not literal at all in *Das Weib ist ein Nichts*, and this slightly more inclusive understanding of the concept, by which a literal death need not but certainly can occur, is in fact elastic enough to cover much more textual ground. The reader is now fully prepared to observe that the subsequent three sections with the Musiker, the Bankier and the Arbeiter are in fact mere repetitions of this first “Bibiana aufoktroierte Rolle.” Much like cold water was poured on the apparently irreconcilable transition of Murnau’s doorman

from rags to riches with the so-called Hollywood ending, the organisation of *Das Weib ist ein Nichts* is itself a neat topological demonstration. Each dramatic change of scene (and of Man, and of manifestation of Bibiana) becomes a less significant fluctuation in an invariant narrative structure through to the end.

Zooming briefly over the rest of the novel, almost every element outlined above is carried over, from the facial transformations (understood now to be part of Bibiana's own inherently topological ability to accumulate faces *ad infinitum*) to the breakage of the male figure, his brilliance, dominance and characterisation as the wielder of all power up to that point. When, for example, in the second section, Bibiana's development of musical ability (which follows much the same pattern as her remarkable procurement of the Russian language) is expressed in terms of her "jäh verwandelte Gesicht" (WN, 53) that is "geisterhaft bleich, eine weiße Flamme" (WN, 53) and has "Inbrunst statt Blut in den Adern" (WN, 61), she has simply taken on the features she herself observes in the Musiker (WN, 53 and 63). Likewise, her third transformation, in which "Ihr Gesicht straffte sich, wurde härter, fast kantig. Ihre Augen, die nur mehr von Kursschwankungen, Aktiengesellschaften, von Kreditgeld und Wechseldiskont träumten, schienen einzufrieren" (WN, 112), is but another impersonation of the Bankier, whose face she observes to be "breit, kantig und dunkel" (WN, 105), and on it goes. Indeed, by the close of the novel, Bibiana seems to confirm as much when she sobs to the Arbeiter:

[...] Ich habe kein einziges Gesicht, kannst du das begreifen, ich habe immer nur das Gesicht gehabt, das ich eben erlebt habe. Ich war immer nur Geliebte, ich war kein Mensch. Ich habe mich in Rasereien verwandelt, in Musik, in Gold, jeden Blutstropfen, jeden Atemzug hab ich hingegeben und war doch kein Mensch.' Ihre Stimme versagte einen Augenblick, dann fuhr sie fort: 'Ich war immer nur ein Gefäß, in das irgendeiner sein Leben hineingestopft hat. Nicht einmal ein Gefäß, eine spiegelnde Fläche vielleicht, die Leidenschaften zurückstrahlt, eine Figurine in einem fremden Spiel, vielleicht' (WN, 151f).

While she cannot completely put it into words, Bibiana here is partially coming to terms with the transformative agency to be found in her invariant "Eigenschaftslosigkeit"; the only issue is that she still overstates the level of control that the men have had in the whole process. The reader, however, knows better.

Lastly, once Bibiana's transformations take place, it is not long before a devastating change consumes these very men. The creative genius Musiker is soon ready to give it all up for Bibiana, choosing her over music (not that it even matters, as she unceremoniously leaves him at the close of the chapter nonetheless). Similarly, the venture capitalist Bankier and the politically active Arbeiter are both imagined as statuesque and hewn from stone, the former as if "in Bronze geprägt" (WN, 105) and the latter with "Schädel und Schultern aus Granit" (WN,

131).¹¹² In both cases, their stony compositions melt away as they buckle to their knees, their resolve shattered, in Bibiana's presence (*WN*, 119 and 161) — precisely what the proud Arbeiter suggests he will *never* do during his first acrimonious meeting with the lavishly dressed Bibiana: “Oder haben Sie vielleicht erwartet, daß ich vor dem Gnadenbilde eines Pelzmantels erschüttert in die Knie stürzen werde?” (*WN*, 139). Contrary to the Weiningerian *Prinzip*, the men of *Das Weib ist ein Nichts* change just as much as Bibiana does, and, as final blow, this is surely because their sense of being an “Etwas” is actually rather ephemeral and is locked into the same relationship with the invariant “Nichts” as with Bibiana. Are they too not merely ontologically empty categories into which “irgendeiner sein Leben hinein[stopfen kann]”? Now, the namelessness of the men, identified only as social categories and roles, is all the more fitting,¹¹³ for they are also just empty *Gefäße* — for beautiful music, speculative finance, revolutionary politics and wild schemes with state security forces in German Kleinstaaten — but unlike Bibiana, they do not become self-aware enough to learn this about themselves.

To briefly summarise, reminiscent of George's focus on modern Viennese dancer and choreographer Gertrud Bodenwieser's *Demon Machine* of 1939 (see Fig. 3.7 below), in which the mechanised female multibody becomes the “Alleszermalmerin,” the everything-crusher,¹¹⁴ the analysis of *Das Weib ist ein Nichts* above has laid bare a certain propensity for destruction in the multifaceted *femme fatale* Bibiana. Although Weininger's categories themselves have not been “zermalmt,” his interlocking oppositional arrangement of transformation and invariance, something and nothing, subject and object, man and woman has come undone. In Bibiana, Hartwig imagines a woman whose transformations, whose taking on of “Etwas,” are actually part of an invariant nothingness, and it is precisely here, in the invariant nothingness, where her status as a subject finds form. The converse is also true, in that the four men of the text, for all their cunning or artistic brilliance, are equally shown to be in states of flux, filling in their inherent *Nichtigkeit* with borrowed characteristics and engaging (albeit unwittingly) in yet another game of roleplay. When the Abenteurer, acting like a ventriloquist dummy for Otto Weininger, tells Bibiana “Du hast keinen Sinn für das Wesentliche, Nastasja” (*WN*, 21) he is certainly correct, but just not in all the ways he imagines. In a thoroughly Nietzschean fashion, there is no “Wesentliche” to speak of with Bibiana, and this is exactly the point, for its absence

¹¹² These descriptions could now be read as a gendered reversal of the *Pygmalion* myth: the men are forged from some Weiningerian “Materie” in the perspective of the woman, i.e. in *her* language.

¹¹³ This inherent nothingness of the men is pushed perhaps further again with the Abenteurer, whose uprootedness and lack of fixed identity is made clear from the outset: “Er hatte kein Vaterland, er hatte keinen Namen. Seine Mutter hatte ihn auf der Durchreise durch Frankreich geboren, seine Geburt dauerte von Basel bis Paris. Sie vergaß ihn in dem Coupé, das sie zur Gare St. Nazaire brachte. Der Kutscher lieferte ihn im Findelhaus ab” (*WN*, 10).

¹¹⁴ George, *The Naked Truth*, 224.

is both that which guides her apparent transformations and the place in which her undeniable agency, her becoming a *Subjekt*, resides. And in the same vein, there is nothing “wesentlich” about him either; he just doesn’t know it. Moving ahead into *Bin ich ein überflüssiger Mensch?*, although Hartwig becomes less overt in her references to Weininger in particular, a similar phenomenon to the above is underway, albeit one that is packaged in a (slightly) less melodramatic and sensational prose style.



Figure 3.7: Gertrud Bodenwieser’s *Demon Machine*¹¹⁵

Talking About Nothing

“Never mind Anna O.; meet Aloisia Schmidt: self-hater, compulsive masturbator, narcissistic manic-depressive, all-round good-time gal,”¹¹⁶ pens Zadie Smith as her introduction to the first-person narrator of *Bin ich ein überflüssiger Mensch?*. With that, Smith reveals that the transition from the “crazywomen”¹¹⁷ of Hartwig’s texts published antemortem to this posthumously published novel is honeycombed by a thematic invariance all of its own. As was mentioned earlier, there is also an invariance across texts on the level of argumentation here. Although keen to avoid repetition, it will be argued in the following that Hartwig’s more refined understanding of transformation and invariance in *Bin ich ein überflüssiger Mensch?* is once again the catalyst for a

¹¹⁵ Image taken from the archival papers of Gertrud Bodenwieser, National Library of Australia, Class MS 9263/Series 2/Piece 31. Reproduced in George, *The Naked Truth*, 224.

¹¹⁶ Smith, *Feel Free*, 291.

¹¹⁷ Painitz, “Lunacy and the Law,” 117.

full-scale *Umdeutung* of modern Vienna's repressive discourse on gender and women's autonomy. Much like before, this topological observation is intimately connected to the yawning chasm at the foundations of the Self. Nevertheless, certain structural and thematic differences to its predecessor allow us to observe both a more deliberate engagement in *Bin ich ein überflüssiger Mensch?* with certain contemporaneous cultural and philosophical debates and an intriguing degree of affinity with the modernist turn in mathematics that extends beyond the level of content in *Das Weib ist ein Nichts* to question of textual form itself.

Let us first consider these traits that are unique to the second novel. Alongside a notable shift into an "augenfällig sachlicheren, damit 1931 allerdings fast schon wieder unzeitgemäßen Stil,"¹¹⁸ *Bin ich ein überflüssiger Mensch?* differs from its predecessor in how it settles upon one particular setting. This second novel is principally a *Büroroman* narrated from the perspective of a young Viennese secretarial typist — a decision that allows for an engagement with a key cultural icon of the early 20th century. Hartwig's *Bin ich ein überflüssiger Mensch?* opens in relative simplicity with the following introduction: "Ich bin Stenotypistin. Ich habe nahezu ein Dutzend Diestjahre hinter mir. Ich stenographiere äußerst flink und bin flotte Maschinschreiberin. Ich erwähne das nicht, um damit zu prahlen. Ich erwähne es nur, weil ich feststellen will, daß ich zu etwas *tauge*."¹¹⁹ With this straightforward opening gambit, Hartwig has wasted no time at all in foregrounding the archetypal "neue Frau" of modernity.¹²⁰ By first and foremost identifying herself via her profession, Aloisia both bears witness to the societal shift that ushered young women into the workspace and casts herself in terms of *functionality*. She is a worker, and one who manipulates *machines* at that. Yet, redolent of Joseph von Eichendorff's *Aus dem Leben eines Taugenichts* (1862), Aloisia also brings into question the use value of that very functionality, setting up a tension between "taugen zu etwas" and the titular *Überflüssigkeit* that will accompany her throughout the entire narration. Further, whereas Bibiana's *Nichtigkeit* was presented as a blankness that registers as an irresistible *Schönheit* for the men she encounters, Aloisia at first seems exemplify the opposite, but an opposite that still generates an all-consuming void of *Eigenschaftslosigkeit* — the "Extrem der Mitte" of an unrelenting "Durchschnittlichkeit," or being

¹¹⁸ Fraisl, *Körper und Text*, 273.

¹¹⁹ Mela Hartwig, *Bin ich ein überflüssiger Mensch?* (Graz and Vienna: Droschl Literaturverlag, 2001), 5. Emphasis added and cited in-text hereafter for brevity in parentheses as "ÜM."

¹²⁰ Gisela Schirmer, for example, takes stock of the cultural icon's representations across time and notes that the "Prototyp der 'neuen Frau' wird vor allem durch die weibliche Angestellte — die Verkäuferin, Stenotypistin und Sekretärin — repräsentiert." Gisela Schirmer, *Käthe Kollwitz und die Kunst ihrer Zeit: Positionen zur Geburtenpolitik* (Weimar: VDG, 1998), 56. Likewise, Martyn Lyons even demarcates the "Typewriter Girl" as a particularly impactful manifestation of New Woman across cultural production from 1890 through to the mid-20th Century. Martyn Lyons, *The Typewriter Century: A Cultural History of Writing Practices* (Toronto, Buffalo and London: University of Toronto Press, 2021), 60f.

in Krausian terms just like “jeder Trottel” in Vienna.¹²¹ Returning momentarily to Hartwig’s distinct literary context, this is not without precedent: while a brief glance at Hartwig’s timeline shows the completion of these two novels in quick succession, the time between 1929 and 1931 gestures to the potential impact of a fellow Viennese Literat, Robert Musil, with the first part of *Der Mann ohne Eigenschaften* published in 1930. Indeed, Musil’s Kakania is introduced to the reader in terms of a comical averageness:

Dort, in Kakanien, diesem seither untergegangenen, unverständenen Staat, der in so vielem ohne Anerkennung vorbildlich gewesen ist, gab es auch Tempo, aber nicht zuviel Tempo. So oft man in der Fremde an dieses Land dachte, schwebte vor den Augen die Erinnerung an die weißen, breiten, wohlhabenden Straßen aus der Zeit der Fußmärsche und Extraposten, die es nach allen Richtungen wie Flüsse der Ordnung, wie Bänder aus heilem Soldatenzwillich durchzogen und die Länder mit dem papierweißen Arm der Verwaltung umschlangen. [...] Natürlich rollten auf diesen Straßen auch Automobile; aber nicht zuviel Automobile! Man bereitete die Eroberung der Luft vor, auch hier; aber nicht zu intensiv. Man ließ hie und da ein Schiff nach Südamerika oder Ostasien fahren; aber nicht zu oft. Man hatte keinen Weltwirtschafts- und Weltmachtetizeiz; man saß im Mittelpunkt Europas, wo die alten Weltachsen sich schneiden; die Worte Kolonie und Übersee hörte man an wie etwas noch gänzlich Unerprobtes und Fernes. Man entfaltete Luxus; aber beileibe nicht so überfeinert wie die Franzosen. Man trieb Sport; aber nicht so närrisch wie die Angelsachsen. Man gab Unsummen für das Heer aus; aber doch nur gerade so viel, daß man sicher die zweitschwächste der Großmächte blieb.¹²²

Neither terribly fast nor prohibitively slow, conquering the skies but never very intensively, living luxurious and sporty lives but neither as refined as the French nor as obsessive as the English, a rich military nation that only manages to be the second weakest, not *even* the weakest European power — Kakania is stuck not just geographically but in every way possible in the “Mittelpunkt Europas.” As such, it is not only the infinite extremity, as Cheng eloquently demonstrates, that is plagued with a parasitic *Null*-ness; the run-of-the-mill, unremarkable and average makes for an equally merciless void. In *Bin ich ein überflüssiger Mensch?*, this opening image of the “neue Frau” at work is immediately undercut by another opening, namely that of the abyss of averageness, of the titular *Überflüssigkeit*:

Ich habe erwähnt, daß ich äußerst flink stenographiere, aber ich habe bisher verschwiegen, daß ich mich, von dieser Fähigkeit abgesehen, niemals irgendwie hervorgetan habe. Ich bin fleißig, gewissenhaft, leidlich verlässlich, aber ich kann mich weder einer besonders raschen Auffassungsgabe noch der Initiative rühmen, die zu einer einigermaßen leitenden Stellung befähigt (*ÜM*, 5).

Now in a territory redolent of Musil’s Kakania, the Land of Not-Quite-Anything, Aloisia is (or at least perceives herself to be) someone who can do *something*, who “taugt zu etwas,” but just

¹²¹ Cf. Fraisl, *Körper und Text*, 273f.

¹²² Musil, *Der Mann ohne Eigenschaften*, 35f.

not in a way that is remarkable. As Aloisia continues, this inexorable mediocrity is then affixed to unsettling focus on the female body once again:

Ich bin nicht schön, ich bin nicht häßlich. Ich habe ein Gesicht, das weder angenehm noch unangenehm auffällt, das weder anziehend noch abstoßend ist, das man einfach nicht beachtet. Ich kann mir, glaube ich, das Geständnis ersparen, daß ich schön sein möchte. Das ist selbstverständlich. Aber ich beteuere, daß ich zuweilen häßlich sein möchte. Vielleicht, weil man mich dann beachten müßte, vielleicht. Aber das ist nur eine Vermutung von mir, erklären kann ich es wirklich nicht. Ich bin weder gut noch schlecht gewachsen. Ich habe einen Körper, den man fehlerlos nennen könnte, wenn er nicht den furchtbaren Fehler hätte, unscheinbar zu sein, unansehnlich, ein Körper, den man einfach nicht beachtet. Ich kann es mir allerdings nicht leisten, mich gut anzuziehen (ÜM, 5f.).

Whereas the mirror scene in *Das Weib ist ein Nichts* identified Bibiana as *Nichtigkeit* embodied, Aloisia is now to be understood as “Durchschnittlichkeit” embodied, and unceasing averageness is indeed just another form of nothingness. If Kakania is the cartographical Land of Not-Quite-Anything, then the “Körper, den man einfach nicht beachtet” of Aloisia becomes the Body of Not-Quite-Anything, capable neither of intense beauty nor a terrible (and thus still *noticeable*) ugliness. Then, quite like nothingness, averageness is also difficult to contain in any stable way. In a final turn in Aloisia’s plainly spoken introduction, while Bibiana stood before the mirror and determined that the “Konturen [ihres] Körpers sind die Grenzen [ihres] Herzens” (WN, 8), in *Bin ich ein überflüssiger Mensch?*, the “Durchschnittlichkeit” of Aloisia cannot in fact be delimited to the contours of her body: “Ich habe behauptet, daß ich ehrgeizig bin, und ich habe zugegeben, daß ich Ursache genug hätte, bescheiden zu sein, und das ist meine Geschichte, die ich niederschreiben will, obwohl sie so lächerlich alltäglich, so verzweifelt alltäglich ist, daß sie eigentlich gar keine Geschichte ist” (ÜM, 6). Like a black hole, Aloisia’s *Überflüssigkeit* is so all-consuming that her entire story itself, which is to say the entire *text* itself, is swallowed up in its deleterious power.

To regather some threads, let us recall that the pre-modernist understanding of mathematics was firstly a “way of seeing and looking” at the material world that became more conceptually nuanced via Kant’s reconciliatory philosophy of *Anschauung* in the 18th Century, exemplified by young Hauke Haien in *Der Schimmelreiter*. The perspective of Musil’s sardonic narrator above in *Der Mann ohne Eigenschaften*, looking backwards at the bygone dual monarchy, echoes the position of the modern mathematician in the 1913 essay: he peers outwards and downwards into the abyss, thus establishing new forms of mathematical practice and knowledge by turning *inwards*. Surely, in Aloisia’s damning assessment of herself, her body and the “Geschichte, die [sie] niederschreiben will,” there is something remarkably similar. With the perspective of a homo- and autodiegetic narrator used to its full effect, the adult Aloisia’s retrospective narration, looking *backwards* like Musil’s narrator over her *abysmically* mundane life to date also corresponds

to the narrative situation of the mathematical “Grundlagenwitz” in Musil’s essay — almost as if Hartwig’s literary form answers Musil’s call for such fiction at the end of the essay. As will become most relevant towards the end of this analysis, it is with this autodiegetic narrative structure that Hartwig’s *Auseinandersetzung* with Weininger becomes interwoven with the concurrent (and very Viennese) philosophical contest with the *Sprachkrise*.

Having laid out the necessary departures from the prose style and format of *Das Weib ist ein Nichts* in the conception of *Bin ich ein überflüssiger Mensch?*, the task of this section begins once more with Hartwig’s particular understanding of metamorphosis and its supposed counterweight. Skimming over some opening remarks about her mediocre childhood — unnoticed by teachers, studying for months on end only to achieve moderately below average grades — Aloisia soon finds sudden solace in “ein Erlebnis, das [sie] zu den schönsten [ihres] Lebens zähl[t]” (ÜM, 16): her first trip to the theatre, i.e. her first meaningful engagement with the creative arts. While she initially struggles to get to grips with the array of characters “eines verschollenen Jahrhunderts” (ÜM, 17), the experience turns out to be formative:

Was sich nachher begab, geht in meinem Gedächtnis ziemlich durcheinander. Ich weiß nur noch, daß ich das Theater völlig benommen verließ und auf dem Heimweg den Entschluss fasste, Schauspielerin zu werden. Vor allem erschien mir eine Existenz, die sich täglich zwei Stunden lang in voller Öffentlichkeit, vom Rampenlicht verklärt und von unzähligen Augen beachtet, abspielte, ungemein wünschenswert. Nicht weniger verlockte mich die Vorstellung von einem Kostüm in das andere, von einem Leben in das andere hineinzuschlüpfen. Anscheinend hatte ich inzwischen unbeständig genug an der Maskerade, die mich anfänglich befremdet hatte, Gefallen gefunden. Geradezu berauschend war die Vorstellung, ein Schicksal um das andere zu erleben, einen Tod um den anderen zu sterben (ÜM, 18).

Carrying over, now quite explicitly, the notion of the masquerade identified in the previous novel, Aloisia identifies early on a desired career path and recognises that it will demand an ability to transform into other people, to live the fates of others. Then, in a possible moment of intertextuality with the opening line of Kafka’s *Die Verwandlung*, in which Gregor wakes from “unruhigen Träumen” to find himself metamorphosed, immediately before Aloisia’s most significant discussion of transformation, she tells us: “Ich hatte eine unruhige Nacht” (ÜM, 18). And while she need not worry about a sudden multitude of insect legs, her morning is nonetheless taken up by a flurry of performative gestures, attempted transformations, in front of yet another mirror. Just like before with Bibiana, it is in fact an overwhelming sense of invariance that comes into view, abruptly elbowing any potential changes out of focus:

Schon am nächsten Morgen jedoch begann ich, an meine Eignung für diesen verlockenden Beruf zu zweifeln. Ich versuchte nämlich, [...] mit meinem Spiegelbild als Partnerin, eine schauerliche Pantomime aufzuführen. Ich zerraupte mir das Haar, zückte imaginierte Dolche, leerte ebensolche Giftbecher bis zur Neige und brach stöhnend in die Knie. Aber je rascher ich agierte, desto beklemmender wurde der Gegensatz zwischen meinen pathetischen Gebärden

und meinem völlig nüchternen Gesicht, das weder meinem Willen, noch meiner angemäßen Erregung gehorchte und fast einer Maske glich, die ihren Ausdruck nicht verändern kann. Ich begnügte mich jedoch nicht damit, an meinen mimischen Fähigkeiten zu zweifeln. Ich hatte noch andere Bedenken gegen mich selbst. Ich hatte eine spröde, brüchige Stimme, fiel mir ein. Ich hatte ein unverlässliches Gedächtnis. Ich hatte einen unscheinbaren Körper. Ich ahnte vor allem, daß ein solcher Beruf nicht nur Talent, sondern auch Konsequenz, Energie, Härte gegen sich selbst erfordert, Eigenschaften also, über die ich nicht verfügte (ÜM, 18f.).

Paralleling the mirror of Disney’s wicked Queen more closely again, Aloisia’s facial reflection *is* one fixed, unchanging mask. Whereas Bibiana’s infinitely malleable face was piloted by a mysterious, mechanical structure of changeability that itself remained unchanging, Aloisia’s face is simply the “Parzellierung” of the invariant void itself, and this stubbornly unchanging face thus puts a check on any potential transformation or procurement of qualities imagined or encountered by Aloisia. In comparison to its predecessor, therefore, the reader need not look all that hard in *Bin ich ein überflüssiger Mensch?* to discover an understanding of transformation and invariance that is redolent of the Topological Turn, which, as Günzel stresses, “hat es nicht mit der Transformation des Raumes als solchem zu tun, sondern vielmehr mit dem, was sich trotz einer Transformation *nicht* verändert.”¹²³ Surpassing even the previous novel, the topological insight by which transformations are secondary to their own counterweight is a very direct one here, because the reader encounters not even the Weiningerian “Weib” that can “alles werden,” but rather one who struggles to become anything at all — a *Taugenichts*.

Despite the different tactic deployed in topologizing Weininger’s fraught binary, the way in which this corrupts the integrity of his wider framework of dualistic concepts is quite similar. While in *Das Weib ist ein Nichts*, the prolongation of the topological mirror scene set up the calamitous potential of the *femme fatale*, an agency that in turn decoupled Weininger’s *Subjekt* vs *Objekt* dichotomy, in the 1931 novel, this breakdown occurs in the scene immediately after Aloisia’s “Pantomime” in front of her mirror, in which her suggested inability to find fixed and inherent characteristics is put to the test. “Der Sommer 1914 begann also für mich mit einer Katastrophe” (ÜM, 22), explains Aloisia, and subverting the reader’s expectations, it turns out that the onset of the First World War is not really even the true catastrophe at hand: “Mein Vater ordnete zunächst lediglich an, daß ich einstweilen meiner Mutter helfen sollte, den Haushalt zu besorgen. Eine solche Anordnung konnte ich nur als Strafe auffassen, denn ich hatte eine unüberwindliche Abneigung gegen häusliche Arbeiten” (ÜM, 22). Blissfully unaware at that point that her father’s “üble Laune [...] der kritischen politischen Lage zuzuschreiben war” (ÜM, 22), Aloisia tries to delay her return home from school, knowing from experience

¹²³ Günzel, “Spatial Turn–Topographical Turn–Topological Turn,” 222.

that “es immer etwas zu putzen, zu plätten, zu flicken, zu stopfen gab” (ÜM, 22), and she stumbles unwittingly into a situation that does in fact have much to do with the critical political situation:

[W]enn ich mich recht erinnere, [...] verweilte ich vor jedem Schaufenster und trieb mich planlos in den glühenden Straßen herum. Es schienen mehr Menschen als sonst um diese Zeit unterwegs zu sein, die entvölkerte sommerliche Stadt schien ihre letzten Reserven vollzählig auf die Straße zu schütten. Es stauten sich Gruppen, zerschmolzen wieder, rotteten sich neuerlich zusammen. Da erfaßte mich auch schon eine Woge aus Menschenleibern und riß mich mit sich fort, mündete an einer Straßenkreuzung in einen Strom erregter Menschenmassen ein, der sich brausend in das weite Becken eines Platzes ergoß, bis er vor einer säulengetragenen Fassade stockte (ÜM, 23f.).

Drawing very heavily on the liquidous connotations of the novel’s title, this scene is overflowing with thermodynamic descriptions of the molten “Flüssigkeit” that is an incensed crowd: as if by a volcanic eruption, the city’s residents pour onto the “glühenden Straßen” and melt together into an igneous “Strom” of moving bodies. Notably, the use of the destructive prefix on “*z*erschmolzen” lends a sense of completeness and irreversibility to the transformational process of melting that begets a change of material state. If one is to speak of topological spaces, therefore, the heating process described here is such that it breaks the homeomorphic restrictions that ensure topological equivalence, and according to Aloisia herself, she too is fully engulfed therein when she notes: “Ich verlor nicht das Bewußtsein, aber ich verlor das Bewußtsein meiner selbst” (ÜM, 24). She continues:

Ich schmolz in diesen gigantischen Körper hinein, den man die Masse nennt. Ich hatte gar keine Ursache, erregt zu sein, denn ich wußte ja nicht einmal genau, um was es ging, aber die vielköpfige Unruhe, die mich immer enger umkreiste und nach und nach zu einem einzigen und einigen Gefühl ungeheurer Erregung zusammenschmolz, durchtränkte auch mein Herz mit einem Fieber der Erwartung. Endlich wurde es verhältnismäßig still, ich wußte nicht weshalb. Anscheinend hielt jemand irgendwo eine Ansprache. [...] Schon mischten sich in das hymnische Chaos aus Hoch und Hurra vereinzelte Stimmen, die verzückt die Volkshymne intonierten, und ehe ich auch nur wollen konnte, sang ich piepsend mit, während das Lied zu einer rasenden Kundgebung fanatischen Patriotismus aufloderte (ÜM, 23f.).

Apparently subsumed into the hot liquid, paralleled by the blood pulsating in her ears, Aloisia seems to describe a metamorphosis so intense that she is now part of the patriotic hive mind, and indeed what is more representative of a mediocrity — so feared by the likes of Nietzsche — than the “Masse” that erases all individuality?

Yet, Aloisia’s retelling here is surely not entirely trustworthy. Taking seriously her disclaimer of uncertainty — “wenn ich mich recht erinnere”¹²⁴ — much of this passage casts doubt as to

¹²⁴ Moreover, Aloisia prefaces this entire section with a more forceful disclaimer again: “Ich habe seither soviel über den Krieg gelesen, zu hören bekommen und debattiert, habe so sehr versucht, ihn zu vergessen, und mir nachträglich jene Skepsis angeeignet, die das Jahr 1918 bereits bestätigt hatte, daß ich mich nicht verbürgen kann, die Eindrücke der kaum Fünfzehnjährigen völlig den Tatsachen entsprechend wiederzugeben. Ich werde mich

whether she really “verlor das Bewußsein [ihrer] selbst” at all, whether it really mounts, as she then claims to the experience “eines erlöschenden Ichs” (ÜM, 24). Meandering by accident into the crowd with the sole intention of avoiding more greasy housework, Aloisia no doubt feels the intense heat of the moment, i.e. the “Gefühl ungeheurer Erregung” and the “Fieber der Erwartung,” and screams along with the others, but she does not really know why, and moreover, does not seem like she cares all that much about finding out. While the rest of the crowd are “verzückt” in their rendition of the unifying national anthem, Aloisia chirps along somewhat absentmindedly, precisely because she is thinking only of the impact of the fiery sensations on *herself*. Though participating, Aloisia is still an observer of the others around her, and more importantly, she is *aware* of her position as such, which casts doubt on the idea of an “erlöschenden Ichs” that she insists upon. As her narration of this experience continues, Aloisia begins in fact to corroborate this interpretation. When the procession comes to a close and “die kompakte Masse je verschwisterter Herzen zerbröckelte” (ÜM, 24), it is with disappointment that Aloisia begins to come to terms with the transience and superficiality of the experience:

[Ich] wurde mir meine Unwissenheit bewußt, die in einem verwirrenden Gegensatz zu der Erregung stand, die ich eben erlebt hatte. Ich hatte also, wie ich einsehen musste, Ursache genug, erregt und begeistert zu sein, und ich begann die Volkshymne vor mich hin zu summen. Aber so sehr ich auch summete, es gelang mir nicht, in meinem Herzen jenen Rauschzustand aus Patriotismus wiederherzustellen, den ich eben erlebt hatte. Ich empfand so etwas wie Begeisterung gewiß, aber keineswegs das strahlende Gefühl, das ich empfinden wollte und sollte, und dass sich auch nur annähernd mit dem Raserei verglichen ließ, die ich eben noch erlebt hatte (ÜM, 24).

The moving crowd, caught up in a swell of nationalistic sentiment, in this early scene *does* generate a process of change, an intense increase in temperature, but the heat, as it is physically prone to do, dissipates just as quickly as the crowd itself disperses, and Aloisia cannot regenerate the fleeting effects that accompanied the changes she “eben gerade erlebt hat.” To stick with patriotic and militaristic images, just as the empowering effects of Herr Samsa’s uniform (and that of Murnau’s doorman) swiftly fade, the ultimately ephemeral effects of the patriotic proceedings at the outbreak of the First World War serve to expose another invariance. This, Aloisia rightly recognises, is her *Überflüssigkeit*, an inability to isolate any *Eigenschaften* that permanently adhere: “Ich [...] ahnte nicht, daß ich mir die Fähigkeit zu fiebern von einer fanatisierten Volksmenge ausgeborgt hatte, begriff nur, daß ich einem leidenschaftlichen, einem überschwenglichen Gefühl anscheinend nicht gewachsen war” (ÜM, 24f.). If “eine topologische Beschreibung weist zunächst nicht auf Veränderung hin, sondern auf *Gleichbleibendes*,”¹²⁵ then

deshalb auch darauf beschränken müssen, aus diesen vier Jahren nur ganz wenige Erinnerungen herauszugreifen und nur solche, für die mein Gedächtnis einigermaßen einstehen kann” (ÜM, 22).

¹²⁵ Günzel, “Spatial Turn—Topographical Turn—Topological Turn,” 222.

this scene is a topological demonstration *par excellence*, but it is also the moment at which Hartwig's manipulation of Weininger's conceptual binaries is put to work again.

With the false dichotomy of transformation and invariance reimagined as something much closer to their modern mathematical conception, the emergence of a feminine subjectivity follows in such a way that is reliant, somewhat paradoxically, on this unchanging dearth of discernible characteristics. This being Not-Quite-Anything, heated and cooled but *never* melting or freezing, is precisely that which mitigates against the loss of Aloisia's individuality in this passage, against her subsumption into liquefied torrent of group-think. While achieved in a slightly different (indeed simpler) manner than in *Das Weib ist ein Nichts*, Hartwig has once again rendered Weininger's strictly gendered distinction between *Subjekt* (=male) and *Objekt* (=female) collateral damage to a rethinking of transformation and invariance along overtly topological lines, because it is in her invariant *Eigenschaftslosigkeit* itself that this particular "Frau ohne Eigenschaften" comes to be any sort of *Subjekt* at all. Conversely, while the baying crowd is not *explicitly* gendered as masculine, the clear ways in which the "Krieg" itself is connoted as such in the text¹²⁶ (and of course beyond it, if Ruth Klüger's famous assertion that "die Kriege gehören den Männern" applies retroactively),¹²⁷ it is not much of a stretch to assume an implicit gendering of the other members of the moving "Masse," and it is these very participants — who certainly seem to have a sense of "Etwas" about them — that blur into the nationalistic collective. So Aloisia's *Überflüssigkeit* is *not* like that Nietzschean mediocrity after all, for her sheer inability to meaningfully hold onto character traits and qualities, her explicit failure to transform completely and permanently into something, prevents her, in a neat twist of the term, from melting into the "Flüssigkeit" of lost individuality in the first place.

To avoid unnecessary repetition with the previous discussion of *Das Weib ist ein Nichts*, the question of Aloisia's destructive agency will be examined more concisely and with a focus on the later sections of the novel. While Fraisl does not attempt to stretch the trope of the *femme fatale* across into *Bin ich ein überflüssiger Mensch?* (which, given her unnecessarily literal understanding of it, is not surprising), it is Smith who comes very close to guaranteeing its relevance when she notes that, by the close of the text, Aloisia is essentially the "last one standing."¹²⁸ To briefly summarise the novel until its closing section, while her father is conscripted to the front, Aloisia joins the workforce as a secretarial assistant to secure income for the household. Akin to the opening of *Der letzte Mann*, while struggling to adjust to the vivid

¹²⁶ See Fraisl's compelling focus on the portrayal of "Kriegerfrauen" in the text, i.e. the women left behind as the men are sent to war, for a detailed discussion on this point. Fraisl, *Körper und Text*, 284ff.

¹²⁷ Klüger, *weiter leben*, 12.

¹²⁸ Smith, *Feel Free*, 295.

“Lärm” of “ein halbes Dutzend Schreibmaschinen, die unaufhörlich im Chor rasten” (ÜM, 28), Aloisia is dealt a humiliating blow at work in the form of a dismissal — even before her three week probation is up. Much like the poor doorman, she pitifully tries to keep up appearances at home and follow her normal daily work routine, fooling her other into thinking she is still employed. Becoming something of a *flâneuse*,¹²⁹ she roams the city for hours on end and reads voraciously in the park — yet another engagement with art that is imagined as a vehicle for Aloisia’s fleeting assumption of qualities and meaningful experiences.¹³⁰ Quickly caught out by her mother, she is made to slave away at home once more, before her father is sent home injured after eighteen months and she secures secretarial employment for a second time. Here, still entirely mediocre and incapable of working at the pace of “tüchtige” colleagues, Aloisia manages to last nine months not by transforming into an ideal typist, but actually on account of her *Überflüssigkeit*: “Ich hatte genug damit zu tun, eine gleichgültige Miene zur Schau zu tragen, während ich stündlich mit meiner Entlassung rechnete, ich hatte genug damit zu tun, mir nicht anmerken zu lassen” (ÜM, 45). Now something of a survival technique, it is in fact to her unrelenting averageness that Aloisia begins to cling, almost obsessively, once she encounters a sequence of men: Emil K., Anton W. and Egon Z. The first is a pockmarked young medical student to whom Aloisia is not at all attracted, but whose attraction to her prompts a fleeting transformation of her sense of self (ÜM, 49). When he kisses her hand, Aloisia toys for some time with the potential of beauty: “Ich [...] bemerkte zum ersten Mal, daß meine Hände schön waren. Ich blickte sie verstohlen an und dachte dabei an den Mund, der mir mit einem Kuß verraten hatte, daß sie schön waren” (ÜM, 50).¹³¹ The change, of course, is fleeting, and Aloisia soon self-sabotages¹³² her brief relationship with Emil K. by insisting that her lack of qualities presents a fundamental mismatch with his apparent intelligence — simply refusing to be told otherwise (ÜM, 56f.). Then, even though she accepts his hand in marriage, the persistent “Gleichgültigkeit” towards the equally unattractive Anton W., for she cannot muster any real feelings towards him beyond transient bouts of affection and pity, brings about a similar devolution to the Bankier and the Arbeiter from *Das Weib ist ein Nichts*, in that the emotionless,

¹²⁹ Indeed one could read in Hartwig’s feminised adoption of this well-known modernist symbol some structural parallels to the argument of this chapter, with the sense of aimless wandering, i.e. movement and transition governed by a notable lack of direction and purpose, echoing the phenomenon of operation and functionality despite an absence of *Grundlagen*.

¹³⁰ “Ich las wahllos, las, was mir unter die Hände kam, zuweilen sogar belehrende Bücher, Reisebeschreibungen etwa oder Biographien, zumeist aber und mir Vorliebe Romane. Das hatte seinen Grund. Ich las, um ich selbst zu vergessen, um aus einem Buch in das andere, aus einem Schicksal in das andere hineinzuschlüpfen, um mich mit der jeweiligen weiblichen Hauptfigur zu identifizieren. Ein solcher Roman [...] verlieh mir Schönheit, Talente, Erfolge, verlieh mir die ersehnte Fähigkeit, Leidenschaften zu empfinden und einzuflößen. Ich [...] entlieh vom Autor, was mir am empfindlichsten fehlte, Phantasie” (ÜM, 33).

¹³¹ Again, there is the “Parzellierung” of the body that De Budt explores in depth.

¹³² Cf. Smith, *Feel Free*, 292.

dry and detached bureaucrat is soon “in Tränen” and begging desperately for Aloisia’s “Nachsicht” (ÜM, 66f.). Resigned to the same fate as the Musiker from before, however, he is quickly abandoned by Aloisia a few pages later.

With an eye on the previous novel, none of this is particularly new. Aloisia’s prolonged encounter with the final man of the three, Egon Z., however, is more revealing, and it is intriguing for the simple fact that it is intimately interwoven with the development of complicated relationship with yet another character — another woman, a young actor named Elisabeth. Despite the obvious overtones, it is in fact De Budt who is the first in existing scholarship on the novel to call this sequence of events what it is, namely a heavily implied Queer relationship.¹³³ While it would be no doubt intriguing to explore the this facet of the text, with an eye to how Aloisia’s suggested bisexuality draws upon contemporaneous (again, Freudian) conceptions of more ambiguous forms of sexual expression, it suffices for now to note how it complements the wider argumentation of this chapter: rather than explicitly breaking down Weininger’s categories “Mann (M)” and “Weib (W)” themselves into something more androgenous,¹³⁴ Hartwig is reimagining the ways in which these categories relate to one another beyond a simple heterosexual binary. Presented by Aloisia as having at least “ein Dutzend Gesichter, für jede Laune, für jede Stimmung ein anderes” (ÜM, 81f.), Elisabeth, writes Daniela Hurezanu, is Aloisia’s literary “double,”¹³⁵ and indeed the more the narrator talks about Elisabeth, the more she becomes aware she is also referring to herself — “Mein Gott, mein Gott, was rede ich denn da? Spreche ich von ihr oder spreche ich von mir?” (ÜM, 83). Cognisance of Hartwig’s previous novel would suggest to us that the multifaceted Elisabeth is, in fact, Bibiana’s *Doppelgänger*, and more of a parallel-universe Aloisia, in which the protagonist *is* the successful actor she aspires to be. At any rate, in an inversion of her own difficulty in meaningfully transforming her invariant face, it is Aloisia’s difficulty to keep track of the various faces of Elisabeth that leads to something of an epiphany on the nature of acting and theatre that proves to be decisive for the rest of the novel.

As a reminder, the beginning of this chapter opened with an epigraph containing Paul Mongré’s droll suggestion in *Sant’ Ilario* that the components of theatre and dramaturgy can be represented mathematically, i.e., as an n^{th} term expression. While Aloisia does not explicitly attempt to articulate a mathematisation of performance arts, and despite her insistence that her sense of

¹³³ De Budt, “Polarisierung, Parzellierung und Emotionalität,” 49.

¹³⁴ Indeed, De Budt seems to suggest as much in her own interpretation of this scene. *Ibid.*, 50.

¹³⁵ Daniela Hurezanu, “Mela Hartwig’s novel *Am I a Redundant Human Being*,” *Words Without Borders*, 1 September, 2010, accessed 12 August, 2023: <https://wordswithoutborders.org/book-reviews/mela-hartwigs-am-i-a-redundant-human-being>.

“Phantasie” is so unrefined that she “muß in realen Begriffen operieren” (ÜM, 7), her consideration of Elisabeth’s face prompts a new understanding of acting that echoes Noether’s very much unreal *begriffliche Mathematik*. Having come to visit the actor and being greeted by someone who had “eine unverkennbare Ähnlichkeit” with Elisabeth but simply could not be her — “das hätte ich beschwören können” — Aloisia is forced to reckon anew with the ever-changing face before her, this time one that resembles “eine steinerne Maske” (ÜM, 88). Left to peruse Elisabeth’s pile of texts and postcard covered wall, Aloisia lingers inexplicably on a copy of *Die Zarin* and cannot recall why it is familiar to her. When she then notices a photograph of another actor on the wall “mit einer steinernen Maske” (ÜM, 90) for a face, with the words “Die Zarin” scribbled onto the rim, the proverbial penny drops:

Ich wußte plötzlich, und die Photographie, die den Namenszug einer sehr berühmten Schauspielerin trug, bestätigte es mir, daß hinter diesen beiden Worten gar kein Erlebnis, wie ich vermutet hatte, sondern nur diese rätselhafte Ähnlichkeit steckte, die überdies gar keine richtige Ähnlichkeit war, weil Elisabeth keineswegs der Schauspielerin selbst, weil sie nur der ‘Zarin’, die diese auf dem Bild zu sein vorgab, glich, aber ich wußte zugleich, daß ich diese Ähnlichkeit nicht wahrhaben wollte, weil ich sie mir mit jener anderen, die ich vor einigen Tagen festgestellt hatte, einfach nicht zusammenreimen konnte. [...] In diesem Augenblick begriff ich, daß sie gar nicht der Photographie glich, wie ich geglaubt hatte, daß sie nur die Züge, die Haltung, die Stimme der Rolle angenommen hatte, mit der sie sich eben beschäftigte, und ich ahnte zum ersten Mal, was es heißt, Schauspielerin zu sein, ahnte, dass die Rolle der Mensch ist, der man fiebernd zu sein wünscht, daß jede Rolle ein solcher Mensch ist, in den man sein Herz hineinschüttet, sein Blut, um in ihm zu einem erborgten Leben zu erwachen (ÜM, 91f.).

Like algebraic categories that can take on content that is essentially arbitrary — “inhaltsleere Begriffsschemata,” to recall Einstein’s phrasing¹³⁶ — the “Rolle” does not have any essential or binding relationship to the particular actor who tried to substantiate it; instead, there is a network of categories and structural “Ähnlichkeit[en].” Then, Aloisia is joined in her theoretical theatrical musings by Elisabeth, whose more forceful idea of what acting entails harks back to an earlier moment in the novel and implicitly presents Aloisia with several hurdles in her aspiration to become a “Schauspielerin”:

Verlegen äußerte ich diese Ansicht und sie stimmte mir enthusiastisch zu. Sie ging noch weiter, bezeichnete die Rolle als den Feind, den man besiegen oder von dem man besiegt werden mußte und beides nur, um eins zu werden mit der Rolle, um ihr, seinen Willen aufzuzwingen, um aus ihr seinen eigenen Doppelgänger zu machen oder um in sie *hineinzuschmelzen*, ihre Züge und ihre Empfindungen, *ihren* Willen anzunehmen. Keinesfalls durfte man, entschied sie, mit einer Rolle paktieren, mußte entweder völlig in ihr Aufgehen oder völlig auf seinem eigenen Ich bestehen. Als ich sie an diesem Tag verließ, war ich überzeugt, dass sie zur Schauspielerin taugte (ÜM, 92).

Noting the redeployment of the same terminology from the decisive scene involving the hot and fluidic crowd at the outbreak of the First World War (“hineinzuschmelzen”), it seems that

¹³⁶ Einstein, *Geometrie und Erfahrung*, 5.

successful acting involves the very capacity for *complete* change that Aloisia (despite her insistence she did in fact melt into the patriotic crowd and lose her “Ich”) was shown to be incapable of. For Elisabeth, therefore, there is no “eigene[s] Ich” to be found in a transformation that is not carried out to its full capacity, which of course silently appends Aloisia’s closing remark on how the former “zur Schauspielerin taugte” with the question as to whether the protagonist, the archetypal *Taugenichts*, ever could. It is not long at all before the prophetic nature of these deliberations becomes clear.

After nursing Elisabeth through a prolonged illness, in a markedly uncomfortable scene, Aloisia arrives unannounced at Elisabeth’s apartment to find her waiting anxiously for a guest who turns out to be Egon Z., and rather than send her away, Elisabeth hides the protagonist from view behind the curtain to her bedroom. Now a classic Schauspiel in action, Aloisia is made to bear witness, as an audience member, to Elisabeth’s failed attempt to break through Egon’s icy, dismissive exterior and confirm he cares for her. When she asks if he had anything to say about a letter she had sent to him declaring her feelings, he impassively answers: “Nichts” (*ÜM*, 107). Hurrying away without a word to a despondent Elisabeth once Egon has left, Aloisia returns the next morning to realise that the previous day’s encounter was the final one: “Elisabeth wurde eben weggeschafft. Sie hatte sich erschossen” (*ÜM*, 109). Rather than lapse into a period of mourning, however, Aloisia resolves instead to transform herself into Elisabeth, ostensibly with the aim of “winning over” Egon Z., whom she apparently loves — more plausibly, her desire to be like Elisabeth simply involves desiring Egon Z. in turn.¹⁵⁷ And with Elisabeth no longer in the picture, it falls on Aloisia to put their theory of acting to the test.

Taking the narration perhaps too readily at face value, De Budt offers the following assessment of Aloisia’s debut performance: “Chamäleonartig wandelt sich Aloisia in Elisabeth und verliert somit zum Teil ihre eigene Existenz, weil sich ihre grundlegenden Eigenschaften sogar ändern.”¹⁵⁸ Give the trajectory of Aloisia’s life so far and her relentless inability to pin down any fundamental traits at all, if De Budt is correct, then then the protagonist must seemingly achieve the hitherto unachievable. In fact, the opposite is true: Aloisia tries and — true to form — *fails* to metamorphose into Elisabeth, and she fails because of her inability to overcome her distinctive *lack* of “grundlegenden Eigenschaften.” Yet, De Budt’s intuitive use of the term “chamäleonartig” is highly apt, because Aloisia’s alterations are, like the camouflage effect of the Old World lizard, ephemeral and superficial. She begins to sign off documents with the

¹⁵⁷ As Hurezanu similarly concludes: “It is after Aloisia finds out who the man is that she starts to pursue him, as if she wanted to turn herself “into Elisabeth (who, in turn, had spent her whole life trying to be other people).” Hurezanu, “Mela Hartwig’s novel *Am I a Redundant Human Being*.”

¹⁵⁸ De Budt, “Polarisierung, Parzellierung und Emotionalität,” 49.

name “Elisabeth,” alters her appearance to approximately match the deceased young actress (a difficult task in itself, given the latter’s “Dutzend Gesichter”) and even fills her cupboards with the same liqueurs she saw in Elisabeth’s apartment, but a “grundlegende” *Verwandlung* there is not. Using a letter addressed to Egon Z. left behind by Elisabeth to organise a meeting with him and manipulate her way into a new job at his construction firm (ironically, at a time when she does not need a job), Aloisia’s developing obsession with Egon Z. is met, however, with the same coldness and dismissiveness as Elisabeth’s was. Now in possession, to her mind, of a good reason to take on Elisabeth’s “Kummer” in full, she determines to carry through her transformation through to the end, “einen Tod um den anderen zu sterben” (ÜM, 18). Except she does not. Posting a suicide note destined for Egon Z. and sending a telegram to her parents, Aloisia then seals every window in her apartment and stretches the gas hose from the kitchen cooker in through her bedroom door, turns on the gas and lies in bed. During what she thinks are her agonising final moments, however, as much as she tries to muster up the misery of rejection by Egon Z. and fixate upon it long enough for her deathly transformation into Elisabeth to become complete, she just cannot, concluding “ich bin ein überflüssiger Mensch, und ich will nicht sterben” (ÜM, 145f.). Her head pounding with the onset of gas poisoning, she “taumelte ans Fenster, riß es auf, beugte [s]ich weit hinaus, atmete” (ÜM, 146). Like everything else in her life to date, Aloisia’s suicide attempt fails, which is to say, her *Verwandlung* into Elisabeth remains a very limited one.

In light of Aloisia’s recurrent musings on what acting really is, especially in the exchange with Elisabeth on the nature of the “Rolle” and the “Mensch,” this failure is quite illuminating. Let us consider the intertextual moments that reference Elisabeth’s various stage roles, for they are surely very intentional: Aloisia notes how, in her memory, Elisabeth was only ever “jede Gestalt, die sie vorübergehend annahm, die Julia und die Judith, die Hedda Gabler und die Elektra, die Eboli, die Cyprienne und wie sie alle heißen” (ÜM, 83), and they meet first at a staging of Goethe’s *Clavigo* (ÜM, 83f.) With these passing references to an array of doomed female characters, ranging from the works of Goethe and Schiller to Hugo von Hofmannsthal and Henrik Ibsen,¹³⁹ the reader is encouraged to re-think Elisabeth’s extended bout of an unexplained sickness. In an extreme form of method acting, is she not a rendition of the terminally ill Marie Beaumarchais, who finally expires — surprise, surprise — because of her intense love of the titular *Clavigo*? The performance is accurate, quite literally, *to the letter*, i.e. to the question of what is or is not written in a “Brief.” Moreover, it is precisely like the eponymous

¹³⁹ It would be remiss not to note again Weininger’s own aforementioned discussion of Ibsen in *Geschlecht und Charakter*.

protagonist of Ibsen's *Hedda Gabler* that Elisabeth, in her Man-made misery, turns the gun on herself. In a neat case of life (and indeed death) imitating art, Elisabeth refuses "mit einer Rolle [zu] paktieren," really *does* pour her life into them and ultimately achieves what Aloisia imagined to be a cornerstone of acting early in the text: "ein Schicksal um das andere zu erleben, *einen Tod um den anderen zu sterben*" (ÜM, 18).¹⁴⁰ Yet, this final step that makes the character transformation complete — which Aloisia *cannot* achieve — surely serves, in the end, to eradicate the aforementioned system of roles altogether, to bring an end to the processes of slipping in and out thereof that are imagined to be *repetitive* and open-ended. Put simply, when one such process of change works too well, the system in fact ceases to operate; the faulty system of *Schauspielen* is in fact the one that endures. If there is an agency within the *Überflüssigkeit*, therefore, it is surely in the fact that the survival not only of the Self but also of the conceptual system of *Rollen* is contingent upon *not* being able to fully transform, *not* being capable of metamorphosing so completely that the bounds of topological equivalence are exceeded. If the process of slipping in and out of roles and fates, which Aloisia erroneously thinks is Elisabeth's skill, is to be one that can be repeated *ad infinitum*, then it is in fact Aloisia who is more capable of doing so, precisely because no transformation can ever overcome her invariant *Überflüssigkeit*. If she is a *Taugenichts*, then Aloisia "taugt zu nichts" rather skilfully. She is, in a sense, condemned to repeat these processes of transformation because of her limited capacity to transform, but indeed: is this not what she has wanted all along?

Just as Hartwig's entanglement of invariance within transformation with the emergence of a feminine agency becomes apparent, so to do its attendant effects on Weininger's own conceptual system. In fact, Aloisia's failure to overcome her *Überflüssigkeit*, to transform in a way that is complete and lasting, leads to the most notable masculine transformation yet. In a darkly humorous final act, Aloisia realises all too late that she had already posted her suicide letters to Egon Z. and her parents (although the latter registers as an afterthought). Sneaking into the office and failing to retrieve the letter from his post-box in time — and alerting him of her presence go boot — she is forced to come face-to-face with the cold *Bauingenieur* again, and it is with astonishing, indeed *mechanical* "Gleichgültigkeit" (ÜM, 149) that she is greeted:

Er saß, über einen Plan gebeugt, hinter seinem Schreibtisch, blickte flüchtig auf, als ich eintrat, und reichte mir dann, ohne mich anzusehen und wortlos, meinen Brief. [...] Er beugte sich noch tiefer über den Plan herab und gab sich den Anschein, ihn angelegentlich zu prüfen, sagte jedoch: 'Sie werden einsehen, Fräulein Schmidt, daß Sie meine Kanzlei noch heute verlassen müssen' (ÜM, 149).

¹⁴⁰ Emphasis added.

While quipping to herself that “ein Selbstmordversuch war vielleicht, genau genommen, kein rechtsgültiger Entlassungsgrund,” she responds with a “Ja” that is as “tonlos” as can be expected from the Woman of Not-Quite-Anything (ÜM, 149), and at this moment, a curiously subtle but undeniable change is triggered in the man opposite her:

Er blickte überrascht auf. Er hatte sich vermutlich auf Widerstand und Tränen gefasst gemacht, er hatte offenbar nicht damit gerechnet, so leichtes Spiel mit mir zu haben. ‘Aber Sie müssen doch begreifen, Fräulein Schmidt, dass ich Sie bitten *muß*, meine Kanzlei noch heute zu verlassen,’ verteidigte er sich. ‘Es bleibt mir doch gar nichts anderes übrig.’ Ich starrte ihn völlig verständnislos an. Weshalb verteidigte er sich eigentlich, weshalb? [...] Aber was blieb ihm denn anderes übrig? Ich musste zufrieden sein, wenn er mich nicht einfach ins Gesicht lachte. Mit diesem lächerlichen Selbstmordversuch hatte ich es doch wahrhaftig verwirkt, ernst genommen zu werden (ÜM, 149f.).

In an instant, therefore, the austere and uncaring façade of Egon Z. shatters. Speaking agitatedly more to himself than Aloisia, “er sprang auf und begann erregt auf und ab zu gehen,” and noting how she has made a “Hanswurst” of him, he insists: “Sie können doch nicht verlangen, daß ich mich zu solcher *Harlekinade* hergebe” (ÜM, 150). The term is a fitting one, for Aloisia’s failed *Verwandlung* into Elisabeth was but a piece of pantomime gone wrong (*necessarily* so), a first foray into the life of a “Schauspielerin” she so longed for. And, against his own wishes, buckle to the harlequinade Egon does. In addition to promising to Aloisia “selbstverständlich [i]hre vollen Bezüge,” he commits: “Ich werde mich überdies für Sie verwenden und werde Ihnen zu einem anderen Posten verhelfen. Darauf können Sie sich verlassen” (ÜM, 150). Completing his sudden transformation, the scene ends in a moment of unprecedented tenderness: “Plötzlich blieb er direkt vor mir stehen, legte seine Hand auf meinen Kopf und bog ihn zurück, beugte sich ganz nahe über mein Gesicht und sagte eindringlich: ‘Sie werden keine Dummheiten machen, nicht wahr, das versprechen sie mir, ich bitte Sie darum’” (ÜM, 150). Having occasioned in the cold Egon Z. the very sensitivity and vulnerability that the skilled actor and accomplished shapeshifter Elisabeth could not, it is by way of her *failure* to fully metamorphose that Aloisia ultimately gets what she wants. If the more inclusive format for the *femme fatale* from before can stand, by which the eponymous fatality is not a person but an inflexible structure of strict binary concepts — transformation and invariance, subject and object, something and nothing, and man and woman — then this scene is the smoking gun that confirms she has struck again.

At this point, all of the constituent components of Weininger’s pseudomathematical structure of interwoven binaries are, like Olimpia’s mechanical eyes, rolling on the floor. They have been taken apart by Hartwig’s significantly more conceptually nuanced prose work — in a process triggered, no less, by a spatial understanding that sits in *much* closer proximity to simultaneous developments in modern mathematics than Weininger’s vandalistic use of mathematical

notation could ever hope to. By creating in Aloisia effectively a continually intact topological space, a “Mensch” that can be warped and stretched but never fully transformed into anything on account of her unyielding emptiness, and locating a distinctly feminine subjectivity and agency within this, Hartwig is able to quickly dispense with the very notion of the invariant “Mann (M)” who reshapes his infinitely malleable female objects to suit. Now, there is only the question of the man’s own potential *Nichtigkeit* to reckon with. As a reminder, at the close of *Das Weib ist ein Nichts*, Bibiana only half come to terms with her own nothingness, leaving it to the reader to piece together the textual evidence and come to the only logical conclusion that the four men were (unknowingly) just “Nichts” themselves. Thinking of *Sex in the City*, which was in the middle of its third and fourth seasons when *Bin ich ein überflüssiger Mensch?* was finally published in 2001, Smith amusingly wonders whether Aloisia is the “Viennese Carrie Bradshaw from Hell” and suggests that Emil K., Anton W. and Egon Z. are “just like Carrie’s men; they come and go interchangeably and never really shift her from her course; they prove to be paper-thin, ciphers.”¹⁴¹ Smith’s musings are, of course, perceptive ones, but Hartwig, I suggest, goes a step further; unlike in the previous novel, here Hartwig is generous enough to let Aloisia have her moment. It comes, however, not in her narration of past events but in a return to the present-tense voice from the novel’s opening.

Before concluding said moment, this shift of perspective itself cannot go unnoticed, because getting to this point for Aloisia was not without difficulties. Let us recall that Bibiana, in her closing half-recognition of herself, tries to articulate the nothingness within her and brands herself a “Gefäß, in das irgendeiner sein Leben hineingestopft hat” (*WN*, 152). Immediately before this, however, her narration stumbles for a moment: “Ihre Stimme versagte einen Augenblick, dann fuhr sie fort” (*WN*, 152). Hartwig’s context alone might encourage reflection on the Viennese “Sprachkrise,” memorably announced by Fritz Mauthner in his *Beiträge*, for this stumble when talking about her absence of foundations is of course analogous to the perceived emergence of the abyss in language itself. Yet Bibiana does not “pass over in silence”¹⁴² or fall into a Mauthnerian “Schweigen”; she starts speaking again. Accordingly, this brief instance of failure, a momentary lapse in speech, that is nonetheless overcome — *not* by filling in the empty space in any way, i.e. specifically not by overcoming the void, but by accepting it — is thus closer to that Nietzschean impulse that Paul Mongré recognises is underway in modern

¹⁴¹ Smith, *Feel Free*, 292.

¹⁴² Ludwig Wittgenstein, *Tractatus Logico-Philosophicus* (London and New York: Routledge, 2013), 89. The original German of the famous phrase is rendered: “Und wovon man nicht reden kann, darüber muss man schweigen.” Ludwig Wittgenstein, *Tractatus logico-philosophicus, Logisch-philosophische Abhandlung* (Frankfurt am Main: Suhrkamp, 2003), 7.

mathematics in his essay “Sprachkritik.” With its decisive shift into autodiegetic narration, *Bin ich ein überflüssiger Mensch?* converts this analogy on the level of character into a much more significant formal strategy.

Having already established the parity of the text’s structure and Musil’s “Grundlagenwitz,” what then is the effect of Aloisia’s multitude of equivocations, abjurations and contraversions throughout? Occurring first when she laments her inability to hold on to the “Kummer” of her father’s conscription into the armed forces, i.e. her failure to ascertain a fixed *Eigenschaft* of herself, she exclaims “Ich weiß nicht, ob ich mich verständlich ausdrücke” (ÜM, 25). This phrase persists “like a stutter,”¹⁴³ as Smith notes, throughout the text when she grapples in some way with her titular *Überflüssigkeit* (ÜM, 47, 52, 114, 136, 142). The final manifestation is indeed the most explicit, for it is followed shortly after by her conclusion, expressed in arithmetic terms: “Ich mußte mir eingestehen, ob ich wollte oder nicht, daß sich alles, was ich erlebte, fühlte und erstrebte, nur zu einem furchtbaren Nichts summierte” (ÜM, 142). Let us linger anew on Fraisl’s suggestion of a correspondence between Hartwig and compatriot of a later generation, Ingeborg Bachmann, whose works probe the capacities of language in another *Sprachkrise* of unprecedented scale in the aftermath Second World War and the Holocaust. As Caitríona Leahy eloquently concludes: “Bachmann, [...] in struggling to tell a story, was struggling to rethink the way in which language might refer to something other than itself, might *point to* a real, historical *Grund*, even when it could not say it.”¹⁴⁴ While indeed a different phenomenon, these terms are useful in unpicking something analogous at work in Hartwig’s novel. Looking down from “Gebäude” into the empty space below, the “Geschichte” that “eigentlich gar keine Geschichte ist,” Aloisia struggles through her own narration and tries laboriously to “point to” and capture in language feelings, experiences, traits and qualities that could form some sort of solid “Grund”-lage, these repetitive breakdowns in language serve to create yet more distance from the ground. If “Bachmann’s history is firmly anchored in the hands of literature,”¹⁴⁵ Aloisia’s moments of linguistic failure, like helium balloons affixed to the building, counteract any attempts to drop anchor — “feststellen,” as she says at the beginning (ÜM, 5) — thus keeping her story “firmly anchored” at the level of the free-floating *Luftschloss* and leaving the all-too important *Überflüssigkeit* intact. And of course, these possible attempts to drop anchor *must* fail for the text itself, the extended probing of the titular question — is she a redundant human being? — to get where it needs to go, and go somewhere it does.

¹⁴³ Smith, *Feel Free*, 292.

¹⁴⁴ Caitríona Leahy, *Der wahre Historiker: Ingeborg Bachmann and the Problem of Witnessing History* (Würzburg: Königshausen and Neumann, 2007), 225. Emphasis in the original.

¹⁴⁵ *Ibid.*

Considering the case of modern mathematics, the cogs of the *Denkmaschine* keep turning *because* of (not in spite of) the lack of solid foundations, and the unmoored “Gebäude” that houses “der mathematische Mensch,” i.e. the discourse of mathematics itself, expands. Likewise, it could be said that Hartwig’s own castle in the air, rising higher and higher, further away from any solid ground, acquires more rooms, and by the close of the text, gives Aloisia a Room of Her Own. Having noted how Egon Z. did, true to his word, recommend her to another construction firm, Aloisia’s narration ceases to be retrospective:

Ich bin heute noch Angestellte dieser Baufirma. Ich gelte als äußerst flinke Stenographin und als flotte Maschinschreiberin. Ich bin anerkannt, fleißig, gewissenhaft und leidlich verlässlich. Ich habe keine besonders rasche Auffassungsgabe, ich habe keine Initiative. Ich bin daher nicht unentbehrlich und werde es niemals dazu bringen, unentbehrlich zu sein. Aber ich bin längst nicht mehr die Untüchtigste unter meinen Bürokolleginnen, wie früher einmal, und wenn mich auch manche überholt, es bleiben auch manche hinter mir zurück (ÜM, 153).

Topologically cognisant to the end, Hartwig ensures that Aloisia is *still* a Kakania-like “Mittelpunkt,” neither the best nor the worst, neither indispensable nor warranting dismissal. The trajectory of the narrative, therefore, is not an arc but a full circle, another revolving door: to all intents and purposes, nothing has fundamentally changed. Yet, in its revolution around a fixed point, the conceptual space of the text has been stretched sufficiently enough to accommodate one final realisation by the protagonist. Expressed with a mathematical clarity that manages to parody Weininger’s formulaic — “förmliche” — mindset *and* grasp the nuances of the *Null*, of *Nichtigkeit*, that are so lacking in *Geschlecht und Charakter*, Aloisia concludes:

Ich habe eigentlich gar nichts gegen ihn einzuwenden, nur daß er mir vollkommen gleichgültig ist und dass ich ihm nicht vollkommen gleichgültig bin, was gegen ihn spricht, [...] und eine Null ist wie ich, ein überflüssiger Mensch, der nur nicht weiß wie überflüssig er ist, und daß ich mich förmlich mit mir selbst, also Null mit Null, multipliziere, wenn ich ihn heirate (ÜM, 154).

As a more nuanced understanding of *Null* would be able to forewarn, the men of the text have been just as interwoven with an invariant nothingness as the women have, but they just don’t know it. With this rendition of a zero-sum game, Hartwig’s second dismantling of Weininger’s grim conceptual framework is complete, and even here, Hartwig never deviates from the topological character of her writing. While Aloisia’s realisation is a metamorphosis in that it represents a change, indeed a *growth*, in her understanding of herself and others, it remains entirely contingent upon the invariant foundationlessness, emptiness and *Überflüssigkeit* that steers every aspect of this novel, both in form and content. In short, if it is the continued operability of the mathematical *Luftschloss* that cements the claim that there is “keine zweite Möglichkeit so *phantastischen* Gefühls wie die des Mathematikers,” it is Mela Hartwig’s superfluous Aloisia, so apparently lacking in “Phantasie,” that emerges here as the improbable analogue to the modern “mathematischer Mensch.”

Summary, or: *Die nicht-so-neue Frau*

To conclude, while Weininger's *Begriffe* themselves largely remain intact, with her two novels *Das Weib ist ein Nichts* of 1929 and *Bin ich ein überflüssiger Mensch?* of 1931, Hartwig manages to drag them into what might be called another experimental *Spielraum*, rendering the relationships between them much more vexed and their ontological bases arbitrary. With a systematic approach that builds on a characteristically topological spatial imagination, Hartwig delivers, in short, a mathematically modernist discombobulation of Weininger's pseudomathematical system using the very components of the system itself. On the theoretical pathway from Musil's "Der mathematische Mensch" to Weininger, the "Grundlagenwitz" of machines running on empty was put through the grinder twice: firstly, to establish the mathematically self-referential layer of the metaphor in which the sky bound "Gebäude" according to whose laws "die Maschinen liefen" is itself the *Denkmaschine*, and secondly to ascertain a route into Hartwig's prose works with the idea of an ontologically contentless but nonetheless functional *Maschinenmensch*. This image, and its undeniably gendered cultural history, then became the springboard for Hartwig's thoroughly *begriffliche* reworking of Weininger's edifice of binary *Begriffe*. Then, by the close of Aloisia's monologue, having found in both of Hartwig's protagonists the second re-reading of Musil's parable, the analysis rises upwards to the first re-reading of the *Denkmaschine*. Musil's appeal for new writing in the spirit of this mathematical, "geistigen Mensch, der kommen wird" is not, therefore, only answered by himself in his own fictional work. Although Fletcher's suggestion that Kafka is the "ultimate topological author" is certainly valid, the moniker might apply to Mela Hartwig as well. Indeed, she not only manages to write *about* feminine *Identitätskrisen* in a topological fashion, but she comes to do so in a form that is redolent of how a seasoned topologist might examine their spaces of interest, namely with a considered and fervent awareness (or perhaps even embrace) of the "Nichts" at the basis of everything.

As a closing note, let us reflect upon what remains in the wake of Hartwig's engagement with the dominant voices in Viennese discourse on gender, sexuality and psychology of her time. For all of the aforementioned agency developed by Hartwig's protagonists, certain restraints that this approach not only encounters but in fact highlights ought to be kept in mind. It was noted earlier that Wende, in her study of *Das Weib ist ein Nichts* in particular, saw in Hartwig's unsettling prose a form of generational witnessing, which is to say, an attempt to uncover the distressing and embattled existence of a young woman in a modern society that, for all of its gestures towards women's emancipation and feminine autonomy, is still operating entirely according to a playbook written by Man. While this chapter has sought, like Fraisl, to move beyond this sense

of exposure, it is important to note that these conclusions are not, of course, mutually exclusive. Hartwig's literary "Methode des Denkens und Arbeitens," to recall Noether's self-assessment from the very same year *Bin ich ein überflüssiger Mensch?* was completed and rejected for publication, encounters stubborn limitations in terms of the history of women's empowerment, but of course Hartwig is well aware of this and builds thereon a crucial societal observation. In the previous chapter, the ultimate invariance of the doorman in *Der letzte Mann* throughout a whirr of transformational processes was then extrapolated outwards to probe the broader invariance of social class structures. Surely, a very similar process is underway in Hartwig's two novels: the necessary usage — rather than outright disavowal — of 20th Century Vienna's misogynistic and subjugating terms of discourse points to a wider problem regarding the supposed paradigm shift of "die neue Frau." If, in modern mathematics, transformation comes to shed light on its own opposite, in Hartwig's novels the apparent transformations that usher in this new cultural icon draw more attention to that which proves impervious to change, namely enduring patriarchal social structures that secure male dominance throughout. This is to say, the very mythical nature of New Woman itself is underlined. This scepticism is, of course, not without precedent, and it is expressed — with a no less than topological awareness of change and continuity — by Dada stalwart Hannah Höch:

Keiner dieser Männer war mit nur einer gewöhnlichen Frau zufrieden. Aber sie wurden auch nicht einbezogen, um die [...] männliche Moral gegenüber der Frau aufzugeben. Erleuchtet von Freud, in Protest gegen die ältere Generation... sie alle wünschten sich diese 'Neue Frau' und ihren bahnbrechenden Willen zur Freiheit. Aber — sie lehnten mehr oder weniger brutal die Vorstellung ab, dass auch sie neue Einstellungen einnehmen müssten... Dies führte zu diesen wirklich Strindbergischen Dramen, die das Privatleben dieser Männer prägten.¹⁴⁶

Despite the changes encapsulated by the icon of the "neue Frau," its status is never to be untethered from yet another intransigent male fantasy. To circle back to *Metropolis*, the machine woman, the dangerous prophet of a new era, was only ever the fabrication of male fantasy, a plaything between two competing Masters that is literally cooked up in the lab of the archetypal mad scientist.

"The Master's tools will never dismantle the Master's house," Audré Lorde famously remarks in a salient essay in *Sister Outsider*, originally realised in 1984, in which she looks for forms of resistance to the interwoven modes of racial and gendered oppression.¹⁴⁷ With Hartwig's two novels, written half a century earlier and in a markedly different context, a similar didactic

¹⁴⁶ Hannah Höch, cited in *The Photomontages of Hannah Höch*, ed. Peter W. Boswell et al (Minneapolis: Walker Art Center and University of Michigan Press, 1996), 76.

¹⁴⁷ Audré Lorde, *Sister Outsider* (London and New York: Penguin, 2019), 103. Like many of the essays in this collection, "The Master's Tools Will Never Dismantle the Master's House" was adapted from a speech given at a conference in New York in 1979.

principle is at work. By operating within the Weiningerian conceptual organisation, letting his interlocking binaries disentangle and the components combine anew, Hartwig's protagonists do not, in the end, dismantle the societal structures that keep them largely under the control of mediocre men. Rather, the deployment of these tools by the very women they were designed to subjugate lays bare their inadequacy as conceptual categories and allows, in true topological fashion, for the transformative paradigm shifts of women's emancipation to expose the *invariant* nature of this very repressive social architecture throughout ostensible processes of change. In short, the cultural revolutions that accompany "die neue Frau" reveal on a broader societal level that which is not so *neu* after all: a continuation of patriarchal domination merely in a new guise. And yet, Hartwig's novels function as more than just an unveiling, more than a forceful tug to reveal the "man behind the curtain," who, though a very mediocre wizard in the end, has been quietly present throughout Dorothy's quest, his hands on the control panel, fiddling with the dials. The small acts of mutiny that see Weininger's misogynistic theoretical utensils get turned back on themselves may not, ultimately, dismantle the Master's house, but they do manage to destroy a few of the Masters along the way.



Figure 3.8: Another Big Reveal¹⁴⁸

¹⁴⁸ *The Wizard of Oz*, directed by Victor Fleming (Metro-Goldwyn-Mayer, 1939), 01:28:37.

4

Axiomatizing the Avant-Garde

Logic, Construction and Form in Bauhaus and Dada

“I would go so far as to say that the natural, proper, fitting shape of the novel might be that of a sack, a bag. A book holds words. Words hold things. They bear meanings. A novel is a medicine bundle, holding things in a particular, powerful relation to one another and to us.”¹

— Ursula Le Guin, “The Carrier Bag Theory of Fiction”

In 1847, the Irish mathematician and land surveyor, Oliver Byrne, who would become known for his support of the United Irishmen in the 1850s (publishing *Freedom to Ireland* from a distance in Boston, USA), published his famed “colour” version of Euclid’s *Elements*, entitled *The First Six Books of the Elements of Euclid in Which Coloured Diagrams and Symbols Are Used Instead of Letters for the Greater Ease of Learners*. Alas, Byrne did not share Euclid’s proclivity for short titles. Despite the curious simultaneity with the discovery of hyperbolic geometry, Byrne’s text was by no means an attempt to account for any new geometries that challenged Euclidean ubiquity. Rather, as the protracted title dutifully explains, he illustrated the ancient geometer’s work using primary colours and visualisations of shapes and angles that had been represented with letters and symbols in the original. Gleaned from his introduction, Byrne foresees a clear didactic advantage when appealing to “the most sensitive and comprehensive of our external organs,”² the eye, in the study of Euclid’s book of geometrical reasoning: “we do not introduce colours for the purpose of entertainment, [...] but to assist the mind in its researches after truth, to increase the facilities of instruction, and to diffuse permanent knowledge.”³ In line with the Kantian philosophy of geometry and *Anschauung* from the century before Byrne, the role of vision once again takes centre stage in the production of geometrical knowledge, just as it did for Hauke Haien in Storm’s novella. Classical geometry, in short, is a way of *looking* at things, and so Byrne’s

¹ Ursula Le Guin, “The Carrier Bag Theory of Fiction,” in *Dancing at the Edge of the World: Thoughts on Words, Women, Places* (New York: Grove Press, 1989), 169.

² Oliver Byrne, *The First Six Books of the Elements of Euclid in Which Coloured Diagrams and Symbols Are Used Instead of Letters for the Greater Ease of Learners*, ed. Werner Oechslin (Cologne: Taschen Bibliotheca Universalis, 2017), viii.

³ *Ibid.*, vii.

book presents Euclidean geometry with an unparalleled visual clarity, constructing a unique aesthetic in and of itself. Consider, for example, the illustrations of Euclid's concise 32nd proof concerning internal and external angles of a triangle (Fig. 4.1) and the famous proof of Pythagoras' Theorem (Fig. 4.2):

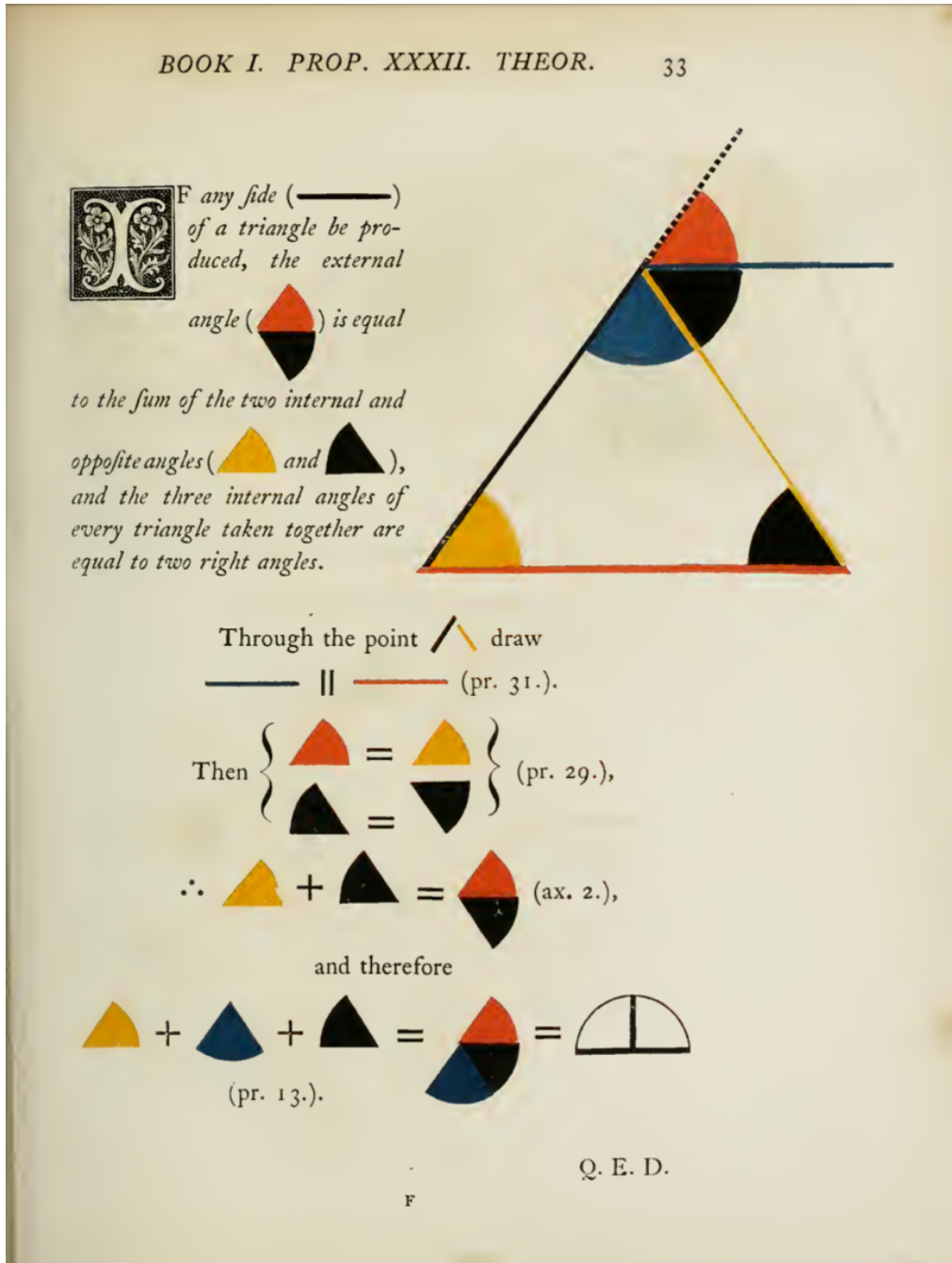


Figure 4.1: Byrne's illustration of Euclid's 32nd proposition and proof⁴

⁴ Ibid., 33.

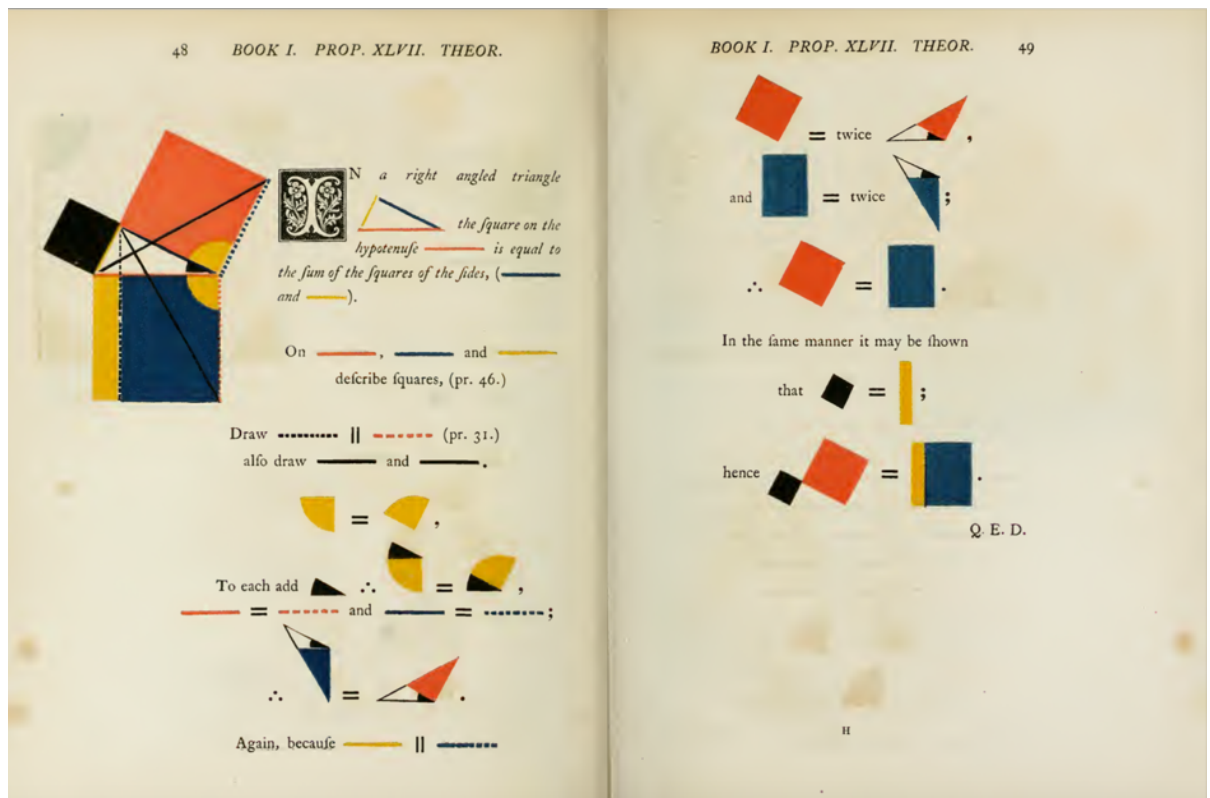


Figure 4.2: Byrne's illustration of Euclid's Pythagorean Proof⁵

As Clare Moriarty notes in her insightful assessment of Byrne's edition, his assertion that his text does not strive to be mere "entertainment" suggests that "the images were intended purely instrumentally."⁶ Unlike some of his engineering works, Byrne's pedagogical intercession did not sell particularly well upon its release, but his striking diagrams have since been linked, as Moriarty continues, to some well-known artistic descendants:

They anticipate many salient features of artistic movements that didn't materialise for a further seventy years. Stylistic and visual comparisons to De Stijl and the Bauhaus are hard to resist — stark primary colours, sparse linear connections, and a restraint with respect to form combine to produce a striking aesthetic resemblance.⁷

Even these two previous reproductions of the book alone bolster this suggestion, making it quite easy to mark Byrne as an early stylistic forerunner to modernist design currents of the early 20th century, and indeed the central instrumentality that Moriarty foregrounds could also be seen to anticipate the often-cited moniker — "der ästhetische Imperativ" — of Bauhaus: "Form folgt Funktion."⁸ Other scholars have come to similar conclusions. In his supplementary essay

⁵ Ibid., 48f.

⁶ Clare Moriarty, "'Tine and Form': The Geometric Philosophy Underlying Oliver Byrne's *Elements*," *Leonardo* 56, no. 2 (2023): 152.

⁷ Ibid. A differing goal than that of this chapter, Moriarty's article helpfully surveys the pedagogical and theoretical insights that accompany Byrne's unique style and contextualises them within Byrne's mathematical interests more broadly.

⁸ Cf. Uwe Rada, *Die Elbe: Europas Geschichte im Fluss* (Munich: Sieglar Verlag, 2013), 175.

to the more recent trilingual Taschen edition of Byrne's text, Werner Oechslin primarily relates motivations of Euclidean geometry and Byrne's visuals to the Dutch context, with a focus on Piet Mondrian's famous use of primary colours.⁹ Likewise, the Bauhaus school, which was formed in the titular city of the Weimar Republic in 1919 under the leadership of Walter Gropius, has also been associated by several scholars with geometrical thought. Concerning Byrne's influence in particular, Alessandra Cirafici, for example, notes that the "high heuristic value" of intuitive, constructive geometry "was clear to the teachers of the Bauhaus *Grundkurs*,"¹⁰ while Josenia Hervás y Heras directly relates Byrne's correlation of primary colours and Euclidean geometrical forms to the "formalism" of Wassily Kandinsky in particular.¹¹ With respect to geometry more broadly, William Smock explains that "Euclidean solid geometry had a fresh appeal to the Bauhaus designers as a kit of simple, logical forms that could lend themselves to mass production."¹² Then, considering Oskar Schlemmer's iconic Bauhaus poster of 1923 (and subsequent logo for the school), reproduced below, Kimberley Elam writes: "As per the Constructivist ideals of the time, the human profile and typography are abstracted into simple geometric shapes of the mechanical machine age."¹³ From this brief survey of Bauhaus commentary, it is clear that the modernist design school is often contextualised within a web of artistic terms that are now familiar to us in a mathematical sense as well, namely "formalism," "construction," "abstraction" and the geometrical elements of points, lines and planes. In this light, the modernist Bauhaus movement seems to present itself as a natural companion to simultaneous shifts in the mathematical community.¹⁴ Yet, these very terms have come to mean very different things to different schools of thought in the mathematical community, particularly regarding the discipline's foundations.

⁹ Werner Oechslin, "To facilitate their acquirement': Oliver Byrne's *The First Six Books of the Elements of Euclid*," in Oliver Byrne, *The First Six Books of the Elements of Euclid in Which Coloured Diagrams and Symbols Are Used Instead of Letters for the Greater Ease of Learners*, ed. Werner Oechslin (Cologne: Taschen Bibliotheca Universalis, 2017), 362ff.

¹⁰ Alessandra Cirafici, "Rappresentazione e processi noetici: 'magnifica evidenza' del disegno / Representation and Noetic Processes: 'Beautiful Evidence' of Drawing," *Elogio della teoria. Identità delle discipline del disegno e del rilievo / In Praise of Theory. The Fundamentals of the Disciplines of Representation and Survey*, ed. Monica Filippa and Laura Carlevaris (Rome: Gangeni Editore spa, 2012), 243.

¹¹ Josenia Hervás y Heras, *Las mujeres de la Bauhaus: de lo bidimensional al espacio total* (Buenos Aires: Diseño Editorial, 2015), 177.

¹² William Smock, *The Bauhaus Ideal Then and Now: An Illustrated Guide to Modern Design* (Chicago: Academy Publishers Chicago, 2004), 60.

¹³ Kimberley Elam, *Geometry of Design: Studies in Proportion and Composition* (New York: Princeton Architectural Press, 2001), 48.

¹⁴ Aside from these cited examples, Nicolas Sutil, for example, explores in "Mathematics in Motion" the role of Bauhaus geometrical thought on modern dance (something also discussed by Kandinsky in *Punkt und Linie zur Fläche*) "Mathematics in Motion: A Comparative Analysis of the Stage Works of Schlemmer and Kandinsky at the Bauhaus," *Dance Research: The Journal of the Society for Dance Research* 32, no. 1 (2014): 23-42.

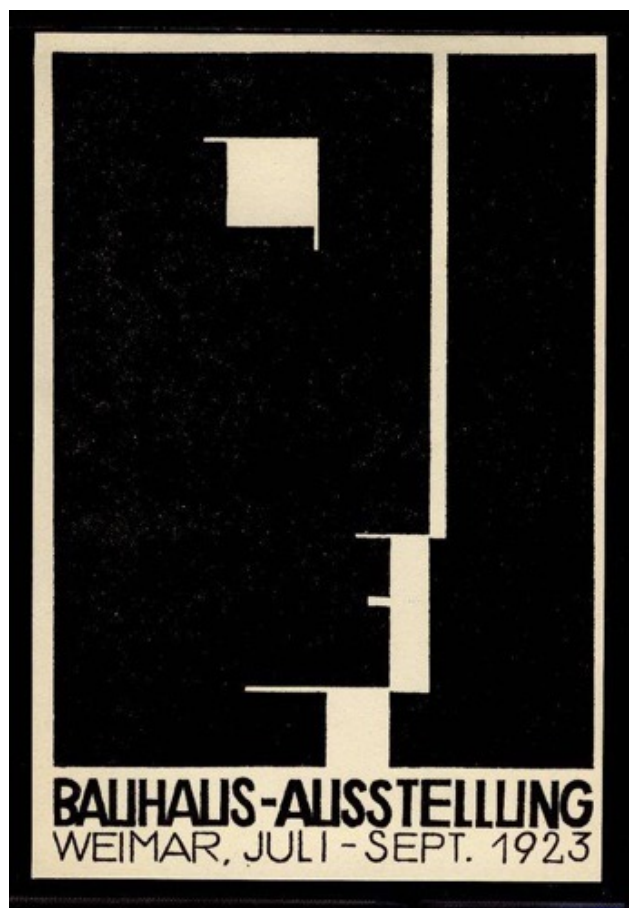


Figure 4.3: Oskar Schlemmer's Bauhaus poster¹⁵

To recall, the response to the so-called *Grundlagenkrise* of mathematics was a manifold one: alongside the “Moderne” camp of the *formalism* of Hilbert, Hausdorff and Noether, stood Dutch mathematician L.E.J. Brouwer’s oppositional *intuitionism*, which tried to salvage the temporal aspects of Kantian *Anschauung*, earning the moniker “Gegenmoderne” for Mehrtens. Then, largely side-lined in the latter’s analysis is the more disparate *logicism*, initiated by the Jena-based Gottlob Frege with his *Grundlagen der Arithmetik* of 1884. This grouping sought to ground mathematics as an extension of logic, i.e. to demonstrate that all mathematical investigations reduce to logical ones and maintained a Platonist view of mathematical objects (more on this to follow). Spurred on by Guiseppe Peano in Turin from the 1890s onwards and Bertrand Russell and Alfred North Whitehead in Britain in the 1910s, the logicist programme became more associated with philosophy rather than the practice of “working mathematicians,” eventually finding its greatest level of appreciation as the basis for the logical positivism of the Wiener Kreis in the 1920s and 1930s.¹⁶ All three of these proposed foundations involve constructive processes, logical steps and formalisations to varying degrees, but they differ ideologically as

¹⁵ Reproduced in Elam, *Geometry of Design*, 49.

¹⁶ Cf. Mehrtens, *Moderne-Sprache-Mathematik*, 277f.

soon as each one of these facets is proposed as the coveted *Grundlage* of mathematics.¹⁷ Considering the aims of this chapter, which step back from the more focused principle of invariance and transformation and reflect, on a metalevel, on the interplay of text, language and content, these differences are very significant.

This chapter will attempt to disrupt the more superficial connections between Bauhaus and mathematical modernism by establishing more nuanced, structural associations between competing mathematical schools and diverse artistic movements. As an opening gambit, by probing the epistemological and methodological underpinnings of a number of Bauhaus contributions, I firstly argue that any attempts to meaningfully relate Bauhaus to mathematical modernism (i.e., the formalist wave) are undermined by a clear reliance upon the very philosophies from which mathematical modernism diverges. In a sense, therefore, this assessment of Bauhaus is set up to fail, but the exploration is no mere “Holzweg.” By isolating the characteristics of the Bauhaus school that render it a *less* fitting counterpart to the mathematical modernism, a better artistic *Doppelgänger* for mathematical formalism given its very rejection of these characteristics emerges. Accordingly, I argue here that the modernist “poetry of logical ideas” finds an ally in perhaps the most unexpected of places: the chaotic, absurdist avant-garde movement of Dadaism. While Dada, in sharp contrast to Bauhaus, is the realm in which logical reasoning *seems* to meet its fiercest opposition, its commitment to a meaningless, experimental, and ontologically unburdened language positions it as a startlingly close affiliate of the concurrent wave of formalism in mathematics, and it does so in such a way that warrants a revision of the usual characterisations of Dada in much existing scholarship. In short, I contend that the less immediately obvious comparison to mathematics is the more solid, and modern mathematics enjoys stronger aesthetic and philosophical links to Dada than Dada does with Bauhaus. With the latter canonically held up as an exemplar of modernist aesthetics in the German context, this outcome speaks to the pluralism of the era as whole and better situates modern mathematics within this pluralism, not outside of it.

Aufbau, Bauhaus and the Necessity of *Grundlagen*

“Ganz langsam bilden sich erst die neuen Elemente zum neuen Aufbau,” writes the founder of the Bauhaus Schule, designer and architect Walter Gropius, in the manifesto-cum-educational prospectus for the nascent design academy *Staatliches Bauhaus Weimar 1919-1923*, encapsulating in one sentence its archetypal modernist drive towards newness and overtly constructivist

¹⁷ For an accessible outline of these three positions, see Ernst Schnapper, “The Three Crises in Mathematics: Logicism, Intuitionism and Formalism,” *Mathematics Magazine* 52, no. 4 (1979): 207-216.

methods.¹⁸ The keenness to “make it new,” to use Ezra Pound’s often-cited maxim, finds its more non-literary expression, therefore, in the Bauhaus approach of *building* anew with new components. Gropius’ academy, whose international impact on modern architecture and design is perhaps unparalleled, rightly occupies a central position in any broad discussion of German modernism. From a perspective that seeks to draw mathematical modernism into the fold, however, Bauhaus does not present itself as a particularly helpful interlocutor, despite its ability to “speak” in overtly geometrical terms. As was suggested above, the mathematical aspects of Bauhaus, which are manifest both in its artistic output and its pedagogical materials, are tied to philosophies of mathematics that chart very different courses than mathematical formalism: the retention of a Platonist view of mathematical objects and a conception of space that is no different to pre-modern Kantian *Anschauung*. The presence of these two positions under one roof could seem, as philosophers of mathematics would rightly point out, somewhat jarring, for logicism — most adherent to mathematical Platonism — follows from explicit rejections of key tenets of the Kantian philosophy of mathematics, and mathematical constructivism, largely indebted to Kant, is the precise opposite of Platonism. These two approaches, however, are enveloped by a common preoccupation with extra-systematic foundations, i.e. for the construction of (mathematical/geometric) knowledge on a firm basis. This differs, of course, from the entirely *self-referential* mathematical formalism, which freed itself from any fixed foundation either in the empirical world or in mental intuition. Given that this lack of foundations is what guarantees formalism’s own sense of “newness,” the way in which Bauhaus speaks geometrically is thus, mathematically speaking, not so *neu* after all.

Keen not to dwell for too long upon negative comparisons and to instead move on to Dada, this shorter section will principally engage with the theoretical and pedagogical writings of two central Bauhaus figures, namely Wassily Kandinsky, who returned to Germany from his native Russia and took up a central teaching role at Bauhaus, and then the writings of the founder Walter Gropius himself. Firstly, a brief analysis of a common example of Kandinsky’s geometrical compositions, namely *Komposition 8*, will reveal how his conception of geometry is very much rooted in the Euclidean paradigm (not its modern counterparts) and unearth a Platonic attitude towards mathematical objects, which will in turn be bolstered by reference to his related theoretical writings. Secondly, a return to Gropius’ input into the aforementioned prospectus for the Bauhaus will demonstrate a conception of space and mathematics that is

¹⁸ Walter Gropius, “Idee und Aufbau des staatlichen Bauhauses,” in *Staatliches Bauhaus Weimar 1919-1923*, ed. Walter Gropius (Munich and Weimar: Bauhaus Verlag, 1923), 7. This volume is included in the recent facsimile edition bearing the same title (Zurich: Lars Müller Publishers, 2019).

likewise rooted in thinking explicitly rejected by modern mathematicians in the wake of non-Euclidean geometries, i.e. the Kantian philosophy of *Anschauung* that tethers innate spatial reasoning to empirical space. Before progressing to these central Bauhaus ideas, it is perhaps necessary to outline briefly what is meant by mathematical Platonism and contextualise it among the competing philosophies of mathematics at play in the first few decades after 1900.

Rooted in its namesake's philosophy of forms, the Platonist approach to mathematical objects remains a subject of debate amongst philosophers of mathematics, with its usage and applicability to an array of mathematicians throughout history still rather contested. In essence a *realist* ontological position, Platonism is, as Mark Colyvan explains, "the philosophical position that mathematical statements such as 'there are infinitely many prime numbers' are true and that these statements are true by virtue of the existence of mathematical objects — prime numbers, in this case."¹⁹ Immediately clear, therefore, is that existence — not the creation or construction — of mathematical objects is at the heart of a Platonist position, which of course engenders a flurry of follow-up questions, as Colyvan duly notes:

Where are these numbers? What are they like? How do we know about them? What about all the other mathematical objects: sets, functions, Hilbert spaces, and the like? Do all these exist as well? [...] In any case, what is their relationship to the physical world? And most difficult of all: if mathematical knowledge is knowledge of these mathematical entities how do we come by such knowledge?²⁰

Evidently, quite a lot is at stake when one either embraces the Platonist view or rejects it. While his ideological leanings on the matter no doubt colour his prose, James Robert Brown provides some accessible answers to these questions. First and foremost, he emphasises:

Mathematical objects are perfectly real and exist independently of us. Mathematical objects are no different than everyday objects (pine trees) or the exotic entities of science (positrons). We don't in any way create them; we discover them. And our theorems try to correctly describe them. [...] *Mathematical objects are outside of space and time.* The typical subject matter of natural science consists of physical objects in space and time. For pine trees, positrons and pussy-cats, we can always say *where and when*; not so for primes, π , or polynomials. The *standard metre* is kept in a special place in Paris; not so the number 27 which is to be found nowhere in space and time, though it is just as real as the Rock of Gibraltar.²¹

While mathematical objects, therefore, are abstract in the common sense of the term, in that they exist outside of time and space, they are nonetheless perfectly real.²² In a concise answer

¹⁹ Mark Colyvan, *An Introduction to the Philosophy of Mathematics* (Cambridge and New York: Cambridge University Press, 2012), 36.

²⁰ Ibid.

²¹ James Robert Brown, *Philosophy of Mathematics: A Contemporary Introduction to the World of Proofs and Pictures* (London and New York: Routledge, 2010), 9f. Emphasis in the original.

²² Or in Colyvan's words: "The traditional view, which comes down to us from Plato (429–347 BCE), is that mathematical entities exist but that they are unlike physical objects. Mathematical objects are abstract entities — objects without causal powers and lacking space-time locations." Colyvan, *Philosophy of Mathematics*, 37.

to the age-old question as to whether mathematics is discovered or invented, Platonism aligns itself loyally to the former camp.

At this stage, it may seem tempting to draw threads from Plato's independent realm to Kant's *Ding an sich*, and indeed the question as to the relationship between the two is by no means a settled one, with some philosophers and scholars quick to identify fundamental parallels and others sharp contrasts.²³ Throughout, however, a conflation on somebody's part is manifest. While none other than Schopenhauer, who as Robert Wicks notes, read Kant and Plato concurrently,²⁴ rushes to conclude that "Platons Ideen und Kants Ding an sich [...] Eins und dasselbe sind,"²⁵ because both posit a realm independent of sensual experience, he overlooks a crucial difference. As Wicks continues: "To Kantian ears, this equation is unjustified, since Kant maintained that the thing-in-itself is unknowable, and hence, not supremely knowable as Plato himself took the Ideas to be."²⁶ As Peter B. Lewis reiterates, this erroneous equation led Schopenhauer "into a cul-de-sac" until he was later forced to revise this assertion.²⁷ Likewise, Christoph Cox, while acknowledging Nietzsche's attempt to dispel both the noumenal realm and Plato's "wahre Welt," argues that Nietzsche similarly conflates the two.²⁸ For Tom Rockmore, however, the problem lies, in fact, with Kant himself, for the way in which he "reformulates the Platonic view of forms is both confusing and confused,"²⁹ which echoes K.T. Seung's assertion that the unclarity rests with Kant's conflation of the "Platonic-Leibnizian tradition with the Cartesian-Lockean tradition."³⁰ While it is clear that Platonic mathematical objects are not really to be thought of as noumena because they are — according to the Platonist tradition — knowable and accessible, these wranglings are worth mentioning, because the way in which these objects are accessed, when Brown's explication is considered, begs comparison with Kant's *Kritik* and the role of *Anschauung*. Having grounded the real-yet-abstract nature of mathematical objects, Brown posits:

We can intuit mathematical objects and grasp mathematical truths. Mathematical entities can be 'seen' or 'grasped' with 'the mind's eye'. These terms are, of course, metaphors, but I'm not sure we can do better. The main idea is that we have a kind of access to the mathematical realm that is

²³ See, for example, Robert Hanna, who notes that it is "natural and all-too-easy" to interpret Kant's noumenal world in terms of classical Platonism, before continuing to explain how Platonism is, for reasons to follow, a "more inclusive ontic category." Robert Hanna, *Cognition, Content, and the A Priori: A Study in the Philosophy of Mind and Knowledge* (Oxford: Oxford University Press, 2015), 372.

²⁴ Robert Wicks, "Plato's Conception of Time at the Foundation of Schopenhauer's Philosophy," in Alan Kim (ed.), *Brill's Companion to German Platonism* (Leiden and Boston: Brill, 2019), 195.

²⁵ Arthur Schopenhauer, *Sämtliche Werke, Band 11*, ed. Paul Deussen (Munich: R. Piper and Co., 1916), 368.

²⁶ Wicks, "Plato's Conception of Time," 195.

²⁷ Peter B. Lewis, *Arthur Schopenhauer* (London: Reaktion Books, 2012), 91.

²⁸ Christoph Cox, *Nietzsche: Naturalism and Interpretation* (Berkeley: University of California Press, 1999), 178.

²⁹ Tom Rockmore, "Lukács as Leninist," in Tom Rockmore and Norman Levine (eds.), *The Palgrave Handbook of Leninist Political Philosophy* (London: Palgrave Macmillan, 2018), 291.

³⁰ K.T. Seung, *Kant: A Guide for the Perplexed* (London and New York: Continuum, 2007), 24.

something like our perceptual access to the physical realm. This doesn't mean that we have direct access to everything; the mathematical realm may be like the physical where we see some things, such as white streaks in bubble chambers, but we don't see others, such as positrons. [...] *Mathematics is a priori, not empirical.* Empirical knowledge is based (largely, if not exclusively) on sensory experience, that is, based on input from the usual physical senses: seeing, hearing, tasting, smelling, touching. Seeing with the mind's eye is *not* included on this list.³¹

This is all quite familiar, give or take a few differences. While the question here is of “grasping” or coming to know the Platonic objects, as opposed to constructing them first, with the inner “mind's eye” that is separate to but nonetheless akin to perception of the physical world, *Anschauung* is back on the table. Brown is, of course, reluctant to mention this, because the differences seem to overshadow the inherent similarities and because Kant is tied to the intuitionist and constructivist school of thought that Brown seeks to undermine in favour of Platonism.

At this point, the central similarity of the Platonist and Kantian (and thus subsequent constructivist) mathematical positions come into view. While for Kant any mathematical objects are first constructed *a priori* by the mind's inbuilt spatiotemporal intuitions in order to exist,³² and for Platonists they already exist and are simply “grasped” and “seen” in this realm, what ensues is rather similar, namely the construction of mathematical knowledge on some given basis, be it real-yet-abstract or constructed as an initial step. Either way, an *a priori* foundation upon which to construct mathematical knowledge is always *in sight*, in all senses of the word: some kind of internal vision is at work. Moreover, this realism inherent to the Platonist position, in which worldly manifestations of mathematical objects are imperfect echoes of an ideal version thereof, maintains a clear link between mathematical objects and the real world. This chimes with the Kantian differentiation as well: while *mathematical* knowledge is not generated by sense perception, in that it is innate and *a priori*, it nevertheless comes to be something of a “Darstellungsmittel” for the empirical space of the world, because we as humans “see” through a pre-conditioned Euclidean lens. In short, despite their differences, both philosophical standpoints retain a bridge between the realm of mathematical reasoning and empirical space, and they posit a necessary *Grundlage* upon which to carry out all further constructions. Equally, in both cases, the prominence of vision, of mental imagery, is very much evident. Setting some (albeit important) particulars aside, and permitting ourselves to linger with architectural

³¹ Brown, *Philosophy of Mathematics*, 10f. Emphasis in original.

³² As Charles Parsons explains, Kant “rarely expressed a philosophical commitment” to the existence of mathematical objects, per se, and this absence is something of a “noteworthy feature of Kant's philosophy.” A closer analysis, as Parsons shows, indicates that Kant (and the mathematical constructivists to follow) *essentially* equates existence of objects with their construction, without fully addressing what this means in “actuality.” Charles Parsons, *From Kant to Husserl* (Cambridge MA and London: Harvard University Press, 2012), 43f.

taxonomy, it is thus no longer *so* inconceivable to suggest that these two positions can be accommodated “unter einem Dach.”

As a brief point of comparison, which both serves to ground this cohesion of a multiplicity of ontological views³³ and also reinforces the common ground between them, a turn to the make-up of the Wiener Kreis is quite illustrative. While the connections between the proposed mathematical foundation of logicism and the Vienna Circle’s programme of logical positivism, on the one hand, and between the Vienna Circle and the Bauhaus group, on the other, are fairly well known and have been discussed in scholarship, they are worth noting here. Aware that mathematical logicism arises from key and nuanced objections to Kant’s philosophy, and although the Circle, as Leila Haaparanta notes, is perhaps the realm in which Frege’s logicism and Platonism found its strongest level of support,³⁴ Ellen Lupton points out in her analysis of Otto Neurath’s “isotype” and Bauhaus aesthetics something very Kantian in approach:

Logical positivism brought together two philosophical attitudes that had previously been contradictory: rationalism, which studies reality through logic, geometry, and mathematics, rather than observation; and empiricism (or positivism), which claims that the only access to knowledge is through direct human observation. Vision is the classic source of empirical knowledge.³⁵

With a unification of rationalism and empiricism via the construction of spatial knowledge — on the grounds of vision, no less — focus is now back on Kant’s breakthrough in the late 1700s. The result, when one combines the two, is the construction of a “mirror of nature,” which is to say a rigorous, logical and meaningful framework for any ensuing scientific method.³⁶ Then, in much more detail, Peter Galison and Lucian Krukowski foreground key similarities between various actors in the Wiener Kreis and Bauhaus contemporaries, with Galison noting plainly that “the modernisms of the Bauhaus and Vienna Circle self-consciously reinforced each other, and in so doing began to articulate a common vision of what both called a modern ‘form of life.’”³⁷ These correspondences, as both articles make clear, encircle the question of building

³³ For example, from the anti-Platonist Rudolf Carnap (despite being under Frege’s tutelage in Jena) to the avowedly neo-Platonist Kurt Gödel.

³⁴ While much has been written on the subject, particular on the impact of Frege’s ideas on the Wiener Kreis via Rudolf Carnap, one of Frege’s only known students in Jena, Haaparanta provides an accessible overview of the role of Frege’s logicism and how it interacts with the Kantian tradition in the context of the Circle. Leila Haaparanta, “The Relations between Logic and Philosophy, 1874-1931,” in *The Development of Modern Logic*, ed. Leila Haaparanta (New York: Oxford University Press, 2009), pp. 222-261.

³⁵ Ellen Lupton, “Reading Isotype,” in *Design Discourse: History, Theory and Criticism*, ed. Victor Margolin (Chicago: University of Chicago Press, 1989), 146.

³⁶ In Thomas Uebel’s words, “the Circle’s distinction between the formal and empirical sciences” is essentially that “the former furnished purely analytical tools for the pursuit of the latter.” Thomas Uebel, *Overcoming Logical Positivism from Within* (Amsterdam: Brill, 2021), 9.

³⁷ Peter Galison, “Aufbau/Bauhaus: Logical Positivism and Architectural Modernism,” *Critical Inquiry* 16 (1990): 709-752, here 711.

upwards from some necessary foundation — the choice of which varies across the spectrum of respective members. Suggesting that the architectural metaphor that runs through Wittgenstein’s *Tractatus* is “not accidental,” Galison explains: “Whether he uses the verbs *bilden*, *bauen*, or the nouns *Konstruktion* or *Bau*, the Wittgenstein of the *Tractatus* is after an image of language, logic, and the world that starts at the basics and works up from there using logic alone.”³⁸ This basis of “atomic sentences” or “molecular propositions” is, according to Gallison, a correlate of the “modernist construction of form out of elemental geometric shapes and colors” carried out in Bauhaus.³⁹ Likewise, Krukowski proposes the following as the central affinity between Bauhaus and the Wiener Kreis: “Both exhibit [...] a foundationalist ontology — which requires the identification of basic forms or primitives upon which the elaboration of the system rests.”⁴⁰ Keen to note the differences between different members, Krukowski shows how Carnap, for example, establishes a “concrete rather than abstract” basis that is on the basis of “‘Erlebs’ [...] or momentary time slices of experience,” whereas Wittgenstein opts for abstract “linguistic simples of ‘facts’ that directly mirror the world.”⁴¹ Regardless of the *particular* choice of basis, it is more important that *some* “extra-systematic or extra-logical” foundation is established and defended in order to shield “such procedures — and, indeed, the system itself — from the charge of arbitrariness.”⁴² This is the impulse shared by Bauhaus, in which the extra-systematicity “is looser but it comes to something like ‘extra-stylistic,’ that is, the basic elements are not derived from any particular artistic style or school, but are what all styles have in common.”⁴³ This short comparison shows, therefore, that like the Wiener Kreis, Bauhaus is not to be imagined monolithically and is less uniform than it initially appears to be.

As a final introductory note before continuing, it is worth stressing at this point — now that the significance of basis and vision has been established — why these approaches are so markedly different to mathematical formalism. While the departure from Kantian *Anschauung* has been discussed at length in the first section, the irreconcilability of Platonism and formalism must be underscored, for this lays the foundations (an unfortunate metaphor) for the turn to Dadaism later on in this chapter. For consistency, let us consider Brown’s juxtaposition of the two:

Abstract terms, according to nominalists, are not the names of abstract objects. Redness and wisdom are just words and nothing more — hence ‘nominalism’. As for mathematics, the

³⁸ *Ibid.*, 726.

³⁹ *Ibid.*, 749.

⁴⁰ Lucian Krukowski, “Aufbau and Bauhaus: A Cross-realm Comparison,” *The Journal of Aesthetics and Art Criticism* 50:3 (1992): 197-209, here 198.

⁴¹ *Ibid.*, 200.

⁴² *Ibid.*, 199.

⁴³ *Ibid.*, 200.

instinctive nominalist holds that there are no numbers, only numerals. Platonists think that the numeral '2' is the name of the number two, just as 'Jim' names me. But, for the nominalist, there are no numbers; the real subject matter of mathematics is numerals, symbols, and words, all of them strictly meaningless — not in the sense of gibberish, but in the sense that there is nothing that they mean, or name, or to which they refer.⁴⁴

As is clear from the term itself, nominalism severs any relationship between names and that which is named, leaving just “numerals” as opposed to numbers and mere “symbols” instead of representative icons. The arch nominalist is, by most accounts, Hilbert and his formalist programme, which builds from a thoroughly nominalist view of mathematical objects. As a convenient illustration, let us recall from Chapter 1 the quarrel that arose following the publication of Hilbert’s *Grundlagen*, in which Frege (a great “gung-ho Platonist” in Brown’s words)⁴⁵ challenged his Göttingen colleague’s work on the grounds that he did not properly *define* what he means by “Punkt,” “Gerade” or “Ebene,” which prompted Hilbert’s vivid retort that: “Man muß jederzeit an Stelle von ‘Punkten’, ‘Geraden’ und ‘Ebenen’, ‘Tische’, ‘Stühle’ und ‘Bierseidel’ sagen können.”⁴⁶ These names thus stand not for an absent or abstract object — neither real-but-abstract ones nor constructed ones; rather they stand for nothing at all (other than themselves). While the question as to whether this counts, to use Brown’s terminology, as “gibberish” is an open one, the terms of formalism — unlike in both Platonism and Kantian constructivism — are “strictly meaningless.” Pulling all of these deliberations together, the groundwork has been put into place for the task ahead: why might Bauhaus not be that mathematically modern after all?

Plato’s Ghost? Kandinsky’s Bauhaus

Linda Henderson’s landmark work of 1983 *The Fourth Dimension and Non-Euclidean Geometries in Modern Art*, as was mentioned in the introduction, charts the enthusiastic uptake of developing scientific ideas, such as Einstein’s relativity, amongst certain members of the artistic community. Since then, a number of unchecked misunderstandings and overstatements have emerged from scholars seeking to draw similar conclusions, and the work of Kandinsky is often in focus. While the Russian painter, whose adherence to certain artistic movements changed significantly over time, is something of a peripheral figure in Henderson’s study,⁴⁷ Floris Bannister and Mark Blum, for example, seek to place the geometrical work of Kandinsky and his contemporaries

⁴⁴ Brown, *Philosophy of Mathematics*, 49.

⁴⁵ *Ibid.*, 8.

⁴⁶ Cf. Landsman, *Foundations of Quantum Theory*, 803.

⁴⁷ She notes how some archival materials suggest Kandinsky was interested in the fourth dimension and the related development of non-Euclidean geometry, but he was by no means one of the key proponents of its absorption into artistic experimentation. Linda Henderson, *The Fourth Dimension and Non-Euclidean Geometries in Modern Art* (Cambridge, MA: MIT Press, 21998), 99f.

including Naum Gabo, a fellow Bauhaus pedagogue, under the non-Euclidean banner on somewhat grounds that misapprehend the role of curvature in geometry. Gabo's sculpture, according to Bannister, "references non-Euclidean geometry in the very shape of the planes of iron which consist of elegant curves and rigid lines."⁴⁸ Likewise, Blum dedicates a chapter to Kandinsky and the "non-Euclidean geometry of the visual image,"⁴⁹ which seems to revolve around Kandinsky's ability to describe the curved lines and circles on planar surfaces. These contentions are, unfortunately, missteps in mathematical terms, as if to say that curvature itself was unknown to geometers throughout history whose two basic tools since antiquity have been a ruler and a *compass*. The alternative geometries to Euclid's, as was shown, did not emerge from an ability to draw or construct curves in either uniform 2- or 3-dimensional space — the thirteen books are replete with theorems regarding and constructions of circles, cones and cylinders — rather, they arose from the possibility that the structure of space *itself* could be conceived of as curved and non-homogenous. While these two texts are no doubt flawed, they are so in a way that is quite helpful, for they point to the possibility that the Euclidean way of thinking is not so easily shaken off.

While there are several dozen examples of Kandinsky's experimental works on geometrical forms, *Komposition 8*, an oil-on-canvas painting from 1923 that is now held in the Guggenheim in New York, suffices to illustrate the thrust of his turn away from the more expressionistic works of the 1910. Moreover, it also reveals a way of working that beckons comparison *not* with non-Euclidean geometries like Riemann surfaces and the pseudosphere but with the ancient model that long pre-dated them. Let us consider the composition, reproduced in Figure 4.4 below. Aside from the obvious (but not exclusive) dominance of primary colours here, thus resembling Byrne's chosen palette, the painting is replete with elements that recall both the Euclidean methods, i.e. that which can be marked with ruler and compass and the constructible geometrical shapes themselves:

⁴⁸ Floris Bannister, "Revolutions in Time, Space, and Art," *UNIversitas* 7, no. 1 (2012): 4.

⁴⁹ Mark E. Blum, *Phenomenology and Historical Thought: Its History as a Practice* (Berlin: Walter de Gruyter, 2022), 117.

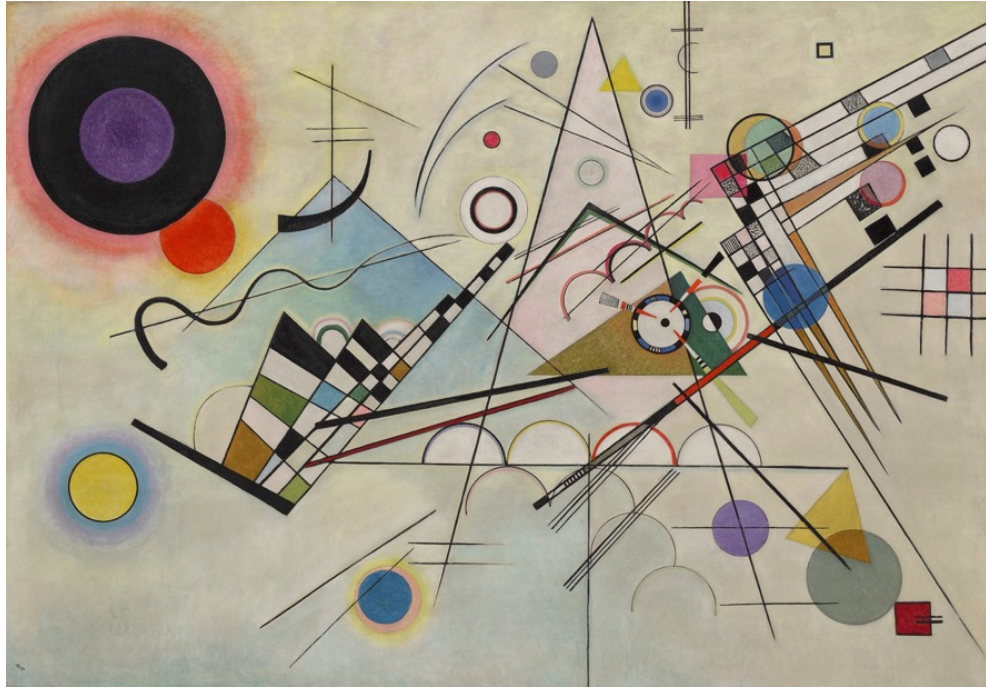


Figure 4.4: Wassily Kandinsky's *Komposition 8*⁵⁰

From the proliferation of straight parallel lines (which guarantees the flat and familiar Euclidean space) to the gentle arcs just to the left of the upper centre and the smaller semi-circles across the bottom of the painting, traces of the two geometrical instruments, the ruler and the compass, abound. This meta-comment on method is arguably pushed further, in that the angular, pincer-like form of the compass itself is brought into view. Take, for example, the overlapping 2-dimensional angular forms with their pointed orange tails to the immediate left of the central gold and green triangle. Furthermore, the entire painting is arguably dominated by the elongated peak that echoes the form of the compass sitting upright in something of a 1-dimensional abstraction. This angle is then sharply cut by a horizontal straight line, the linear trajectory of the second instrument of construction, namely the ruler, which is equally present in the form of several thin 2-dimensional rectangles to either side of the central large “compass.” This placement echoes rather plainly how the two instruments have commonly been illustrated throughout the history of mathematics, with the compass sitting upright on its legs atop a horizontal ruler, such as in Fig. 4.5 below:

⁵⁰ Reproduced from “Vasily Kandinsky Composition 8,” Guggenheim, Last modified September 29, 2023, <https://www.guggenheim.org/artwork/1924>.

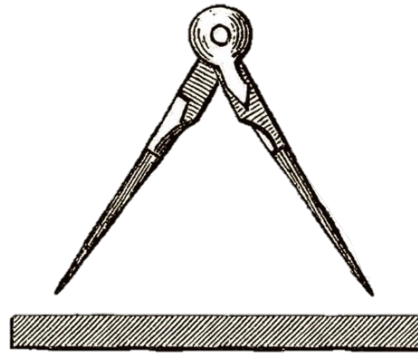


Figure 4.5: The Ruler and Compass⁵¹

On top of this, the composition likewise abounds with the baseline geometric shapes, namely the Platonic forms of the triangle, circle and quadrilateral, most of which are fused to some primary colour or close shade thereof. In sum, the composition exhibits the elementary instruments of Euclidean geometrical construction, elementary forms of geometry and their suggested correspondence to elementary colours — a foundational Euclidean toolkit of objects upon which to elaborate and build more complex structures.

While the ode to Euclidean methods seems to be apparent in *Komposition 8*, the question as to whether there is any particular ontological status attributable to these elements is somewhat less clear, and this is indeed less simple to ascertain on a visual level. Intuitively, however, it could prove fruitful to ask about the much less conspicuous aspect of the painting, namely the cloudy, mist-like space that serves as the backdrop for the elements discussed above. Although in reference to another earlier composition by Kandinsky, *Komposition 6* of 1913, Henderson returns to questions of the fourth dimension with a focus on Kandinsky in an article from 2020. Here, she probes previous analyses of the painter’s famed “breakthrough to abstraction” and lauds in particular Reinhard Zimmerman’s discussion of the “free-floating mists or coloured billows of steam [that] sometimes [...] look like swathes of clouds” with the awareness of Kandinsky’s “interest in an invisible ‘second level of reality [...] that is by nature ethereal and manifests itself above all in auras and thought-forms.”⁵² Henderson builds upon this observation and seeks to indicate the multiplicity of influences at play in Kandinsky’s views, from theosophy to popular science, but for my purposes here, the terms deployed above are quite helpful. The background pictorial space of *Komposition 8* is likewise composed of an ethereal, indeterminate

⁵¹ Taken from the cover art of Andrew Sutton, *Ruler and Compass: Practical Geometric Constructions* (London: Wooden Books, 2009).

⁵² Linda Henderson, “Abstraction, the Ether, and the Fourth Dimension: Kandinsky, Mondrian, and Malevich in Context,” *Internalia Magazine* 61 (2020): <https://www.interialiamag.org/issue/thought-forms/>, last accessed 10.02.2023. Internal citations from: Reinhard Zimmermann, “Early Imprints and Influences,” in Hartwig Fischer and Sean Rainbird (eds.), *Kandinsky: The Path to Abstraction* (London: Tate Modern, 2006), 36ff.

mist that suggests something of an “invisible second level of reality” in which geometrical forms — perhaps “thought-forms” — are suspended and seemingly free-floating.⁵³ Now, of course, the language of mathematical Platonism can be heard. Does *Komposition 8*, therefore, not only serve as a celebration of the Euclidean method but also reveal, on Kandinsky’s part, a Platonic commitment to the reality (yet spatiotemporal abstractness) of mathematical objects that serve as a constructive foundation?

Fortunately, potential answers to this question are not too difficult to locate, for, as Krukowski rightly notes, “unlike some artists for whom explanation is corrosive on creativity, Kandinsky wrote extensively on the principles underlying his work, and often directed these writings towards pedagogy.”⁵⁴ A turn to some of Kandinsky’s theoretical writings can be seen to confirm the suspicions above, unmasking a philosophical position with respect to mathematical objects that is notably Platonic. In a short essay entitled “Die Grundelemente der Form,” also published in the aforementioned prospectus *Staatliches Bauhaus Weimar* in 1923, Kandinsky offers a cursory outline of what has often been called his “formalism,” but which can in no way be related to a formalism in mathematical terms:

Die Arbeit im Bauhaus ist eine *synthetische*.

Die synthetische Methode schließt in sich selbstverständlich die analytische ein. [...] Die Formfrage im allgemeinen muss in zwei Teile geteilt werden:

1. Die Form im engeren Sinne — Fläche und Raum.

2. Die Form im breiteren Sinne — Farbe und die Beziehung zur Form im engeren Sinne.

In beiden Fällen müssen die Arbeiten von einfachsten Gestalten zu komplizierteren planmäßig übergehen.

So wird im ersten Teil der Formfrage die Fläche auf drei Grundelemente zurückgeführt — Dreieck, Quadrat und Kreis — und der Raum zu den daraus entstehenden Raumgrundelementen — Pyramide, Kubus und Kugel. [...] So steht jedes einzelne Studium vor zwei gleich wichtigen Aufgaben:

1. Die Analyse der gegebenen Erscheinung, die von der anderen Erscheinung möglichst isoliert betrachtet sein muß, und

2. Der Zusammenhang der erst isoliert untersuchten Erscheinungen untereinander — synthetische Methode.⁵⁵

At a glance, Kandinsky begins with the usual Kantian terms (analytic and synthetic *a priori* judgements), which can be reconciled, as the section on Mongré and “Sprachkritik” showed, with the “schöpferische” impulse of mathematical modernism. Yet, a more careful consideration of the passage indicates a very different understanding at work: very quickly, as the foundational basis of elementary forms and construction thereon — “die Arbeiten von einfachsten Gestalten zu komplizierteren” — comes into play. A very different trajectory,

⁵³ Ibid.

⁵⁴ Krukowski, “Aufbau and Bauhaus,” 204.

⁵⁵ Wassily Kandinsky, “Die Grundelemente der Form,” in *Staatliches Bauhaus Weimar 1919-1923*, ed. Walter Gropius (Munich and Weimar: Bauhausverlag, 1923), 26.

therefore, is charted here, for any more complex structures, he posits, are entirely reducible to the “Grundelemente” of the Platonic forms — triangle, circle and square — and their corresponding higher order variants. Accordingly, the difference between analysis and synthesis here is the isolated study of these foundational elements in their own separate realm (analysis) and then their deployment as constructive building blocks in the creative process (synthesis), with the latter creating the bridge to the material world. As Krukowski explains, “while Kandinsky affirms the notion of basic pictorial elements, and identifies a method (analysis) for their identification, it is not until they are related within a pictorial context that they function experientially.”⁵⁶ As such, these elements are to be understood in entirely Platonic terms: “The individual *presystematic* elements remain *conceptual abstractions*.”⁵⁷ In short, with a conception of geometry, space and creation that is rooted in Platonism, the “formalism” and “abstraction” of Bauhaus Kandinsky would fail to be recognised as such by the “working mathematicians” in the wake of Hilbert’s formalist call to arms.

At this point, the objection might be raised that this characterisation of Kandinsky is perhaps too narrow, especially given his reputation as an artist to whom no overarching label can be attributed without ignoring his well-known capacity to stylistically metamorphose. Here, it is necessary to stress that I do not stake a claim that is meant to hold beyond Kandinsky’s Bauhaus years; indeed this calls for further research to more broadly probe his potential positions with respect to a rapidly changing mathematical discourse. To bring this section to a close and to suggest that these findings *might* still apply following the Bauhaus relocation to Dessau, it is necessary to briefly reflect upon Kandinsky’s substantial treatise *Punkt und Linie zur Fläche* in 1926. Curiously, in a throwaway footnote in *Plato’s Ghost*, Gray mentions Kandinsky’s text as “an amusing coincidence” in light of Hilbert’s *Grundlagen*, noting without much reflection that both are “modern” in their use of abstraction, or, their “attenuated relationship to the real world.”⁵⁸ The fact that Gray does not elaborate on this is perhaps for the best, because a short glance at Kandinsky’s attempts to *define* the baseline elements of geometry — “der Punkt,” “die Linie” and “die Fläche” — render any possible comparisons void from the outset. For brevity, let us consider Kandinsky’s proposed approaches to the first two, for they are both the most imaginative and most revelatory:

Der geometrische Punkt ist ein unsichtbares Wesen. Er *muß* also als ein unmaterielles Wesen definiert werden. Materiell gedacht gleicht der Punkt einer Null.

⁵⁶ Krukowski, “Aufbau and Bauhaus,” 204.

⁵⁷ Ibid.

⁵⁸ Gray, *Plato’s Ghost*, 185.

In dieser Null sind aber verschiedene Eigenschaften verborgen, die ‘menschlich’ sind. In unserer Vorstellung ist diese Null — der geometrische Punkt — mit der höchsten Knappheit verbunden, d.h. mit der größten Zurückhaltung, die aber spricht. So ist der geometrische Punkt in unserer Vorstellung die höchste und höchst einzelne Verbindung von Schweigen und S p r e c h e n.⁵⁹

Die geometrische Linie ist ein unsichtbares Wesen. Sie ist die Spur des sich bewegenden Punktes, also sein Erzeugnis. Sie ist aus der Bewegung entstanden — und zwar durch Vernichtung der höchsten in sich geschlossenen Ruhe des Punktes. Hier wird der Sprung aus dem Statischen in das Dynamische gemacht.

Die Linie ist also der größte Gegensatz zum malerischen Urelement — zum Punkt. Sehr genau genommen kann sie als ein sekundäres Element bezeichnet werden.⁶⁰

Immediately, there is once more to the question of sight: the point and the line are invisible to the observer in the sense that they are immaterial. The “abstraction” at hand, the “attenuated relationship to the real world,” once again, is merely a question of being spatiotemporally absent, but real in an ideal realm. Though they are imagined “mit der höchsten Knappheit,” they can be “grasped” or “seen” in a non-literal sense, with the “mind’s eye,” which in Kandinsky’s theorizing takes a number of forms appealing to human senses, principally through analogy to sound here. With something of a *Hang zur Gesamtheit* on display, he links his thoughts on points and lines to various art forms, from sketching to music and dance. Fascinating as Kandinsky’s contemplations in the text are and would be to further explore, it is already clear from a mathematical perspective that he operates from the same principles that were unearthed above. Hilbert, under his opening system of terms “Punkt,” “Gerade” and “Ebene,” expressly “will hier nichts als bekannt voraussetzen,” and his entire enterprise would crumble at the attempt to fasten these terms to anything at all. Kandinsky’s Platonic realism, therefore, reveals him to be an unsuitable counterpart to mathematical modernism, despite his status as one of the foremost figures of modern visual art and design.

Kant’s Ghost? Gropius’ Bauhaus

Having uncovered a fundamental disharmony between Kandinsky and key tenets of mathematical modernism, it is now necessary to widen the scope somewhat in order to establish a broader — but of course not totalizing — assessment of the Bauhaus beyond one particular individual. While he is indeed just another individual, a shift of focus to the work of the school’s founding director, Walter Gropius, proves to be quite efficient, for with him, the guiding maxims of the Bauhaus programme are made most explicit. For brevity, focus will remain on the aforementioned prospectus *Staatliches Bauhaus Weimar 1919-1923*, which was edited and

⁵⁹ Wassily Kandinsky, *Punkt und Linie zur Fläche* (Munich: Verlag Albert Langen, 1926), 19.

⁶⁰ *Ibid.*, 51.

curated by Gropius himself but features contributions by the “Meister” across various Bauhaus areas, from the “Formlehre” of Johannes Itten, Paul Klee, Gertrud Grunow and Wassily Kandinsky to the “Werklehre” of Helene Börner and Heinrich Beberniss. Focussing on Gropius’ “Idee und Aufbau des Staatlichen Bauhauses,” it will be argued that Gropius relays a mathematical and spatial philosophy that refrains to move beyond the Kantian model of spatial *Anschauung*, which is typically Euclidean in nature and fused to real, observable space.

Gropius’ opening contribution begins with the following broad question: “Was ist Raum, wie können wir ihn erfassen und gestalten?”⁶¹ Much like Kandinsky and the diligent logical empiricists in Vienna, Gropius is quick to identify and defend his choice of basis in foundational elements of space: “Die Urelemente des Raums sind: Zahl und Bewegung. Durch die Zahl allein unterscheidet der Mensch die Dinge, begreift und ordnet mit ihr die stoffliche Welt.”⁶² While, unlike Kandinsky, Gropius opts not to elaborate on any ontological status of these *Urelemente* (i.e. are they real-yet-abstract in the Platonic sense or constructed themselves?), it is already clear that they are principally imagined as a perfect, ideal representation of the real, material world — “die stoffliche Welt.” Regardless of their initial ontological status, Gropius’ “Zahlen” are representational, they are *numbers* and not self-referential numerals. It would seem that any meaningful comparison with modern mathematics in Gropius’ reflections would fall at the first hurdle. Although the disparity is already quite evident, it is worth briefly examining how Gropius proceeds, for this not only confirms the above but it does so in a way that explicitly posits a space for mathematics and is curiously parallel in form to Hausdorff’s inaugural lecture of 1903. Recalling Hausdorff’s three *Räume* and associated *Spielräume*, Gropius likewise proposes a three-way partitioning of “Raum” of his own, namely into “der mathematische Raum,” “der stoffliche Raum” and “der künstlerische Raum.”⁶³ Considering the first, he writes: “Das Hirn erdenkt den *mathematischen Raum* kraft des Verstandes durch Rechnung und Messung. Über die Gesetze der Mathematik, Optik und Astronomie schafft es ein Vorstellungs- und Darstellungsmittel für den zu erbauenden stofflichen Raum der Wirklichkeit durch das Mittel der Zeichnung.”⁶⁴ First of all, it is immediately clear that this realm is something quite different to Hausdorff’s mathematical space of “eine gewisse freie Schöpfung unseres Denkens, keinem anderen Zwange als dem der Logik unterworfen” that has recourse to the “Spielraum des Denkens” alone.⁶⁵ As that which is “erdacht” by the human brain, “der mathematische Raum” is still, of course, a

⁶¹ Gropius, “Idee und Aufbau,” 8.

⁶² Ibid.

⁶³ Ibid., 9.

⁶⁴ Ibid. Emphasis in original.

⁶⁵ Hausdorff, “Das Raumproblem,” 281ff.

product of thought, but the way in which it is mentally conceived, according to Gropius, i.e. “kraft des Verstandes durch Rechnung und Messung,” is difficult to reconcile with modern mathematics. To recall, as Mehrtens stresses, for example, the concern for spatial measurement in mathematics was supplanted by a concern for structure, which is exemplified in the axiomatics of formalism, from Hausdorff’s topology to Noether’s *begriffliche Mathematik*.⁶⁶ The retention of measurement is, of course, significant, for there is always something — a given *Gegenstand* — to be measured, which is made explicit by the classification of mathematical space as a “Vorstellungs- und Darstellungsmittel” for the second space in question, namely “den stofflichen Raum.” Gropius outlines the latter as follows:

Die Hand begreift den tastbaren *stofflichen Raum* der Wirklichkeit, der außer uns liegt; sie erbaut ihn in der Realität nach den Gesetzen des Stoffs und der Mechanik und mißt und wägt die stoffliche Substanz, die ihn bestimmt, und ihre Festigkeit ebenso wie ihre mechanischen und konstruktiven Eigenschaften. Sie meistert ihn durch das Können des Handwerks mit Hilfe von Werkzeug und Maschine.⁶⁷

Now, it seems, there is a clear-cut case of hand-eye-coordination: the internal “vision” of the mathematical space works its way outwards, into external perception that comes to guide the hand of the intuitive and well-coordinated *Baubäusler* — the manipulation of the “Stoff” is guided at all times by visual geometrical knowledge and its subsequent *Anwendung*. Quite plainly, this chimes with the philosophy of innate geometrical knowledge that comes to be a schematic diagram for the empirical world, much like Haien’s childhood feat of Euclidean imagination, when he draws “mit der Hand eine weiche Linie in die Luft, als ob er dem Deiche damit einen sanfteren Abfall geben wollte.”⁶⁸ Soon *realising* this intuitive design in what Gropius would call the “stofflichen Welt,” mathematical knowledge is thus “schöpferisch” principally in its ability to act as a blueprint for the world. Expectedly, the successful *Übergang* from the first to the second *Raum* gives rise, at last, to the third:

Den bewegten lebendigen *künstlerischen Raum* vermag nur der zu erschaffen, dessen Wissen und Können allen natürlichen Gesetzen der Statik, Mechanik, Optik, Akustik gehorcht und in ihrer gemeinsamen Beherrschung das sichere Mittel findet, die geistige Idee, die er in sich trägt, leibhaftig und lebendig zu machen. Im künstlerischen Raum finden alle Gesetze der realen, der geistigen und der seelischen Welt eine gleichzeitige Lösung.⁶⁹

The space of creativity, in short, is the successful mastery of the application of mathematical knowledge (imagined here in terms of measure and proportion) and no small amount of inspired handicraft.

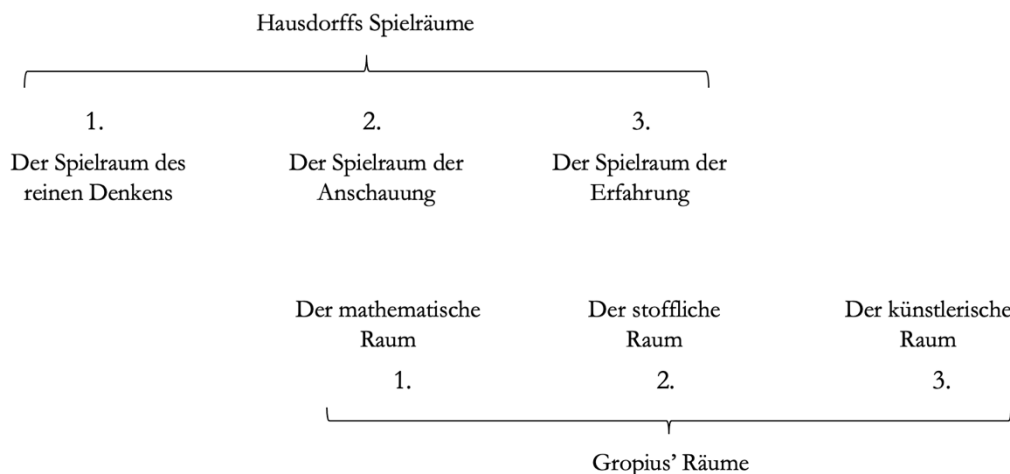
⁶⁶ Mehrtens, *Moderne-Sprache-Mathematik*, 93.

⁶⁷ Gropius, “Idee und Aufbau,” 9.

⁶⁸ Storm, *Der Schimmelreiter*, 18.

⁶⁹ *Ibid.*

By picking apart Gropius' passage on the different *Räume* at work in Bauhaus constructivism, the above suspicion that space and geometry are imaged entirely in line with the Kantian philosophy of *Anschauung* is confirmed: mathematics (and geometry in particular) is a product of human intuition, "innere Schauung," that is closely bound to and codifies the "stoffliche Raum der Wirklichkeit." From the very outset of the school's prospectus, therefore, it would seem that that the mathematics involved in the Bauhaus programme is by no means as "neu" as the allegedly "neuen Elemente" that cohere "zum neuen Aufbau." In fact, the geometry involved in Bauhaus, according to Gropius, falls back onto the very Kantian territory from which mathematical modernism took its leave. Yet, Gropius' text has proved illustrative on a more fundamental level here, for a very clear philosophy of how mathematical thought and creativity can be potentially linked is made explicit. Despite the remarkable harmony in expression, in that both Hausdorff and Gropius propose a three-way spatial partitioning into "(Spiel-)Räume," they are clearly out of sync with one another. Let us consider them more diagrammatically below:



So aligned, Gropius' "mathematischer Raum" — the *first* realm in the sequence — is effectively Hausdorff's *second* one, namely the Kantian "Spielraum der Anschauung," and Gropius' second space is Hausdorff's third ("der stoffliche Raum der Wirklichkeit" and "der Spielraum der Erfahrung," respectively). Residing at either side of these disjointed spaces are Hausdorff's abstract "Spielraum des Denkens," the modern mathematical space of thought experiments and axiomatic language games, and Gropius' "künstlerische Raum." Now, there is for Gropius a clear pathway from mathematics to creativity that is rooted in *applicability* in the world, but this artistic realm finds itself at *precisely* the opposite end of the diagram to Hausdorff's modern mathematics. This is, of course, the realm that modern mathematicians would deem to be the

most inherently creative, the space that becomes no less than “the poetry of logical ideas,” to use Einstein’s words. The creative space of modern mathematics *precedes* any realm of spatial intuition or experience; it is not generated by their fusion. In a sense, Gropius affirms Oechslin’s claim in his essay that accompanies Byrne’s edition of Euclid’s *Elements*. Making his ideological leanings on the matter clear, Oechslin notes that, with geometry, “a *connection to reality* is expressly needed,” and he concludes that “[m]athematicians and artists meet here.”⁷⁰ While mathematics and art do meet at Bauhaus, it is not a meeting point that can accommodate the avowed modernists of the former grouping.

On Ghosts: A Short Summary

If “a ghost” is, as the elderly Rosa Diamond intuits in Salman Rushdie’s 1988 *The Satanic Verses*, “unfinished business, that’s what!”⁷¹ then the works of Kandinsky and Gropius are haunted by the ghosts of Plato and Kant. In the above, it was shown how in the geometrical compositions of Wassily Kandinsky and his subsequent theoretical and pedagogical writings in his Bauhaus epoch are beholden to a very realist and Platonic understanding of mathematical objects, which form the basis of a constructivism that is familiarly Euclidean in approach. Likewise, a turn to the writings of Bauhaus founder Walter Gropius unearthed not only an understanding of space and mathematics that fails to succeed anything imagined by Immanuel Kant well over a century beforehand, but exposed a philosophy that links mathematics and the artistic impulse in ways that are antithetical to those of the mathematical “Moderne.” Returning once more to the coherence in approach between Bauhaus and the Wiener Kreis, it is this “recursion to basis” in both realms that engenders meaningfulness, a resistance to the arbitrary, and, in Krukowski’s words, a sense of “certainty” that “not only locates the world within its true descriptions, but also situates those descriptions *within the world*.” As the latter concludes: “*Word and world*, at some originary point, must be the same for their subsequent differences to be about each other.”⁷² Recalling Mongre’s Nietzschean explorations embrace of “Worte ohne Wirklichkeit,” with the awareness that this propelled him to the formalist camp of David Hilbert, it is now clear why the mathematics of the Bauhaus is anything but “modern” in the mathematical sense of the word. For all the Bauhaus associations with scientism and functionality, “the poetry of logical ideas” does not, in the end, find a suitable match in Weimar Germany’s flagship modern design school. In need of a sharp change in direction, it may prove beneficial to take partial inspiration

⁷⁰ Oechslin, “To facilitate their acquirement,” 360. Emphasis added.

⁷¹ Salman Rushdie, *The Satanic Verses* (London: Viking and Penguin inc., 2000), 133.

⁷² Krukowski, “Aufbau and Bauhaus,” 202. Emphasis my own.

from the very logical principle that mathematical formalists cherish in the face of fierce opposition from constructivist counterparts, namely the Law of the Excluded Middle: if a certain approach is shown not to work, its precise opposite should stand a better chance. While, for methodological reasons, it is not an especially robust approach to ascertain the “opposite” of Bauhaus and work from there (more on this later), it may nonetheless provide the right provocation of thought to ask instead: what is the opposite of the “poetry of logical ideas”?

Dada: The Poetry of Anti-Logical Ideas?

“Das Unwirkliche ist das Unlogische,”⁷³ writes Hermann Broch in the essay collection “Zerfall der Werte,” which are included in the third novel of the *Schlafwandler* trilogy. This focus on the illogical is quickly pinned to a commentary on the legacy of the First World War: “Und diese Zeit scheint die Klimax des Unlogischen, des Antilogischen nicht mehr übersteigen zu können: es ist, als ob die ungeheure Realität des Krieges die Realität der Welt aufgehoben hätte.”⁷⁴ Broch’s deliberations here are, of course, nothing out of the ordinary in that they echo the modernist maxim decrying the utter absurdity of senseless slaughter between 1914 and 1918 — a sentiment that is central to much of the Expressionist enterprise, for example. For my purposes, however, it is perhaps worth remarking upon Broch’s curious use of two different negations of the “logical” here, namely “das Unlogische” and “das Antilogische” as vehicles to express this overwhelming sense of senselessness. While Broch seems to use the terms interchangeably, with both shaping the “ungeheure Realität” of the immediate interwar years, is there any differentiation that could be secured by the use of the two prefixes?⁷⁵ Is it the case that “das Unlogische,” the more common term that perhaps best maps onto “the illogical” in English, describes that which is absent of logic and sound reasoning, whereas the distinctly less common “Antilogische” suggests some element of counter-logic, an alternative form of logic, a turning of logic against itself? If this difference is allowed to stand, then anti-logical, as opposed to the illogical, curiously retains and involves aspects of its own apparent opposite, namely logic. Although the answer to these speculations will not be sought in Broch, this

⁷³ Hermann Broch, *Das Dichterische Werk: Kommentierte Werkausgabe. Teil I*, ed. Paul Michael Lützeler (Frankfurt am Main: Suhrkamp, 2011), 418.

⁷⁴ Ibid.

⁷⁵ In her aforementioned work on mathematics and modernism, Engelhardt dedicates a chapter to Broch’s *Schlafwandler* texts, arguing that Broch, while remaining light on direct references to mathematics and science, engages with contemporary research into mathematics and language in his diagnosis of post-war crisis: “Since mathematics is a structural science that abstracts from empirical reality to describe general relations, it is, in the terms of *The Sleepwalkers*, the field in which change can best be observed and lends itself to understanding the course of modern reality and its crisis in the First World War.” Engelhardt, *Modernism, Fiction and Mathematics*, 61. Notwithstanding the potentially misleading characterisation of mathematics here, Broch’s discussion of the “Unlogische” and “Antilogische” could indeed be read in this vein.

potential difference will be used in the following as a springboard to move away from the above findings concerning Bauhaus, logicism and intuitionism, and it will serve to identify a better counterpart for mathematical formalism in the most unlikely of places: Dadaism.

The mere suggestion of linking Dada to the retention of any kind of logic could understandably engender suspicion, for the famously incoherent grouping perhaps best exemplifies the above re-evaluation of sense, rationale and meaning in the wake of the needless barbarism of the First World War. Dragging any respect for the usual Enlightenment tools of sense-making to unprecedented lows, the contempt with which Dada seemingly approaches all things logical finds perhaps its most concise and scornful expression in Tristan Tzara's "Manifest Dada 1918." Later published in Richard Huelsenbeck's *Dada Almanach* in 1920, in his characteristically caustic prose, Tzara discusses the pernicious influence of rationale and logic in art:

Was wir brauchen, sind starke, gerade, genaue und für immer unverstandene Werke. Die Logik ist eine Komplikation. Die Logik ist immer falsch. Sie zieht die Fäden der Begriffe, Worte, in ihrer formalen Äußerlichkeit, zu illusorischen Endpunkten und Zentren. Ihre Ketten töten, riesige Tausendfüßler, die die Unabhängigkeit ersticken. Mit der Logik verheiratet, würde die Kunst im Inzest leben, indem sie ihren eigenen Schwanz, immer wieder ihren Körper, verschlingt und herunterschluckt, sich in sich selbst liebt, und das Temperament würde zu einem mit Protestantismus geteereten Alptraum, einem Monument, einem Haufen fahlgrauer und schwerer Eingeweide.⁷⁶

Echoing Nietzsche's denunciation of logic in "Über Wahrheit und Lüge" as an epistemological tool, Tzara proceeds to cast any attempt to bring logic into the artistic realm as a desperate, impermissible contamination that leaves one tarred with the most terribly adhesive substance around: German Protestantism. In this light (or perhaps purposeful opacity), any attempt to meaningfully bring the logically controlled, precise and ordered language of modern mathematics into a discussion with Dadaism would seem unthinkable.

Yet, as was shown in the previous assessment of Bauhaus, the most plausible and thinkable connections, are not always the most robust. Indeed, the association of Dadaism with the wholly "illogical" and chaotic has long since been corrected in critical examinations of the epoch, and many scholars have pointed out how Dada's determined position as anti-logical, i.e. in opposition to logic, actually serves to generate some form of an *Antilogik*. Observing that "as thought systems collapse in on themselves," they tend to either "instigate their own dissolution through anti-logic" or "in lamentable ignorance, invert and thereby reproduce the flawed logic that was ostensibly the object of critique," Dafydd Jones maintains that Dada is an example of

⁷⁶ Tristan Tzara, "Manifest Dada 1918," in *Dada Almanach*, ed. Richard Huelsenbeck (Berlin: Erich Reiss Verlag, 1920), 127f. The facsimile of this edition is available in digital format, courtesy of the International Dada Archive: <https://dada.lib.uiowa.edu/items/show/310>. Accessed 13/03/2022.

the former phenomenon.⁷⁷ He explains, “before Dada ever reached us — indeed, before Dada had even reached Dada [...] — it was argued that Dada had already collapsed in on itself,” which gives rise to a “Dada (anti)logic” characterised by the “negatively defined interstices, or *in-betweens*, where Dada occurs.”⁷⁸ Echoing this sentiment, Joel Freeman claims:

Dada was in part consciously and in part unconsciously guided by a philosophical system; it is however a unique system because it has an open and fluid structure. It is not a system in the traditional sense of unfolding a set of organising principles in a logical and ordered fashion. [...] To think of Dada as system, despite itself, means simultaneously to rethink the notion of system itself.⁷⁹

With Dada, therefore, the attack on logic yields a quasi-logical anti-logic, and the spurning of systematicity becomes systematic. As Stephen Forcer vividly puts it, “the self-defeating anti-logic of the Dadaists finds a particular analogy in [...] ‘redemptive sacrifice’, the military logic of which works along the following lines: ‘In order to save the village we had to destroy it.’”⁸⁰ Although these assessments capture well the slippery and subversive nature of Dadaism, the understanding of modern mathematics built up over the course of this thesis could serve to further nuance the puzzling and paradoxical ways in which Dada seems to operate. Having created necessary distance with Bauhaus, I argue in the following that a closer look at Dada’s covert *use* of logic to tear the shroud of logic asunder points to a crucial, albeit unexpected, overlap with mathematical formalism.

To illustrate this, this section will open with and dwell upon an aspect that has already been quietly prominent throughout this thesis, from Hilbert’s *Grundlagen*, through the theoretical underpinnings of the spatial turn(s) and Hartwig’s 1929 novel: a concern for names and name-giving. Beginning with existing scholarly input on the “meaning,” the effect and the origins of the name “Dada,” key sources will be brought into conversation with Ernst Cassirer’s *Substanzbegriff und Funktionsbegriff* of 1910 — a text that anticipates his later philosophy of symbolic forms and has been suggested by Mechthild Koreuber as a way to conceive of the structural workings of Noether’s *begriffliche Mathematik*. As will be shown, Cassirer’s juxtaposition of different forms of logic not only highlights a correspondence between the *modus operandi* of modern mathematics and that of Dadaism, but it also offers up a vocabulary to nuance and radicalise the observations of an anti-logical impulse in the name “Dada.” Ultimately, that which

⁷⁷ Dafydd Jones, *Dada 1916 in Theory: Practices of Critical Resistance* (Liverpool: Liverpool University Press, 2014), 201f.

⁷⁸ Dafydd Jones, ed., *Dada Culture: Critical Texts on the Avant-Garde* (Amsterdam and New York: Rodolpi, 2006), 21.

⁷⁹ Joel Freeman, “Ernst Bloch and Hugo Ball: Toward an Ontology of the Avant-Garde,” in *Dada Culture: Critical Texts on the Avant-Garde*, ed. Dafydd Jones (Amsterdam and New York: Rodolpi, 2006), 239f.

⁸⁰ Stephen Forcer, “Beyond Mental: Avantgarde Culture and War,” in *Aftermath: Legacies and Memories of War in Europe, 1918–1945–1989*, ed. Nicholas Martin, Tim Haughton and Pierre Purseigle (Surrey: Ashgate, 2014), 94.

has been branded to date as *Antilogik* will be shown to be remarkably similar to the alternative, *functional* form of logic that underwrites mathematical formalism. Afterwards, this section will begin to work outwards, from the name itself to a process of nominalization, bringing the results of the above to bear upon the wider Dada programme. Here, two possible ways of doing so are mapped out — one an embryonic reappraisal of some existing scholarship on Dada and the other something of an experiment in mathematical translation. For the former, by briefly touching on critical discussions of Duchamp’s *readymades*, Hannah Höch’s photomontages and Raoul Hausmann’s poster poems, it is suggested that an unwitting convergence on modern mathematical ideas in these deliberations is already quite evident. Secondly, I will return to the co-founder of the inaugural Zürich wing of Dadaism, Tristan Tzara. In an attempt to bring this uncovered overlap in approach and expression between Dada and mathematical formalism to, one could say, its (anti)logical conclusion, Tzara’s famous metapoem of 1920 will be re-conceptualised as the very phenomenon that codifies the notion of “topological invariance”: a homeomorphism. These latter deliberations, for reasons of scope and scale, will be regrettably somewhat thumbnail in approach. Far from attempting an overarching and binding characterisation of Dada — a movement as fragmentary and “unsystematizable” as it gets — this section seeks to suggest possible routes to re-thinking its common characterisations in existing criticism. As such, it seeks to answer, to a certain extent, Stephen Forcer’s invitation for scholars to read Dada “in combination with unlikely new fields [...] and being prepared to go out on a limb if evidence and findings support it.”⁸¹ In short, this chapter reflects (and calls for further reflection) upon the ways in which Dada can potentially interact with forms of expression that, on the surface, look very different.

“You name it”: On the Meaning(s) of Dada

Early on in Shakespeare’s *Romeo and Juliet*, the young female protagonist muses: “What’s in a name? That which we call a rose by any other name would smell as sweet.”⁸² While the famous line is often taken to imply the meaningless of names and Juliet’s ability to love Romeo despite his family name “Montague,” it nevertheless sets up a simple dichotomy between a name and

⁸¹ Stephen Forcer, *Dada as Text, Thought and Theory* (Cambridge and New York: Legenda, 2017), 3. Here Forcer is building on Barnaby Dicker’s review of *Dada and Beyond*, a two-volume collection edited by Elza Adamowicz and Eric Robertson (2011-12), in which Dicker posits that more innovative research into Dadaism could shed light on other fields and disciplines. Barnaby Dicker, “Review: *Dada and Beyond*,” *Modern Language Review* 8, no. 4 (2013): pp. 1287-1289. Forcer’s own work, for example, brings Dada into conversation with Lacanian psychoanalysis, understandings of madness and film semantics.

⁸² William Shakespeare, *Romeo and Juliet* (London: Penguin, 1988), 38.

the substance it is supposed to represent, and it is clear that Juliet is inclined to lend more significance to the latter. Just as the name “rose” falls into insignificance next to the olfactory pleasure that accompanies the flower, the name “Montague” means little against the person of Romeo. The object, in short, is much more meaningful than its name. Sticking with botany, how might Gertrude Stein’s well-known rendition “Rose is a rose is a rose is a rose” in her poem “Sacred Emily” (1913) be understood?⁸³ Often misquoted with an extra indefinite article “a” at the beginning, the line is regularly taken as the simple claim that “things are what they are.” Yet, it is deliberately unclear whether the opening “Rose” is a person or an object — is the capital “R” for a person’s name or just because it is the beginning of the line?⁸⁴ Noting that other names are notably written lowercase in the poem, Jean Michel Rabaté suggests that Stein “abolishes the distinction between proper names and common nouns,”⁸⁵ and so its process of signification becomes fraught. By letting the word’s meaning become overstretched, as Sarah Bay-Cheng and Barbara Cole explain, Stein “divorced the individual words from their usual representative function.”⁸⁶ Names, it seems, can be meaningless because they mean too little or too much. Lastly, how might these examples compare to the strict meaninglessness of Hilbert’s formalism noted by Brown earlier in this chapter, where points, lines and planes of geometrical systems could just as easily be tables, chairs and beer mugs? Imagined with no substance in mind at all, Hilbert’s opening terms are meaningless neither because they are *less* important than that which they represent nor because they have come to refer to *too many* things. Rather, they were never representational in the first instance. Meaninglessness of names, therefore, can cut several ways. What, then, is in the name “Dada”?

Fittingly, a curious amount of debate and speculation encircles the name for the disorderly, incoherent and international group of artists that emerged in the latter half of the 1910s, with a range of suggestions regarding the “Wirklichkeit” of the “Wort,” so to speak, becoming stock responses. As Ingo Roland Stoehr explains, many protagonists of Zürich Dada “claimed to be the true originator of the name for the movement” and, as such, told various different versions of an origin story for said name.⁸⁷ Eckard Bernstein, for example, unquestioningly adheres to Richard Huelsenbeck’s recollection that Hugo Ball “randomly picked [the word] from a French

⁸³ Gertrude Stein, *Writings, Volume 1: 1903–1932*, ed. Catharine R. Stimpson and Harriet Chessman (New York: Library of America, 1998), 395.

⁸⁴ Jean Michel Rabaté, *1913: The Cradle of Modernism* (Oxford: Blackwell Publishing, 2007), 106.

⁸⁵ *Ibid.*

⁸⁶ Sarah Bay-Cheng and Barbara Cole, eds., *Poets at Play: An Anthology of Modernist Drama* (Cranbury, NJ: Associated University Presses, 2010), 267.

⁸⁷ Ingo Roland Stoehr, *German Literature of the Twentieth Century: From Aestheticism to Postmodernism* (New York: Camden House, 2001), 84.

German dictionary and is baby talk for a horse”⁸⁸ — a tale that Dietmar Elger deems the “most credible” version, in contrast to Tzara’s claim to have found the word in the Larousse dictionary or that Hans Arp is actually the original and “only begetter” of the name.⁸⁹ Elger reiterates Stoehr’s point, arguing that, when declaring original authorship of the term “Dada,” the Dadaists involved were actually “deadly serious” in their claims.⁹⁰ Here, perhaps, to state the obvious is actually to state the more plausible: rather than one instance being correct, the Dadaists were simply enjoying a collective joke, in which the search for the “origin” of the name points deliberately in many different directions. To engage with the search is, therefore, to be foolishly misled (and likely be met with the mocking laughter of those who initiated the search in the first place). While Elger may have fallen into the proverbial trap here, when it comes to the *meaning* of the term, whatever its origins, most scholars follow one of Tzara’s more sincere moments, when he outlines: “*Dada bedeutet nichts*. [...] Aus den Zeitungen erfährt man, daß die Kroneger den Schwanz einer heiligen Kuh: Dada nennen. Der Würfel und die Mutter in einer gewissen Gegend Italiens: Dada. Ein Holzpferd, die Amme, doppelte Bejahung im Russischen und Rumänischen: Dada.”⁹¹ Bearing connotations in several languages, but where there exists no relationship between these connotations,⁹² it would seem that Dada acquires so many meanings that it lapses into nominal instability. As if it were a much more drastic case of Stein’s roses, “Dada” thus ultimately means, as Tzara shows, “nichts.” And so the usual story of Dada goes: this sense of nominal nonsense and uncontrolled clash of meanings neatly articulates the central tenets of the movement — chaos, absurdity and nonsense.

This rather prolonged focus on the name, both in this chapter and in pre-existing scholarly discussions, is of course well warranted. The detachment from meaning and sense conveyed by the name is emblematic of the movement’s wider agenda, as Astradur Eysteinnsson puts it, of “radical semiotic warfare against the sign system of conventional, communicative language”⁹³ and against Western societal norms. As Elger notes, for example, the name’s “onomatopoeic conciseness [...] and freedom from interpretable meaning” render it an appropriate “war-cry for their assault on the traditions of literature and art” and their “disgust at all bourgeois

⁸⁸ Eckard Bernstein, *Culture and Customs of Germany* (Connecticut: Greenwood Press, 2004), 168.

⁸⁹ Dietmar Elger, *Dadaism* (London and Cologne: Taschen, 2004), 10.

⁹⁰ Ibid.

⁹¹ Tristan Tzara, “Manifest Dada 1918,” 118f. Emphasis in the original. Forcer, for example, clearly relies upon Tzara’s contribution here in the first page of his introduction to his study of Dadaism, in which he notes that “dada [...] connotes nonsensical baby-like babbling as well as actual words in different languages, from hobby horses to double negatives and positives, via the penises of sacred animals in parts of West Africa.” Forcer, *Dada as Text, Thought and Theory*, 1.

⁹² Cf. Jonathan Austad, “From Dada to Nada,” in Jeffrey Herlihy-Mera and Vamsi K. Koneru (eds.), *Paris in American Literatures: On Distance as a Literary Resource* (Madison: Fairleigh Dickinson University Press, 2013), 54.

⁹³ Astradur Eysteinnsson, *The Concept of Modernism* (Ithaca and London: Cornell University Press, 1992), 173.

convention.”⁹⁴ Tethering the Dada incursion on language to the movement’s inherent and purposeful internationalism, Martin Puchner points out that the “entire Dada program [...] is epitomized in Dada’s very name.”⁹⁵ While these claims will by no means be contested here, at this point necessary to intervene and to ask whether the understanding of the name “Dada” has yet been exhausted. Is there perhaps something else at play when it comes to the potential differences between the “Unlogische” and the “Antilogische”? To better address this question, let us turn to Ernst Cassirer, whose philosophical enterprise can to a significant extent be characterised by an awareness that “Logik” is not a singular entity. As is shown below, by dwelling on some of Cassirer’s differentiations, it becomes apparent that the discussions of the nonsensical that often follow from Tzara’s explanation of the name “Dada” are somewhat misplaced, and that his musings are much closer to logic than initially appears to be the case, albeit in a new form.

In his re-assessment of logic and concepts in *Substanzbegriff und Funktionsbegriff* (1910), Cassirer begins his analysis of “Begriffsbildung” by outlining the classical Aristotelian logic of abstraction. This, he suggests, guides the formation of concepts via a comparison of the features of given objects, and like Nietzsche and Mongré in their critiques of language, he begins with a horticultural example before turning to the geometrical:

Wie wir den Begriff des Baumes bilden, indem wir aus der Gesamtheit der Eichen, Buchen und Birken usw. die Menge der gemeinsamen Merkmale herausheben, so bilden wir in genau derselben Weise etwa den Begriff des ebenen Vierecks, indem wir eine Beschaffenheit isolieren, die sich im Quadrat und Rechteck, im Rhombus und Rhomboid, im symmetrischen und asymmetrischen Trapez und Trapezoid tatsächlich vorfindet und die sich hier unmittelbar anschaulich aufweisen läßt. Die bekannten Hauptsätze der Begriffstheorie ergeben sich auf dieser Grundlage von selbst. Jede Reihe vergleichbarer Objekte besitzt einen höchsten Gattungsbegriff, der alle die Bestimmungen, in welchen diese Objekte übereinkommen, in sich faßt; während andererseits innerhalb dieser höchsten Gattung durch solche Eigenschaften, die nur einem Teil der verglichenen Elemente zugehören, Artbegriffe verschieden hoher Stufe definiert werden.⁹⁶

Be it with trees or geometrical shapes, concepts are built by isolating common “Merkmale” and raising them to a more abstract, enveloping term, echoing Nietzsche’s observation that concepts become the equation of the unequal, in other words a *lie*. The problem here, according to

⁹⁴ Elger, *Dadaism*, 11.

⁹⁵ Martin Puchner, *Poetry of the Revolution: Marx, Manifestos, and the Avant-gardes* (Princeton and Oxford: Princeton University Press, 2006) 136. Puchner is indeed not the only scholar to link the internationalism of Dada to their critique and dismantling of language (inherent in the cross-language connotations of the name “dada”), with Andreas Kramer noting, in the aforementioned two-volume collection *Dada and Beyond* edited by Elza Adamowicz and Eric Robertson, how Dada’s response to the politics of war became fused to their stance on language, with this coupling grounding their international outlook. Andreas Kramer, “Speaking Dada: The Politics of Language,” in Elza Adamowicz and Eric Robertson (eds.), *Dada and Beyond, Vol. 1: Dada Discourses* (Amsterdam and New York: Rodopi, 2011), pp. 201-214.

⁹⁶ Ernst Cassirer, *Substanzbegriff und Funktionsbegriff* (Berlin: Verlag von Bruno Cassirer, 1910), 6.

Cassirer, is that higher concepts are built only upon comparable “Eigenschaften” of a given set of objects, not upon the objects in their completeness. The logical raising of an “Eigenschaft” to a “Begriff” entails, therefore, a sacrifice of meaning. This process, as Cassirer elaborates, continues:

Die ‘Begriffspyramide’, die wir kraft dieses Verfahrens aufbauen, endet nach oben hin in der abstrakten Vorstellung des ‘Etwas’, einer Vorstellung, die eben in ihrem allumfassenden Sein, kraft dessen jeglicher beliebige Denkinhalt unter sie fällt, zugleich von jeder spezifischen Bedeutung gänzlich entleert ist. [...] So ist es dieser Grundbegriff der Substanz, auf den auch die rein logischen Theorien des Aristoteles dauernd bezogen bleiben.⁹⁷

With Nietzsche’s towering “Bau der Begriffe”⁹⁸ now a “Begriffspyramide,” the further up one climbs, the more thoroughly a process of *emptying* takes place: the newly fashioned concepts, with their increasing degrees of abstraction, are literally emptied out — “entleert” — of all meaning. As a more tangible example, Cassirer proposes the following: “Wenn wir [...] Kirschen und Fleisch unter die Merkmalgruppe rötlicher, saftiger, eßbarer Körper unterordnen, so gelangen wir hiermit zu keinem gültigen logischen Begriff, sondern zu einer nichtssagenden Wortverbindung, die für die Erfassung der besonderen Fälle nichts bedeutet und leistet.”⁹⁹ In a sharp twist, the steps that are usually parsed as classical, Aristotelian logic amount, in the end, to “keinem gültigen logischen Begriff”; they amount, in fact, to *nonsense*. Logic, it would seem, is not as close to sense, rationale and sound knowledge as it is often taken to be — a claim that would be wholly unsurprising of Nietzsche and his followers but that is somewhat startling from the pen of the neo-Kantian philosopher of science.

Let us consider Tzara’s sardonic explanation as to precisely why “Dada bedeutet nichts.” Tzara’s supposedly illogical, senseless proposition here can now be re-read as no less than Aristotelian logic of concept formation at work. A given set of objects in the world all are referred to by the word “Dada”: a cow’s penis in the language of the Kru people, an ethnic group indigenous to what is now the Ivory Coast and Liberia; a cubic die and a mother in a particular Italian region; a hobbyhorse; a wet nurse; and a double affirmative in Russian and Romanian. By way of the Aristotelian tradition, this unifying term — “ein gemeinsamer Merkmal” — then ascends to become the higher-order “Gattungsbegriff” that encompasses all original objects. Yet, only one particular “Eigenschaft” has been isolated at the cost of the cognisance of each individual whole, and thus the concept “Dada” is “entleert” of any original meaning. Tzara’s biting assessment of logic cited previously, in which he decried that “ihre Ketten töten,” becomes unexpectedly less

⁹⁷ Ibid., 7ff.

⁹⁸ Nietzsche, “Über Wahrheit und Lüge,” 887.

⁹⁹ Ibid., 8.

polemical and more justified in this light, for classical logic does indeed destroy meaning, and it does so to an extent that increases proportionately with the height of the “Begriffspyramide.” As with the case of red and edible “Kirschen und Fleisch,” there is now just *meaninglessness*. Like Cassirer, in short, Tzara allows a typically logical process, rooted in the abstraction from a given substance, to unfold with the aim of revealing how it leads to “illusorischen Endpunkten und Zentren.” If there is an *Antilogik* to speak of, therefore, perhaps it lies in this *use* of logic to undermine the credibility of logic itself, which is precisely what plays out in Tzara’s often-cited explanation of Dada.

At this point, the methods that characterise Bauhaus and solidify its links to the Wiener Kreis could not be further from view. Note, for instance, Cassirer’s scepticism when he describes the process of constructing concepts upon some extra-systematic basis: both Cassirer’s “Begriffspyramide” and Nietzsche’s “Bau der Begriffe” adopt that central metaphor of *bauen*, of *Aufbau*, but they do so simply to reveal their architectural unsoundness. The constructivist approach from the previous subsection clearly does not stand “im Einklang” with the above. Despite this, however, meaningful overlap between Dada and mathematical formalism has not *yet* been established, beyond loose structural similarities in rejecting logic as a foundation as opposed to (anti-)method. Thankfully, Cassirer is quick to provide a stronger alternative to the “einförmige Schema der ‘Abstraktion’”¹⁰⁰ inherent to Aristotelean logic of *Substanz*:

Wird dies aber einmal anerkannt, so eröffnet sich damit zugleich für die Logik ein völlig neues Gebiet der Untersuchung. Der Logik des Gattungsbegriffs, die, wie wir sahen, unter dem Gesichtspunkt und der Herrschaft des *Substanzbegriffs* steht, tritt jetzt die Logik des mathematischen *Funktionsbegriffs* gegenüber.¹⁰¹

Looking to developments in modern mathematics (he regularly uses the term “reine Mathematik” to refer to formalist school of thought), Cassirer thus posits the titular “Funktionsbegriff,” which operates very differently to the foregoing “Begriffsbildung” on substance:

Was der Theorie der Abstraktion Halt verleiht, ist somit lediglich der Umstand, daß sie die Inhalte, aus welchen der Begriff sich entwickeln soll, selbst nicht als unverbundene Besonderheiten voraussetzt, sondern sie bereits stillschweigend in der Form einer geordneten Mannigfaltigkeit denkt. Der ‘Begriff’ aber ist damit nicht abgeleitet, sondern vorweggenommen: denn indem wir einer Mannigfaltigkeit eine Ordnung und einen Zusammenhang ihrer Elemente zusprechen, haben wir ihn, wenn nicht in seiner fertigen Gestalt, so doch in seiner grundlegenden Funktion bereits vorausgesetzt.¹⁰²

¹⁰⁰ Ibid., 18.

¹⁰¹ Ibid., 27.

¹⁰² Ibid., 22.

Now, the usual understanding of concept formation has been turned, quite literally, upside down, placing the *Begriff* not at the end of a semantically diluting process of abstraction but rather as the initial spark, “vorweggenommen” as opposed to “abgeleitet.” Cassirer’s inversion here involves, therefore, as S.G. Lofts puts it, “a decentering of the substance-centered logic” and posits an already abstract and “general law” by which any elements that fall into its remit acquire a “meaning” that is purely inter-relational.¹⁰³ Lofts explains:

Being thus comes to be seen as unfolding itself in a series of particular and determined beings, each of which represents a concrete expression of the law governing the series as a whole. All that the individual being *is*, is nothing more than the *place* in the series assigned to it by the functional law. And now it becomes clear that what is ‘essential’ to a being are the relations in which it finds itself, and not any underlying substance, as the Aristotelian tradition would have it.¹⁰⁴

This, of course, is the basis for Cassirer’s later advocacy for structuralist mathematics (i.e. the formalist axiomatic method that would become *begriffliche Mathematik* for Noether). Rather than extracting potential features of a collection of objects to build a unifying *Begriff*, one posits a “general law,” which is to say mathematical concepts and structures underwritten by a set of axioms, and these describe the structural relationships between *arbitrary* objects that fall into their remit. Such is the case with the topological spaces of Hausdorff’s *Grundzüge* to the groups, rings and fields of modern algebra. To underscore an overlap in terminology, let us recall the remarkably concise encapsulation of mathematical formalism by Einstein: *inhaltsleere Begriffsschemata*.¹⁰⁵ Whereas, on one hand, the logic rooted in the “Substanzbegriff” is compromised by the fact that all concepts are processually “entleert” of meaning and content, on the other hand, the general law posited by way of the “Funktionsbegriff” is *already* “inhaltsleer.” In short, these *Begriffe* are not built via abstraction but are *readymade* (pun intended) as abstract, and any attempt to define or discern the contents that they come to encompass is not of any interest or significance.

Now equipped with a different type of logic that is exemplified by modern mathematics and the axiomatic method, Cassirer sets up not only the task of the text *Substanzbegriff und Funktionsbegriff*, but also much of his own extended project: “Das Anwendungsgebiet dieser Form der Logik aber kann nicht im Gebiet der Mathematik allein gesucht werden.”¹⁰⁶ As Francesca Biagioli explains, in *Substanzbegriff und Funktionsbegriff* “Cassirer advocated the priority of the concept of function [...] to account for the structure of scientific theories from a holistic perspective,”

¹⁰³ S.G. Lofts, *Ernst Cassirer: A “Repetition” of Modernity* (Albany: State University of New York Press, 2000), 37.

¹⁰⁴ *Ibid.*

¹⁰⁵ Einstein, *Geometrie und Erfahrung*, 5.

¹⁰⁶ Cassirer, *Substanzbegriff und Funktionsbegriff*, 22.

because he observed that “both the nineteenth-century mathematical tradition and the history of physics and the special sciences show a tendency to shift away from concepts of substance to concepts of function.”¹⁰⁷ In short, Cassirer begins the non-mathematical task of application, suggesting that scientific fields bring their own content to concepts of functions in order to better refine the scientific method. More broadly, the 1910 text becomes a model for Cassirer’s later work on the philosophy of symbolic forms and his differentiations between the theoretical spaces of the “Kulturwissenschaften” and the “Naturwissenschaften,” for the concept of function comes to characterize for Cassirer all forms of theoretical knowledge.¹⁰⁸ Pertinent though this is to broader explorations of overlap between the sciences and humanities, for my purposes it is sufficient to bring this differentiation between types of logic to bear on an area Cassirer would likely not have anticipated: Dadaism. The above assessments have already interwoven Cassirer’s critique of traditional Aristotelian logic with Tzara’s discussions of the name “Dada,” nuancing in turn the usual markers of Dadaism to underline a potential anti-logic at work. Is it possible, however, to go a step further in light of Cassirer’s inherently modern-mathematical alternative to logic? Is there anything like a “Funktionsbegriff” in Dada?

Let us return to the question of the meaningless name. At this point it is necessary to note the contributions of some scholars, who point towards an important nuance in this regard, namely that there is a functional, non-trivial difference between *happening* (again, pun intended) to mean nothing following an *Entleerung* by way of conceptual abstraction to *deliberately* meaning nothing to begin with. While avant-garde curator Anne Umland gestures towards an operational understanding of Dada in her discussion of “the movement’s disyllabic, *deliberately* nonsensical and multivalent name — terse and insistently simple,”¹⁰⁹ it is in Richard Murphy’s *Theorizing the Avantgarde* that an assessment of Dada arises that not only echoes the earlier differentiation between the illogical and the antilogical but also clearly encroaches upon the language of mathematical formalism and Cassirer’s “Funktionsbegriff.” Observing Walter Sokel’s discussion of the “recoil from prophetic excesses” in the more avant-garde wing of German Expressionism, Murphy notes:

¹⁰⁷ Francesca Biagioli, *Space, Number, and Geometry from Helmholtz to Cassirer* (Cham: Springer International, 2016), 45.

¹⁰⁸ For some examples of this narrative, see Lofts, *Ernst Cassirer: A “Repetition” of Modernity*, 36ff; Gideon Freudenthal, “The Missing Core of Cassirer’s Philosophy: Homo Faber in Thin Air,” in Cyrus Hamlin and John Michael Krois (eds.), *Symbolic Forms and Cultural Studies: Ernst Cassirer’s Theory of Culture* (New Haven: Yale University Press, 2004), 204f.; and Thora Ilin Bayer, *Cassirer’s Metaphysics of Symbolic Forms: A Philosophical Commentary* (New Haven: Yale University Press, 2008), 17ff.

¹⁰⁹ Anne Umland, “Dada in the Collection: A Permanent Paradox,” in Anne Umland and Adrian Sudhalter (eds.), *Dada in the Collection of the Museum of Modern Art* (New York: The Museum of Modern Art New York, 2008), 16. Emphasis added.

This recoil has its counterpart in dada's later onslaughts on the expressionists' prophetic excesses, where the very name of the group 'dada' itself becomes an empty signifier parodying the often repeated watchword of the idealists within expressionism: 'Geist' [...]. This central term, like the name 'dada' itself, could be thought of as a hollow vessel, and one which is receptive for any new contents one cares to fill it with.¹¹⁰

Murphy's conceptualization of the name "Dada" here is highly significant here. Note, for instance, the overlap with the terminology of Cassirer's juxtaposition of types of logic and Einstein's characterisation of modern mathematics. Unlike the semantic draining that accompanies the abstraction of features from substance, the "hollow vessel" of Dada is imagined from the very beginning as empty; it can be filled with contents in an entirely arbitrary fashion — what these objects *are* is irrelevant and any significance they have can be expressed only in relational terms. In short, the name "Dada" is not *emptied*, rather it is simply *empty*. According to Murphy, therefore, the name for the movement signifies not the loss of meaning but the inbuilt absence thereof to begin with, which allows it to function, it would seem, much like the *Begriffe* from mathematical formalism. Where, then, can this be observed?

Let us enter another *Drehtür* and return for a third time to Tzara's statement on Dada's meaninglessness: "*Dada bedeutet nichts.* [...] Aus den Zeitungen erfährt man, daß die Kruneger den Schwanz einer heiligen Kuh: Dada nennen. Der Würfel und die Mutter in einer gewissen Gegend Italiens: Dada. Ein Holzpferd, die Amme, doppelte Bejahung im Russischen und Rumänischen: Dada."¹¹¹ While this passage was used previously to propose a possible anti-logic at work, by which Tzara simply allows a substance-oriented logical process to unfold in vain, if the above contention is valid, then it must be asked whether something more refined again is happening here. Is the apparent anti-logic really an *alternative* form of logic like that of Cassirer's "Funktionsbegriff"? Examining the passage more closely, it is important to recognise that Tzara stakes absolutely no claim to the validity of these manifold meanings. Consider, for example, that which is overshadowed by the more vivid imagery of bovine reproductive organs and wet nurses, i.e. that these possible correlations are discovered "Aus den Zeitungen." They have been merely lifted from the very medium for the mass "information" that the Dadaists viewed as the most dubious, compromised and intrinsic to the Western bourgeois sensibilities worthy of the greatest scorn — a stance communicated not least by the dismembered newspapers that populate their satirical cut-out compositions (more on this later).¹¹² The notion that the *Zeitungen*

¹¹⁰ Richard Murphy, *Theorizing the Avant-Garde: Modernism, Expressionism, and the Problem of Postmodernity* (Cambridge: Cambridge University Press, 2004), 73.

¹¹¹ Tristan Tzara, "Manifest Dada 1918," 118f. Emphasis in the original.

¹¹² Matthew Biro, for example, details the impact of print journalism on the Dada movement, charting the trajectory of post 1900 mass communication towards the promotion of consumerism, nationalism, journalistic sensationalism and a so-called "de-politicization" that tends to mask what was really a shift towards the support of right-wing

of the interwar period, with their own reactionary agendas, can establish reliable links between the word “Dada” and stable referents is merely a part of the game, for these myriad meanings are pinned on the claims of unreliable actors and no small amount of hearsay. This short passage, therefore, is not *only* a demonstration of how traditional logic ultimately hoodwinks us; it is also a trick in itself. Tzara reveals that the demonstration itself is in vain, for even the cited “original” meanings are highly circumspect.

As a possible parallel, let us recall none other than Hausdorff’s (as Mongré) musings in “Sprachkritik,” whose opening fable of the origins of language offers up with some serendipity a simple “Da! Da!” as a primitive noise to mark some sensory phenomenon. While initially the “Da!” accompanies a lightning strike upon a tree, it soon “löst sich vom Zeichen ab und lügt sich ein eigenes Leben,” coming to mean absolutely anything at all:

Sie werden ihre Gefährten an die Schreckensstätte führen und mit Da auf die gestürzte Fichte weisen; die Horde wird das Da aufnehmen und es wird vielleicht Fichte, vielleicht Donner, vielleicht Himmel oder Feuer oder Schrecken oder Gott bedeuten — aber die Entdeckung kann nicht wieder verloren gehen, das erste noch schwankende, noch vieldeutige Wort der künftigen Sprache ist gewonnen.

Und andere Horden bilden andere Lautzeichen. Bei Kampf und Tausch, Wanderung und Eroberung mischen sich auch die Laute, verbreiten sich herüber und hinüber, die Geschichte der Sprachen beginnt.¹¹³

Much like Tzara’s passage, this looks very like another demonstration of the limits of concept formation via abstraction from substance, by which the “Da!” is “entleert” of its meaning and contents. Then, however, the *form* in which this deliberation takes place is in a stylised fabulistic introduction — not in the more methodical analysis of language itself that ensues in the essay. Like the case of Tzara’s “Zeitungen” above, Mongré’s chart of a loss of meaning from something stable, a basis upon which a “Geschichte der Sprachen” is triggered, is worthy only of *fiction*, of storytelling; it is not real. The punchline of the essay, “Worte ohne Wirklichkeit,” describes not a process by which the “Wort” loses its “Wirklichkeit”; rather, the “Wort” never had a “Wirklichkeit” to begin with. All that the “Da!” — or indeed any utterance — can possibly refer to is not some initial meaning from which it has since moved off, but the *movement* itself, on the motion of *filling* that which is preordained as empty, a “hollow vessel.” The basis of language rests, to recall Nietzsche’s “Bau der Begriffe,” upon running water, upon *Bewegung* itself, not on some mirroring process that anchors words soundly to solid ground. To dig for an original meaning, for an exterior, extra-systematic basis, is merely to dig further into the system. Not only do Dadaism and modern mathematics diverge from Bauhaus and the Wiener

politics. Matthew Biro, *The Dada Cyborg: Visions of the New Human in Weimar Berlin* (Minneapolis: University of Minnesota Press, 2009), 88ff.

¹¹³ Mongré, “Sprachkritik,” 552.

Kreis by spurning any sense of construction on solid foundations, but they are also fundamentally irreconcilable, because, for the former pair, no such foundation in fact exists. In terms of Tzara's extract above, therefore, it is thus not *really* the case that "Dada" has so many meanings that it *becomes* meaningless, i.e. is "entleert" of its original "Bedeutungen" by the usual means of the Aristotelian logic of abstraction. This (anti-)logical process, which serves to undermine logic's credibility, is already futile, for there never was a meaning from the outset. In a way that both verifies Murphy's suggestion and exposes an alternative, much more functional and modern-mathematical type of logic at play in Tzara's manifesto, "Dada" is not emptied of content, because it is already empty to begin with.

With the "big picture" of this thesis in mind, let us pause to briefly take stock. Aware that Mongré's deliberations on language and (de-)ontology not only survive the end of the pseudonym but can also be meaningfully linked to Hausdorff's career-defining turn to mathematical formalism, the significance of the return here to Mongré's "Da!" from the 1903 essay cannot be stressed enough. To talk about Dada in this manner is thus necessarily to talk about mathematical modernism with a startlingly similar vocabulary. By attributing to the "meaninglessness" of the name "Dada" a sense of *deliberateness*, of functional logic that is characteristic of mathematical formalism, Dadaism is in turn tethered to the same web of ideas that holds mathematical modernism to an extent unimaginable with Bauhaus. With the turn to Dada, certain key maxims of Bauhaus have fallen away: restorations of "Wort" and "Wirklichkeit"; a criterion of meaningfulness; and a conception of space in pre-modern terms. More significantly, however, the much-debated name of Dada discloses conceptual processes at play in the formation of concepts by way of *function*, as opposed to *substance*, just like in the axiomatic method that exemplifies the work of Hilbert, Hausdorff, Noether and their formalist colleagues. This protracted focus on the name was imperative, for if the broader programme of Dadaism is indeed "epitomized" by the way in which its name operates, then the insights above ought to also be carried over as well. Just as Mongré's Nietzschean notions were seen to exceed the use of the pseudonym, can this new conceptual basis be seen to exceed the name "Dada"?

In Name Only: Readymades, Language and Combinatorics

Given that the central argument of this chapter has been rounded off above, the following attempt to cover more ground and begin to generate a picture of Dada beyond its name alone will be rather brief. The examination of the name "Dada" by way of Cassirer, as was seen, converged upon what could be read as an indulgent *Wortspiel*, i.e. that the term "Dada" operates anti-logically by virtue of being a concept that is *readymade* as contentless, as empty. The fact that

this pun functions on some level, suggests that the well-known label for prefabricated, mass-produced objects that have been elevated to (Anti-)*Kunst* could be a convenient place to begin the route outwards. At this point, it is worth recalling Mehrtens' regrettably scant but nonetheless well-intuited suggestions of possible inroads into a dialogue between modern art and modern mathematics. Following a discussion of Henderson's 1983 work — an enterprise Mehrtens sees as more fruitful for exploring the overlap between art and modern physics, as opposed to abstract mathematics¹¹⁴ — he picks up on her prolonged focus on French experimental artist Marcel Duchamp, who first coined the term “readymades” and is associated with the Parisian variant of Dada and later its New York rendition. Noting that Duchamp “hat [...] sich intensiv mit Mathematik und Naturwissenschaften auseinandergesetzt,”¹¹⁵ Mehrtens foregrounds a rather revealing remark by Duchamp on the subject: “I was interested in introducing the exact and precise aspect of science [...]. It wasn't for love of science that I did this; on the contrary, it was rather in order to discredit it, mildly, lightly, unimportantly. But irony was present.”¹¹⁶ The subversive nature of Duchamp's engagement with the exact sciences is, of course, not lost on Mehrtens, who offers the following assessment:

Zudem ist seine Arbeit von zu jener Zeit noch seltener Radikalität, die durch ein am Muster der Wissenschaft geschultes begriffliches Denken gestützt wird. Doch zugleich, vielleicht als notwendige Bedingung der langfristigen Wirksamkeit des Werkes, geht es um Kunst und eindeutig *gegen* Mathematik und Naturwissenschaft. [...] Die Readymades von Duchamp stehen durchaus in konzeptuellen Zusammenhängen, die mit geometrischen und numerischen Konzeptionen zu tun haben. [...] Duchamp kommt vielleicht der mathematischen Moderne am nächsten in der Radikalität, mit der er die Sprache der künstlerischen Arbeit ohne eine Ontologie formuliert.¹¹⁷

In both Mehrtens' assessment of Duchamp and indeed Duchamp's self-assessment, this sense of turning the scientific against science, surely chimes with the prior discussion of the deployment of the logical against logic itself.

More significantly, however, the sustained focus on Cassirer's *Begriffsbildung*, with a view to ascertaining how the name “Dada” functions conceptually, renders more tangible Mehrtens' observation that Duchamp's readymades mark him out as unusually close to modern mathematical thinking. The association of Duchamp's works with nominalisation is by no

¹¹⁴ Much of Henderson's work correlates aspects of modern visual art with the ideas of the French mathematician Henri Poincaré, who is remembered for his conservatism (in mathematical terms) and efforts to retain the close proximity of mathematics and physics. In the wake of non-Euclidean geometry, he worked to demonstrate its utility and relevance to the real, empirical space of nature, anticipating of course Einstein's theories of relativity but charting a very different course to the abstract, self-referential and axiomatic mathematics that Mehrtens marks out as “die Moderne.” Ibid., 552-556.

¹¹⁵ Ibid., 555.

¹¹⁶ Marcel Duchamp, in Pierre Cabanne, *Dialogues with Marcel Duchamp* (New York: Viking Press, 1971), 39, cited in Mehrtens, *Moderne-Sprache-Mathematik*, 556.

¹¹⁷ Mehrtens, *Moderne-Sprache-Mathematik*, 555f.

means new, and indeed Duchamp himself is largely responsible for this: he proposed a description of his turn to abstraction as “a sort of pictorial nominalism.”¹¹⁸ In a book-length assessment of this, Thierry De Duve contextualises Duchamp’s nominalism as part of a two-pronged “abandonment”¹¹⁹ — of painting and of the notion of art itself — concluding that with the readymades, “Duchamp kept nothing of art but its name.”¹²⁰ As De Duve helpfully notes, this is underpinned by a fundamental “functionalism” that is *not* one associated with the “artist-artisan of the industrial culture that Gropius dreamed of forming,”¹²¹ but a “naked symbolic function” that amounts to no more than a “pure signifier.”¹²² Once more, a notable distance to Bauhaus and remarkable proximity to the language of mathematical formalism is on display here. Accordingly, focus can now move off from the name “Dada” and onto the practice or function of naming, of name-giving more broadly, which in turn better explains why Mehrrens highlights the “begriffliches Denken” inherent to readymade art. As is now evident, it is *conceptual* in such a way that echoes how mathematical concepts are generated, i.e. “vorweggenommen” as opposed to abstracted from some initial substance. The status of readymade artwork is guaranteed only by its declaration as such, by its receipt of a name and some placement as a work of art — any relationship to the material substance involved, be they bicycle wheels or urinals, is not at play in this conceptualisation in any way beyond the “irony” that is present, as Duchamp duly notes. To “make” readymade art could be called, in short, “das Denken in Begriffen.”

While the readymades are primarily associated with Duchamp, the term has been used retroactively (and more loosely) to describe similar impulses underway across the Dadaist spectrum, especially in reference to the use of “found materials” in the collages and photomontages of Hannah Höch and Raoul Hausmann, the co-founders of Dada Berlin. Although by no means aiming for such comparisons, in many cases, scholars have assessed and described the works of Höch and Hausmann with a taxonomy that is startlingly redolent of previous discussions of modern mathematics in this thesis. Consider, for example, Höch’s iconic 1919 *Schnitt mit dem Küchenmesser durch die letzte Weimarer Bierbauchkulturepoche Deutschlands* (Fig. 4.6):

¹¹⁸ As Thierry De Duve notes, the phrase was written on a note attached to the *White Box* (1914). Thierry De Duve, “A Critique of Pure Modernism,” in *The Duchamp Effect*, ed. Martha Buskirk and Mignon Nixon (Cambridge, MA: MIT Press, 1999), 106.

¹¹⁹ Thierry De Duve, *Pictorial Nominalism: On Marcel Duchamp’s Passage from Painting to the Readymade* (Minneapolis: University of Minnesota Press, 2005), 16.

¹²⁰ *Ibid.*, 110.

¹²¹ *Ibid.*

¹²² *Ibid.*, 115.



Figure 4.6: Hannah Höch’s *Schnitt mit dem Küchenmesser* (1919)¹²³

Here, clippings of well-known figures like Albert Einstein and national politicians are recontextualised, like Duchamp’s bicycle wheel, in such a way that renders their previous referents void and acquires a “meaning” that is purely interrelational. Reflecting upon this, Jaime Tsai is keen to stress the machine-like conception of photomontage held by figures like Höch: “the Berlin Dadaists first described themselves as *photomonteurs* — mechanics or engineers rather than aesthetes or artists.”¹²⁴ This “cyborg aesthetic”¹²⁵ runs parallel to the focus on machines

¹²³ Reproduced here from Leah Dickermann et al, *Dada: Zurich, Berlin, Hannover, Cologne, New York, Paris* (Washington: National Gallery of Art and D.A.P Press, 2006), 138.

¹²⁴ Jamie Tsai, “Pixel Pirates,” in *Dada Data: Contemporary Art Practice in the Era of Post-Truth Politics*, ed. Sarah Hegenbart, Mara-Johanna Kölmel (London: Bloomsbury Visual, 2023), 268.

¹²⁵ *Ibid.*

(and indeed *Denkmaschinen*) in the previous chapter on Hartwig, and likewise amounts, as Anna Katharina Schaffner writes, to dismemberment of “the bourgeois *Begriffswelt* and all that comes with it: convention, agreement and social consensus, hierarchies and power structures, [...] and the possibility of stable meaning.”¹²⁶ In her discussion, Schaffner then moves onto Hausmann’s poster poems (Fig. 4.7), which are less politically riotous than Höch’s photomontages.

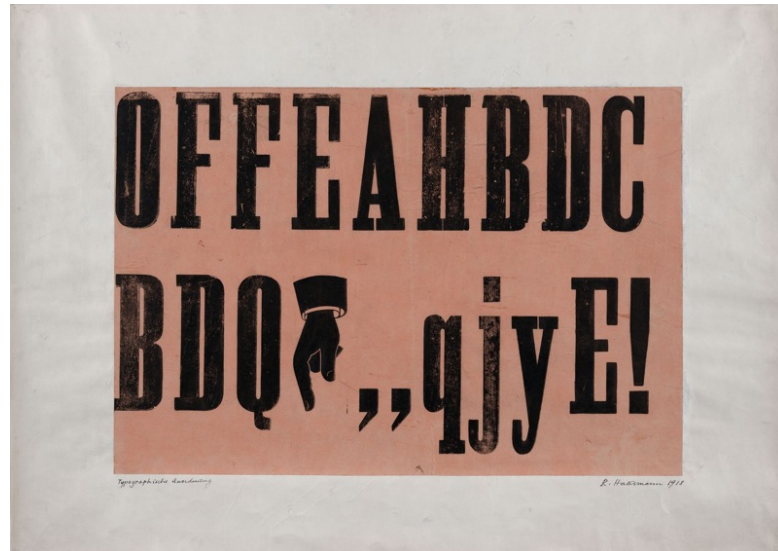


Figure 4.7: Raoul Hausmann’s poster poems (1918)¹²⁷

Here, Schaffner describes a linguistic dissection that could easily be transposed into an assessment of the language of mathematical formalism. “Radically devoid of semantic content and essentially self-referential,” she writes, Hausmann’s poster poems “do not refer to any

¹²⁶ Anna Katharina Schaffner, “Assaulting the Order of Signs,” in *Dada Culture: Critical Texts on the Avant-Garde*, ed. Dafydd Jones (Amsterdam and New York: Rodolpi, 2006), 119.

¹²⁷ Reproduced from Dickermann, *Dada*, 133.

external reality but only to themselves. They do not fuse into words, but form a string of isolated monadic units [...].”¹²⁸ Aware that the symbols on the posters are *just* that, she continues:

The linguistic signs have abandoned their task to point to something other than themselves and have gained aesthetic autonomy. The chain of signification is interrupted; signifiers become their own referents and signify only themselves. Language is dissected into its smallest independent units, phonemes and graphemes. They do not represent an absent object any more, they do not fill an empty presence acting as *Stellvertreter* [...] for the real thing, but refer only to their own material essence, to their visual and their acoustic qualities.¹²⁹

Remarkably, there is not a word of Schaffner’s description that would look out of place in a musing on Hilbert’s formalism or Noether’s *begriffliche Mathematik*, which equally amount to strings of ontologically empty symbols and signs on a page. Considering Einstein’s “inhalteere Begriffsschemata” of mathematical modernism, if the task of defining “was ihnen Inhalt gibt” is no longer one that *belongs* to the discipline of mathematics, then something similar underwrites Dada: the task of pinning down what these “dissected units” mean or represent is simply no longer the point. Not only is that task to be considered outside the remit of art, but it has also been rendered utterly futile by the irreverent Dada project, which seems to operate in what can only be described as an experimental *Spielraum*.

However perfunctory these last deliberations have been, it is nonetheless evident that the previous reflections on the name of Dada and the alternative logic of the *Funktionsbegriff* seem to hold up well when it comes to reviewing the movement more broadly. If discussions of Dada’s anti-substantive concept formation could pertain equally to mathematical formalism, i.e. where one can speak *about* key maxims of Dadaism and mathematical modernism in the same breath, then a potentially provocative corollary might be posed: are Dadaism and modern mathematics, when made to speak *to one another*, in some sense mutually intelligible? Or could they be made so by way of some creative translation? In looking for a fitting case study, let us return to Tzara, for the crucial aspect of “language dissection” noted by Schaffner above is perhaps most explicitly expressed by Tzara in “Um ein dadaistisches Gedicht zu machen” and published in 1920. Something of a metapoem, a poem about the making of Dada poems, the text features, aside from a sole pair of scissors, only a bag and some words. In a final move, the following paragraphs will attempt to mediate between the language of Dada and modern mathematics, more specifically point-set topology, and thus answer the above corollary in the affirmative.

¹²⁸ Ibid., 122.

¹²⁹ Ibid.

At the beginning of this chapter, Ursula Le Guin’s astute and provocative essay “A Carrier Bag Theory of Fiction” was cited, in which she dismisses the enduring cultural imagery of a masculine hunter armed with a spear as the *Urmensch* of civilisation in favour of the feminine gatherer equipped with a bag. As the passage shows, Le Guin reconceptualises the novel, and indeed fiction more broadly, as something of a carrier bag, as a container of words that themselves serve as containers for meaning. From the discussion of “hollow vessels” and the processes of emptying and filling, Le Guin’s idea presents a curious overlap in terms, as if to say that storytelling is the determined collection of desirable objects into a useful container, i.e. an act of filling an empty vessel. Yet, of course, Le Guin describes something very different here: with stories like “medicine bundle[s]” and items of “particular” value, the text is imagined here not as an empty space that is filled arbitrarily, but rather as something brimming with contents from the outset, with items unpacked with care by virtue of their pre-conceived meaning. Fullness, substance and meaningfulness, therefore, characterise Le Guin’s bag of words, rendering it something of a precise inverse to Dada containers that are “vorweggenommen” as empty in order to secure an inherent *lack* of meaning. How, then, might Tzara’s version be read? Let us consider the poem more carefully:

Nehmt eine Zeitung.
 Nehmt Scheren.
 Wählt in dieser Zeitung einen Artikel von der Länge aus, die
 Ihr Eurem Gedicht zu geben beabsichtigt.
 Schneidet den Artikel aus.
 Schneidet dann sorgfältig jedes Wort dieses Artikels aus und
 gebt sie in eine Tüte.
 Schüttelt leicht.
 Nehmt dann einen Schnipsel nach dem anderen heraus.
 Schreibt gewissenhaft ab
 in der Reihenfolge, in der sie aus der Tüte gekommen sind.
 Das Gedicht wird Euch ähneln.
 Und damit seid Ihr ein unendlich origineller Schriftsteller mit
 einer charmanten, wenn auch von den Leuten unverstandenen Sensibilität.¹³⁰

For all of its apparent disorder, the experiment outlined here by Tzara is actually a rather controlled one; it describes a relatively methodical *process*. This sense of step-by-step procedure — i.e., a logically controlled method geared towards an undermining of logic and sense — has not been lost on some more observant scholars of the avant-garde. Austad notes, for example, that the “Dadaist poem has *pattern* and *purpose*: the poet should follow these instructions with the intent of creating a poem.”¹³¹ More explicitly, Sascha Bru rather intuitively calls Tzara’s poem

¹³⁰ Tristan Tzara, “Um ein dadaistisches Gedicht zu machen.” The poem appeared in the 1920 *Manifest über sschwere und bittere Liebe*. Reproduced here from Alice Stašková, Anne Hultsch, Klaus Schenk, eds., *Experimentelle Poesie in Mitteleuropa: Texte-Kontexte-Material-Raum* (Göttingen: VandR Unipress, 2016), 326.

¹³¹ Austad, “From Dada to Nada,” 55. Emphasis added.

an “algorithm” — a directly mathematical idea that describes a finite set of rigorous instructions that govern a computational process.¹³² In short, a set of input elements are posited, and they are made to undergo a well-defined procedure. Tzara’s poem, as it turns out, can be quite easily “translated” into another type of procedure that is local to the strands of modern mathematics foregrounded in this thesis, namely topology and its abstract concern for structural invariance. While topological equivalence has, of course, underpinned the forgoing analyses of *Der letzte Mann* and Mela Hatwig’s novels, in that it is the concept that grounds this structural “Gleichbleibendes” between spaces, it is worth expressing more formally for the benefit of the following re-assessment of Tzara’s work. In his accessible *Introduction to Metric and Topological Spaces*, a common English-language text for an undergraduate course in topology, W.A. Sutherland offers the following definition:

A homeomorphism $f: T_1 \rightarrow T_2$ of topological spaces is a one-one correspondence such that f and f^{-1} are both continuous. [...] In other words, f is a one-one correspondence that preserves all the structure that topological spaces possess (the analogous concept for algebraic structures and vector spaces is that of isomorphism). If there exists a homeomorphism $f: T_1 \rightarrow T_2$, we say that T_1 and T_2 are *homeomorphic* or *topologically equivalent*.¹³³

The criterion of *continuity* here is what governs the process of a homeomorphism, for it is to say that every element in the first topological space is uniquely mapped — without any breaks or elements unaccounted for — onto an element in the second, hence Sutherland’s use of “one-one.” Intuitively, this corresponds to the previous explanations of the “insides” and “outsides” of spaces; a function that is discontinuous would disrupt the “Nachbarschaftsbeziehungen” of the spaces, thus preventing the distinction between the inner and outer from remaining intact. A homeomorphism adheres to an added layer of restriction in that its inverse (the function “ f^{-1} ”) is also continuous, which effectively means that the entire process is reversible: deforming T_1 into T_2 , so to speak, is counterbalanced by the ability to deform T_2 back into T_1 , otherwise the equivalence relationship between the two spaces is severed.

Let us reimagine Tzara’s poem in this light. Consider the snippet of the original article whose words are arranged in some ordered fashion, and let us assume, for the sake of demonstration, that the article is 25 words long. This can be considered as the topological space T_1 , with its 25 elements (the words) as a collection of points. The first part of the process, which involves

¹³² Sascha Bru, *The European Avant-Gardes, 1905-1935: A Portable Guide* (Edinburgh: Edinburgh University Press, 2018), 15. This contention is taken further again by Laure Thompson and David Mimno, who bring the cut-up poem technique into conversation with computer science and the structure of convolutional neural networks (CNNs) — a tool for image analysis and processing. Here they link the “bag-of-words” format to search engines, spam filters and social media recommendations. Laure Thompson and David Mimno, “Computational Cut-Ups: The Influence of Dada,” *The Journal of Modern Periodical Studies* 8, no. 2 (2017): 179-195.

¹³³ W.A. Sutherland, *Introduction to Metric and Topological Spaces* (Oxford: Oxford University Press, 1975), 56.

cutting the article into individual words and placing them into a bag, mimics a simple homeomorphism, let us call it f_a : for each word in T_1 , there is a distinct and corresponding position in the bag, which lets us view the full bag as a topological space T_2 . The process could, of course, be reversed and the words re-assembled in their original order. As such, T_1 and T_2 are topologically equivalent, which is to say, nothing distinguishes each one structurally from the other. Similarly, the process of removing and arranging the words “in der Reihenfolge, in der sie aus der Tüte gekommen sind” forms a second homeomorphism, let us call it f_b , from T_2 to yet another topological space T_3 — the newly ordered set of words that constitutes the “Gedicht.” For all the same reasons, the space T_3 is topologically equivalent to T_2 , which is in turn equivalent to T_1 . Therefore, T_3 and T_1 are also topologically equivalent: for each and every element in the original space, there is a unique, distinct and corresponding position in the final space. “Um ein dadaistisches Gedicht zu machen” describes, in short, a composition of two simple mappings from equivalent topological spaces: the initial setting, an ordered collection of 25 words, is structurally and spatially no different to the final setting, namely a collection of 25 words merely with a different ordering.

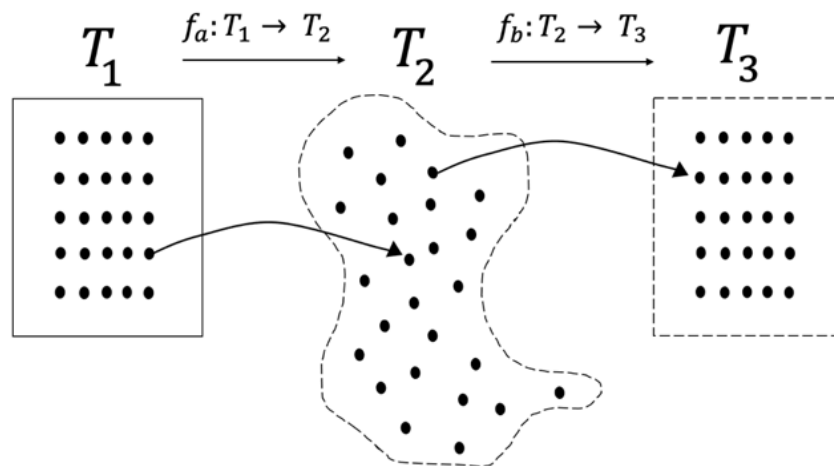


Figure 4.8: Tzara’s Homeomorphisms

Assuming a few words have not gone astray in the scissoring and others have not materialized in the bag that were not in the original set, i.e. to guarantee the continuity of the functions, the usual conditions of topological invariance have been fulfilled. So, Tzara’s contention that each execution of this process yields an “unendlich originelle[s]” poem cannot be taken very seriously: viewed from just one level of abstraction, the diligent Dada disciple is merely producing the same thing over and over again — in a mockery of artistic originality itself — not

even *ad infinitum*, lest there exist an article of infinitely many words.¹³⁴ Theoretically, with an article of 25 words there are exactly 15511210043330985984000000 possible combinations. While such an amount, to borrow Mongré's phrasing from "Sprachkritik," would be "beim Barte des Polonius [...] zu lang, zu lang"¹³⁵ to exhaust in practice, it is of course a pithy sum in comparison to the untameable expanse of the infinite. Yet, of course, we as readers are not *supposed* to take the contention seriously. As with most Dada pursuits, the person who engages in earnest — cutting out paper words, assembling them in random combinations anew and believing in their own capacity for originality — is ultimately the butt of the joke, because any originality that could arise would demand a retention of stable meaning and significance of the words used.¹³⁶ Contrary to most expectations, it would seem that the mathematical formalist, a point-set topologist, who is acutely aware that "Punkte, Geraden und Ebenen" could just as well be "Tische, Stühle und Bierseidel," is best placed to "get" the joke and evade the mirth of the Dada jesters.

To come to a close, this experimental demonstration, it must be stressed, has been no mere gimmick, for Tzara's poem encapsulates with remarkable clarity the characterisation of space put forward by this thesis in the introduction. I have ascribed to modern mathematics a new understanding of space that examines not a material or transcendental object but the invariant properties within spatial transformations, which is in turn bound to a wider renunciation of all external referentiality in mathematical language. Then, this framing formed the basis for an attempt to reach across disciplinary lines. While this chapter has principally dealt with the wider phenomenon of de-ontologized language, with "Um ein dadaistisches Gedicht zu machen," the fundamentally interconnected nature of these two spatial tenets emerges once again. Just as the *Transformationsprinzip* (an early rendition of the topological homeomorphism) could not hold when any of the points therein cease to be *arbitrary* and acquire meaning, nor could Tzara's layered joke function if any attainability of stable meaning is presumed. In an *ewige Wiederkehr* all of its own, the process described in the poem yields the same thing over and over again, and it does so strictly because all of the components in flux are no more than arbitrary, meaningless conglomerations of signs.

¹³⁴ Even then, a homeomorphism is perfectly capable of describing mapping between spaces of infinitely many points.

¹³⁵ Mongré, "Sprachkritik," 557.

¹³⁶ As Austad pens: "It is merely a string of random words with the label 'poetry'. Tzara's critique delves deeper than denouncing reason; he additionally removes the poet's influence and questions the role of the poet [...]. Tzara likewise removes poetry's importance by concluding that anything can be poetry and anyone can be a poet. Tzara's advice to 'copy conscientiously' random words mocks a traditional poet's concentrated use of words to evoke images or thoughts. His endowment of this newly created poet with poetic 'sensitivity' and ability to be 'infinitely original' further dismantles the poet's shroud." Austad, "From Dada to Nada," 55.

Summary, or: The Eyes Do Not Have It

At the beginning of *Grundzüge der Mengenlehre*, Hausdorff warns that the reader is about to enter the realm in which “das Plausible falsch und das Richtige paradox ist.”¹³⁷ In a sense, this describes rather well the argument put forth in this chapter, which has sought to dispel the initially more *plausible* alignment of modern mathematics with the Bauhaus design school and point instead to an ostensibly very different companion piece in Dadaism. Firstly, by re-evaluating the works and theories of both Wassily Kandinsky and Walter Gropius, a philosophical positioning was uncovered that is variably beholden to a Platonist conception of mathematical objects, a Euclidean constructivist approach, and an understanding of space that fails to surpass Kant’s own. While of course differing philosophies in their own right, they are held together by a presumption of some extra-systematic basis, be that in reality or intuition — an understanding that simply runs counter to key tenets of modern mathematical formalism. Any nature of Bauhaus that can be described as mathematical is thus limited to pre- or counter modernist ideas; for Bauhaus, geometry and mathematics remains, in short, a “way of seeing” the world.

In an about-face, however, I have suggested that the ways in which the brazen Dadaist attacks traditional logic, establishing what some scholars call its unique antilogic, reveal a much more robust (if seemingly *implausible*) parity with mathematical modernism. Beginning with the name “Dada” and working outwards, the very form of logic and concept formation at work that Cassirer pins to mathematical formalism was identified, i.e. a function-based logic that supplants the substance-based model. Considering processes of nominalization in Dada more broadly, both Dada and modern mathematics can be seen not only to propagate but also function according to a deliberate severance of ties to *any* external reference and stable meaning. By placing side-by-side these two inward-looking, self-referential and experimental languages, it became possible to literalise a metaphorical claim of this thesis in the introduction: modern mathematics and aesthetic modernism can, in fact, be heard to “speak” in a common language. To close, the Bauhaus idea that both art and mathematics amount to diagrammatic “ways of seeing” the world, harken back to the very theories of space and geometry from which modern mathematics broke away with great determination. If Dada is indeed a more fitting counterpart to modern mathematics, a field that lost confidence in the role and utility of visualisations and diagrams as it grew, perhaps Hannah Höch ought to offer a fitting (if confrontational) replacement visual aid for modern mathematics. The centrality and power of “ways of seeing”

¹³⁷ Hausdorff, *Grundzüge der Mengenlehre*, 97.

in art and mathematics could be seen to meet their match, in a notably derisory fashion, in her 1925 montage “Der Strauß” (Fig. 4.9), in which a bundle of eyes is amassed to form a parody of what may be the most clichéd, unimaginative and mediocre object of everyday, household aestheticism: a nice bunch of flowers.



Figure 4.9: “Der Strauß” by Hannah Höch (1929)¹³⁸

¹³⁸ Reproduced from Dickermann, *Dada*, 145.

5

Conclusions, or: On Marriage and Divorce

“Once again, I was back to pondering this ‘marrying of the wrong spouse’ business. I don’t mean the outgrowing of what was once a successful union, with each partner contributing and committing to each other, celebrating each other until they reached a natural end of their shared path together [...]. I mean this business of people marrying people they didn’t love and didn’t want and where someone from the outside might look in and shake their head and say that somebody ought not to be in such an intimate position in another somebody’s life if it turned out they were the wrong somebody.”¹

— Anna Burns, *Milkman*

At a university banquet in Göttingen in 1934, David Hilbert had the misfortune of being seated beside the Nazi government’s Minister for Science and Education, Bernhard Rust, who asked the former: “Wie geht es der Mathematik in Göttingen jetzt, da sie vom jüdischen Einfluss befreit ist?”² Rarely short of a memorable retort, Hilbert, who had witnessed the dismissal of any Jewish colleagues such as Emmy Noether, Richard Courant, Paul Bernays and Edmund Landau the year before, responded: “Mathematik in Göttingen? Es gibt wirklich keine mehr.”³ For all the failures of Bieberbach’s “Deutsche Mathematik” and its irregularly published journal compared to *Entartete Kunst*, for the “Generaldirektor” of mathematical modernism in Germany, the year 1933 brought to a close a period of unparalleled productivity, creativity and growth in the field of mathematics. Of course, neither Göttingen nor the discipline of mathematics as a whole is unique in this regard, and perhaps only few could have foreseen that the *Berufsbeamtengesetz* was but an initial step in a process of erasure of the Jewish community in Germany, culminating in the genocide of around two thirds of the European Jewish population. While modern mathematics, just like modern art and literature, ultimately endured, spurred on and disseminated internationally by many of its proponents in exile, for the “heartland in

¹ Anna Burns, *Milkman* (London: Faber and Faber, 2018), 255.

² Being a conversation based on anecdotal evidence, there are several variants of the conversation in scholarly writings (with some presenting Hilbert as more confrontational again), but this account in Siegfried Horst Lehnigk’s study is quite representative on average. Siegfried Horst Lehnigk, *Eine deutsche Katastrophe: 1933-1940* (Landau: Verlag Empirische Pädagogik, 2010), 64.

³ *Ibid.*, 64f.

Germany,” to recall Gray’s term, the rise of German Nazism brought with it a terrible conclusion to German-language modernism across disciplines and cultures. In a historical sense, therefore, this dissertation began at the end.

The introduction to this thesis opened with the multi-pronged incursion against modernism in Nazi Germany, correlating the party-led suppression of modern art in the 1930s with the lesser-known attempt to establish a paradigm of “Deutsche Mathematik,” which sought to ostracise the Jewish mathematical community and racialize the discipline itself. This ideological alignment of two “modernist” expressions was then used to set up the central question of this dissertation: just how modernist is modern mathematics? In historical terms, the idea of “mathematical modernism” was raised most explicitly in the German-language context by Herbert Mehrtens in *Moderne-Sprache-Mathematik*, whose far-reaching survey of the “Moderne” and “Gegenmoderne” as responses to various path-altering discoveries in mathematics laid much of the groundwork for much of the historical aspect of this thesis. While perhaps overly reliant on the Foucauldian methods of his day, Mehrtens charted out these oppositional disciplinary positions with respect to key aspects of mathematical thought: space, number, function and their bearing on mathematical language. By considering the subsequent contributions by Jeremy Gray in *Plato’s Ghost* and Leo Corry in his article, several methodological questions arose concerning the extension and refinement of the term “modernism” in mathematics. Gray, it was shown, sought to spread the remit of the modernist transformation beyond Mehrtens’ narrow focus on Germany in order to create a more international picture of the phenomenon — a process that could be carried out, he suggests, by way of a rather delicate definition of modernism. While designed to avoid sweeping over-generalisations and circumvent the risk of perceiving commonalities as “two-way traffic” paths of influence, the shortcomings of Gray’s starting point in a definition were made clear, both in terms of establishing a meaningful characterisation of mathematical modernism and of beginning to reach across disciplinary lines to discuss modernism more widely. Furthermore, it was noted that while Gray’s scepticism of two-directional influence is merited, it is by no means the only form cultural and philosophical influence can take. These procedural issues were then taken up explicitly by Leo Corry in his article on the utility of “modernism” as a historical marker in mathematics: here, he proposes an avoidance of definitions of modernism and cautions against conflating commonality on the level of “features” with broad “historical processes” that potentially underwrite both realms. Settling upon the latter as a more robust way forward, it remained unclear, however, how “features” and the “processes” that generate them might be cleanly divorced from one another. Moreover, a glance at Corry’s own embryonic efforts to interweave modern mathematics and

aspects of aesthetic modernism ultimately (and unwittingly) served to exonerate Mehrrens' more localised and thematic approach, for they too were at their most viable on a smaller geographical scale. The three main historical works on this overarching question, it was shown, thus point in several different methodological directions.

Turning to the contributions of literary and artistic criticism, it became clear that this discordant set of approaches tended to guide literary scholars towards the examination of explicit thematization of mathematical ideas *within* literary works, especially those of Robert Musil and Hermann Broch, both of whom were trained mathematicians (in Musil's case, mathematical engineering). In a German-language literary context, such an approach is exemplified by the works of Andrea Albrecht, whose work spans a larger range than just modernism (e.g. Novalis), and Nina Engelhardt's more recent monograph *Modernism, Fiction and Mathematics*. In the latter case, a clear focus on modernism in particular is forthcoming, and Engelhardt adds to the two aforementioned Viennese writers the US-American novelist Thomas Pynchon (another mathematical engineer). Observing similar issues with Gray's use of definitions and Corry's division of features and historical processes, the focus on the three authors above emerges as something of a compromise between "broader strokes" and specificity of ideas. Although no doubt an insightful and necessary pursuit, by converging on writers who were educated in mathematics, an unnecessarily narrow category for analysis takes shape: predominantly male cultural actors with access to elite European institutions. As such, the observation of mathematical ideas inside texts by writers who were keenly familiar such ideas cannot be the only approach when assessing how modern mathematics may be placed more firmly alongside an array of manifestations in modernist culture.

In light of these scholarly efforts, the method of this dissertation became a synthesis of the above, isolating the most viable aspects of the multitude of approaches. To avoid being hamstrung by binding and unworkable definitions of modernism, this thesis married Corry's appeal to search for shared historical processes with the more thematic approach of Mehrrens, following the latter's lead by foregrounding the concept of space as a simultaneously specific yet inherently transferable lens through which to examine overlap between modern mathematics and aesthetic modernism. As a point of departure, I proposed the following spatial characteristics of modern mathematics, forming in essence a two-fold *Raumkonzeption* for this thesis: (i) the measurement-oriented field of geometry gives way to the examination of invariant properties within spatial transformations, which (ii) both occasions and is enveloped by a wider renunciation of external referentiality, either in the material world or in some transcendental apprehension thereof. On this basis, I suggested, a more viable search for common

philosophical influences and parity of modes of expression across both realms is enabled, which brings the added advantage of a possible departure from a restricted focus on mathematically trained writers and nevertheless maintain a hold on key tenets of the *Raumproblem* in modern mathematics. Seeking to widen analytical horizons, therefore, Alice Jenkins' idea of the "untaught" geometer was stretched — hopefully within the bounds of topological equivalence — to better account for mathematical ways of thinking that need not be explicitly marked as such. If similar spatial concerns in mathematical and aesthetic modernism can be seen to emerge, at least in part, due to shared influencing factors and actors, then it follows that their modes of expression may be more comparable than initially meets the eye. With a two-fold conception of spatial understanding, a two-fold analysis along these lines — influence and expression — was initiated.

Opening with some deliberations on Theodor Storm's realist novella *Der Schimmelreiter*, Chapter 1 began the lengthy task of laying out a historical account that give rise to this new *Raumkonzeption* in modern mathematics. Beginning with Euclid's *Elements*, a historical pathway through was mapped out, traversing Early Modern debates, the rise of a Kantian model for space and geometry, and the collapse thereof precipitated by the discovery of non-Euclidean geometries. Here, something of a marital breakdown between mathematics and physics took place, and differing schools of thought emerged in response to the interwoven *Grundlagenkrise* and *Gegenstandsproblem* — with David Hilbert's formalism entrenching itself as the dominant modernist expression of mathematics. This historical survey then converged upon Felix Hausdorff, whose swift turn towards formalism in his inaugural lecture of 1903 in Leipzig followed a several-year-long stint of philosophical and creative writing under the pseudonym Paul Mongré. Finding in "Das Raumproblem" a neat encapsulation of this two-pronged spatial understanding of space, this section built on the valuable work of Walter Purkert, Moritz Epple and Werner Stegmaier to set up a dig site with a view to excavating potential instances of common philosophical influence, in this case Friedrich Nietzsche. Undermining the so-called "double life" of Felix Hausdorff, a shorter (and more self-explanatory) discussion of the two more significant Mongré texts, *Sant'Ilario* and *Das Chaos in kosmischer Auslese*, was able to bolster the case for the impact of Nietzsche's *ewige Wiederkehr des Gleichen* on Hausdorff's epistemological positions and his developing understanding of space exemplified in the prototopological *Transformationsprinzip*, itself an examination of sameness within arbitrary transformations. Eager to move off from existing scholarship and further concretise the influential role of Nietzsche in Hausdorff's transition to mathematical modernism, i.e. formalism, in particular, a more substantial discussion was dedicated to one of the final texts published under the pseudonym

Mongré, namely “Sprachkritik” of 1903. Here, I argued that Hausdorff’s notably *fachpolitische* declaration of the space of mathematics as “eine gewisse freie Schöpfung unseres Denkens,” emancipated from any ontological burden in real objects or those apprehended in *Anschauung* and residing within the boundless “Spielraum des Denkens,” is best contextualised alongside Mongré’s critique of language that likewise draws heavily on Nietzsche’s own. Just as Nietzsche saw in the epistemological inadequacy of language the opportunity for fresh, radical creativity to take shape, Mongré likewise casts abstract mathematics as a way to break free of the linguistic pessimism of Fritz Mauthner by embracing as opposed to mourning the loss of a material or transcendental *Gegenstand*. Equipped, then, with a deeper and more nuanced understanding of Nietzsche’s influential role on one of the key proponents of modern mathematics, the close of the chapter began to gesture outwards towards neighbouring developments in the discipline that echo the tenets of the spatial model examined in this thesis, with Emmy Noether’s *begriffliche Mathematik* presenting itself as a uniquely productive and inherently creative expression of this. Having established a common instance of philosophical influence in Nietzsche, Chapter 2 began the task of exploring common modes of spatial expression across modern mathematics and aesthetic modernism. Bending away from Sigrid Weigel’s landmark “topographical turn” towards Stephan Günzel’s proposed counterpart, a “topological turn” in cultural studies, the topological principle of invariance throughout transformation was poised to re-evaluate the ubiquitous trope of metamorphosis in (German-language) modernism. Using “the ultimate topological author” Franz Kafka as a recurring comparison point, a substantial and close re-reading of landmark contribution to Weimar Cinema, F.W. Murnau’s *Der letzte Mann* of 1924, was carried out. Calling into question the canonical analyses of the film by Siegfried Kracauer and Lotte Eisner, which cast the film as an example of unrelenting change *par excellence*, the central aesthetic components of the film — the *Drehtür* and the “entfesselte Kamera” — were reimagined as fluctuations that actually draw attention to stasis and invariance. In the end, the story of the hotel porter (and indeed the social class he is set up to represent) was shown to be one resembling the Nietzschean “Weltanschauung” that so beguiled Paul Mongré: for all the disguise of unremitting transformation, the misery of the doorman is repeated again and again, even if he is not aware of it. He always was and remains invariantly “der Letzte,” an object of ridicule and scorn. In terms of the bigger picture of the thesis, with transformations becoming secondary to the invariances concealed within, that first proposed tenet of modern mathematical space evidently looms large in this formative moment in Weimar Cinema.

If Chapter 2 sought out in modern German-language culture a parity of expression with modern mathematics on the basis of the topological maxim of invariance within change, then Chapter

3 continued this task in such a way that was cognisant of its fundamental entanglement with the second, wider tenet of modern mathematical space: the ontological void of the enterprise itself. First engaging explicitly with Corry's suggestion of Vienna as a multidisciplinary expression of modernism and Engelhardt's significant work on this topic, this chapter then followed the trail of nothingness through Karl Kraus' sardonic commentary, Robert Musil's call for fiction that takes the "mathematische Mensch" as a unique role model, and the gendered aesthetic of machine humans to the disturbing pseudomathematical reveries of Otto Weininger in *Geschlecht und Charakter* of 1903. In Weininger's treatise, an attempt to describe gender relations and sexual attraction in oddly formulaic terms soon descends into a dogmatic arrangement of binary concepts that casts the female as an infinitely malleable and indeed dangerous "Nichts" — lacking in any fundamental essence, subjective agency or discernible characteristics of her own — in contrast to the unchanging rational man. This rigid scaffold of gendered concepts, I argued, became no less than an experimental *Spielraum* for Viennese author Mela Hartwig with her two convention-defying novels *Das Weib ist ein Nichts* of 1929 and *Bin ich ein überflüssiger Mensch?* of 1931. Revealing herself to be what might be called an "untaught" topologist, Hartwig not only spots but exploits the implicitly topological underpinnings of Weininger's misogynistic concept of womanhood, letting the breakdown of one Weiningerian binary, i.e. invariance vs change, compromise the rest in an unstoppable ripple effect. Building on and refining Bettina Fraisl's observation of the *femme fatale* in Hartwig's prose, it was shown that both Bibiana and Aloisia (while complicating the binary of invariance and change in differing ways) come to utilise their inherent and invariant *Nichtigkeit* and "Überflüssigkeit," finding a destructive agency in their variable capacities to shapeshift. This echoes most clearly the entwined nature of the two-fold *Raumkonzeption* at work in this thesis. Hartwig's two texts become, in short, discussions of invariant spatial properties within change that never lose sight of (and in fact embrace) the ontological emptiness of those very spaces — a finding that underscores, it was argued, the hidden structural invariance of the supposed paradigm shift of "die neue Frau" and its fundamental hollowness as a social concept.

Finally, Chapter 4 took a conceptual step backwards in order to examine in its own right the second, wider tenet of the *Raumproblem*, namely questions of language and ontology. Beginning with Oliver Byrne's colourised version of Euclid's *Elements*, in the first instance, this chapter was concerned with vision and sight. Soon, however, it was able to bear witness to the age-old maxim that appearances can be deceiving. By starting with the modern German design school of Bauhaus, which on a surface level "looks" the most mathematical for its conscious deployment of geometrical language and forms, I proposed that the school's guiding principles

betray an attachment to two specific philosophies that are irreconcilable with mathematical formalism. Wassily Kandinsky and his popular geometrical compositions, replete with odes to the tools of Euclidean construction and forms, were shown to adhere to a Platonist philosophy of mathematical objects and their spatio-temporal abstraction — a claim that was further evidenced when Kandinsky's own theoretical writings were considered. Having used Brown's outline of various philosophical positions in mathematics, a clear opposition to the nominalist thrust of Hilbert's formalism was thus emphasised in the compositional and theoretical works of Kandinsky. As a vehicle to covering more ground in Bauhaus, the contributions of the founder, Walter Gropius, were then briefly assessed, which in turn exposed a conception of mathematical, perceptual and material space that is no different to Kant's from the late 1700s. Chapter 1 already established that Kant's transcendental philosophy was so entrenched that the departure from it in the discipline of mathematics produced the antagonistic "Streit" of the early 1900s — the modernist camp breaking away with great enthusiasm next to the reluctance and foot-dragging of its opponents, finding therein a sense of meaning and purpose. By the 1920s in Weimar, it seems that the ideas of Kant are *still* quite entrenched, informing what the school's director identifies as its central programme for work. While Platonism and Kantian *Anschauung* are by no means the same, they are both wedded to a presumption of some extra-systematic basis, be that in reality or intuition. Ultimately, this should not be too surprising if the Bauhaus "Meister" were indeed directly inspired by Byrne's stylised version of geometry's ancient *Urtext* and not the philosophical and mathematical implications of the alternatives to it that emerged in the late 1800s. Mathematics remains for Bauhaus, in short, a "way of seeing" and perceiving that is rooted in the real world.

Then, the prompt change of direction to Dada accompanied a shift away from a concern for sight and vision to that of *speaking*. If nominalisation is the inverse of Bauhaus philosophy, then a focus on the name and naming processes at work in Dada established a much greater proximity between the "poetry of logical ideas" and very avant-garde realm that *ostensibly* pitches its tent as far away from logic as possible. Reflecting upon Ernst Cassirer's more differentiated assessment of logical forms, the perceived "anti-logical" (*not* "illogical") impulse at work in Dada was shown to be remarkably similar to the *functional* form of logic and concept formation that subverts traditional Aristotelean logic rooted in *substance*. With Cassirer's alternative logic being the very model he attributes to the formal and structural turn in mathematical modernism, the *Antilogik* of Dada becomes a curiously modern-mathematical "way of speaking." Grounding this argument firstly with recourse to discussions of the name alone, a brief glimpse at the wider movement and procedures of nominalisation evidenced further overlap with readymades and

photomontage. Significantly, scholars have already begun to discuss Dadaism with a taxonomy that harmonises unexpectedly well with Mehrtens' *Moderne-Sprache-Mathematik*, for example, which describes in mathematical formalism a deliberate divorce from *any* external reference and meaning — either in material space or the mind's internal field of vision. Finally, having observed the emergence of a common analytical language when “talking about” Dada and mathematical modernism, a closing experiment in translation between homeomorphisms and metapoems was suggested. With some minimal degree of mediation, Dada and topology, the flagship field of modern mathematics, can converse with each other rather well. In a way that somewhat ironically attributes to Mehrtens a clear scholarly *foresightedness* when he foregoes shared fields of vision in favour of “Sprache” and “Sprechen,” it is ultimately in the non-concreteness of language where the most concrete parity of expression across mathematical and aesthetic modernism is situated here.

Let us briefly reflect upon some aspects that fell beyond the scope of this thesis and take stock of their potential role in further explorations into this cross-disciplinary domain. Working in reverse order, while Chapter 4 ultimately sees Bauhaus and Dadaism as being closer to differing mathematical philosophies than they could even be to each other, further research into curious intermediary figures like Kurt Schwitters could indeed provide further nuance. An independent mind best known for his *Merz* periodical and the *Merzbau* sculpture, Schwitters enjoyed “cordial relations” with the Bauhaus pedagogues,⁴ and his work indicates, as Patrizia McBride notes, “imaginative engagement with strategies of disarticulation and assemblage.”⁵ Later on, however, he became something of a fringe Dadaist, with his interactions with Hausmann and other Berlin Dadaists the subject of some scholarly debate.⁶ A cursory glance at Schwitters' collage works alone suffice to reveal aspects that both echo the constructivist, overtly geometrical overtones of Kandinsky and his Russian contemporaries *and* anticipate the more non-sensical, photomontage approach of Hausmann and Höch:

⁴ Kathryn Porter Aichele, *Paul Klee: Poet/Painter* (Rochester, NY: Camden House, 2006), 149. See also Elizabeth Burns Gamard, *Kurt Schwitters Merzbau: The Cathedral of Erotic Misery* (New York: Princeton Architectural Press, 2000), 137.

⁵ Patrizia McBride, *The Chatter of the Visible: Montage and Narrative in Weimar Germany* (Ann Arbor: University of Michigan Press, 2016), 148.

⁶ Cf. Elger, *Dadaism*, 21f.



Figure 5.1: Kurt Schwitters' (constructivist) collages⁷

Moreover, in another cross-pollination of influences and outlooks, Schwitters' musings on poetry and form both gesture towards a constructivist approach of building upwards from *Grundelemente*, but in such a way that is neither seemingly rooted to a particular ontology of these elements nor informed by some criterion for meaningfulness:

Elemente der Dichtkunst sind Buchstaben, Silben, Worte, Sätze. Durch das Werten der Elemente gegeneinander entsteht die Poesie. Der Sinn ist nur wesentlich, wenn er auch als Faktor gewertet wird. Ich werte Sinn gegen Unsinn. Den Unsinn bevorzuge ich, aber das ist eine rein persönliche Angelegenheit.⁸

Indeed, there is a possible parity with “Dada” when it comes to the name “Merz” for Schwitters' independent project: as Shearer West notes, Schwitters “claimed the name Merz was chosen by accident” when he cut the name “Kommerz- und Privatbank” from a newspaper. Following Chapter 4's engagement with the Dada mischief-makers, one might suspect, however, some further sleight of hand here. Is “Merz” another example, therefore, of functional logic and concept formation that is obscured by its apparent nonsensicality? How exactly these hybrid works of Schwitters, falling between the two avant-garde expressions that were treated as quite separate in Chapter 4, fit with the foregoing conclusions could prove to be an intriguing line of inquiry.

⁷ To the left is “Das Unbild” (1919) and to the right is an untitled work from 1925. Reproduced from *Kurt Schwitters* (London: Tate Gallery, 1985), 42ff.

⁸ Kurt Schwitters, *Kurt Schwitters. Das Literarische Werk, Band V: Manifeste und kritische Prosa*, ed. Friedhelm Lach (Cologne: DuMont, 1981), 77.

Moving back to Chapter 3, it could be remarked that the analysis of Hartwig's two novels approaches asymptotically the tricky category of unreliable narration, for both case studies involved at various points reading against the grain of what Hartwig's narrators — both Aloisia and indeed the heterodiegetic narrator of *Das Weib ist ein Nichts* — commit to paper. Coined first by Wayne C. Booth in *The Rhetoric of Fiction* (1961) with respect to his ill-defined notion of the “implied author,”⁹ the concept has undergone many metamorphoses of its own and remains something of a contested narratological *Raumproblem* itself. Be it by way of Ansgar Nünning's reconceptualization of the term as an *extratextual* cognitive process in the mind of the reader¹⁰ or Tom Kindt's *intratextual* phenomenon ground entirely in textual inconsistencies,¹¹ the concept itself rests upon a textual manifestation of a familiar topological couple: the distinction between the inside and outside of a given space. By formalising the use of this well-known but often truncated concept here, an interesting vocabulary for the analysis of Hartwig's work could emerge, and indeed it would better align her prose with the novels of her aforementioned mathematically trained compatriot Leo Perutz, which have been analysed in this light. Indeed, keeping the medium of film from Chapter 2 in mind, re-reading the film against the grain of its narrative arc was part and parcel of the analysis there too. If the camera in a film is ultimately the narrator, as narratology would have it, then there is a narrator in *Der letzte Mann* that constantly draws attention to its own story-telling capacity, both via its portability and the aesthetic of turning and revolving, just like the 1920s film camera and its quietly rotating film reel. This framing would allow for the consideration of another landmark contribution to Weimar Cinema, itself a story of frames, namely Robert Wiene's *Das Cabinet des Dr. Caligari* (1920) — one of the few discernible cinematic manifestations of narrative unreliability.

Furthermore, by zooming in on a historically side-lined writer like Mela Hartwig, with her work rejected in a devolving political climate and soon forced into exile with the *Anschluss* looming, it is also hoped that this demonstration can lay foundations for further comparative work examining other “vergessene Autorinnen.” In her own study, which sticks with Austrian examples alone, Fraisl even offers the names of a few female writers who likewise ran up against overtly gendered discourses of their time, such as Marta Karlweis, Maria Lazar, Frederike Maria Winternitz, Alma Johanna Koenig, Therese Rie and Else Feldmann.¹² Political exile from German-speaking territories is, of course, a spectre that haunts the development of modern

⁹ Wayne C. Booth, *The Rhetoric of Fiction* (Chicago and London: University of Chicago Press, 2010), 158f.

¹⁰ Ansgar Nünning, “Unreliable, Compared to What? Towards a Cognitive Theory of Unreliable Narration,” in *Grenzüberschreitungen: Narratologie im Kontext*, ed. Walter Grünzweig and Andreas Solbach (Tübingen: Gunter Narr Verlag, 1999), pp. 53-74.

¹¹ Tom Kindt, *Unzuverlässiges Erzählen und literarische Moderne* (Berlin: Walter de Gruyter, 2008).

¹² Fraisl, afterword to *Bin ich ein überflüssiger Mensch?*, 163.

mathematics across the Western world. Foregrounding the attendant impact of cultural transfer (often to the US or Britain) could present itself as a useful way to not only find further correspondence between modern mathematics and literary, visual and cinematic modernism but also to shed necessary light on often overlooked figures in the process. To raise the issue of exile, however, is of course to circle back to one particular methodological quandary in the introduction. While this dissertation, as was noted above, settled for practical reasons on *local* manifestations of mathematical and cultural modernism, i.e. arising in Germany and Austria, this was not for lack of sympathy with Gray's wish to chart a more international and multilingual basis for a cross-cultural comparison. As a final musing on possible inroads into further research, it is worth noting some recent trends in modernism studies to this effect that have surprising counterparts in the writing of history of mathematics.

Often in response to Jürgen Habermas' "incomplete modernity,"¹³ efforts to historicise modernism over the past decade or so have called its commonly used temporal markers into question to explain why the epoch is, as Tony Pinkney vividly suggests, "recalcitrantly unperiodizing."¹⁴ More often than not, scholarly responses have thus tried to incorporate and account for more contemporary literary interventions that could then be included in a more temporally expansive modernist project, often citing "Kafkaesque," "Joycean" and "Beckettian" revivals in the works of Ian McEwan, W.G. Sebald and J.M. Coetzee, John Banville, and Anna Burns, for example.¹⁵ There are obvious pitfalls at play here. As Aarthi Vadde points out, such approaches tend to conflate both individual authors and their particular styles or narrative devices with broader movements, suggesting that the presence of literary influences associated with modernism alone is enough to constitute "late" and "neo" manifestations thereof.¹⁶ To address this, some scholars have begun to subordinate the question of modernism's temporal limits to the question regarding its spatial ones, with Susan Stanford Friedman calling for "planetary modernisms" and Laura Doyle and Laura Winkiel putting forward

¹³ Jürgen Habermas, "Modernity: An Incomplete Project," in *Postmodern Culture*, ed. Hal Foster (London: Pluto, 1985).

¹⁴ Tony Pinkney, introduction to Raymond Williams, *The Politics of Modernism: Against the New Conformists* (London: Verso, 2007). See, for example: David James, *The Legacies of Modernism: Historicising Postwar and Contemporary Fiction* (Cambridge: Cambridge University Press, 2012); and Jean Michel Rabeté and Angeliki Spiropoulou, eds., *Historical Modernisms: Time, History and Modernist Aesthetics* (London: Bloomsbury Academic, 2022).

¹⁵ For two recent examples that focus on the epochal belatedness of modernism, see Ian Ellison's discussions of W.G. Sebald and Patrick Modiano in *Late Europeans and Melancholy Fiction at the Turn of the Millennium* (Cham: Palgrave MacMillan, 2022); and John Greaney's discussion of Eimear McBride and Anna Burns in the epilogue to *The Distance of Irish Modernism* (London: Bloomsbury Academic, 2022).

¹⁶ Aarthi Vadde, "Scalability," *Modernism/Modernity Print+* 2, no. 4 (2018): <https://doi.org/10.26597/mod.0035>, accessed November 13, 2022.

“geomodernisms.”¹⁷ In her own discussion of modernism’s geographical “scalability,” Vadde asks a question that is inadvertently *mathematically* modernist — more specifically, topological — in nature: can modernism be scaled or stretched outwards from its supposed European centre in such a way that it does not lose its structural integrity as a meaningful concept? Noting the critiques of several postcolonial scholars, she suggests that such approaches risk being “epistemologically colonizing” as well as “conceptually diluted,” enveloping non-European cultural production within an explicitly European framework. As such, Vadde views *positively* the fact that modernism may scale rather poorly: this gestures to a less “axiomatic,” more “conjunctural” understanding, by which modernism becomes a more nuanced cultural “temperament [...] and set of relationships with modernity.”¹⁸ Indeed, many of these observations echo the misgivings around Gray’s insistence upon definitions in his elucidation of mathematical modernism; in order to work outwards, these reflections would suggest that “axiomatic” definitions ought to be dispensed with.

As it happens, the history of mathematics is no stranger to inspired attempts to challenge the Eurocentric lens through which (modern) mathematics is normally viewed. Recently, Irish-Nigerian scholar Emma Dabiri, in her bid to destabilise engrained myths of European superiority in *Don’t Touch My Hair* (2019), ultimately turns towards mathematical ways of thinking that “are largely ignored [when] the origins are located with the Greeks,” namely in “African, Arab and Chinese mathematical systems.”¹⁹ Drawing on the largely side-lined works on “ethnomathematics” by Claudia Zaslavsky in the 1970s and Ron Eglash in the 1990s,²⁰ both of which uncover highly complex understandings of symmetry, pattern, recursion, and infinitude in forms of ancient design across the African continent, Dabiri links the study of fractals to traditional hair-braiding patterns in Cameroonian and Yoruba culture.²¹ The implications for the term “modern” are not lost on Dabiri: “Fractals are found throughout indigenous African design yet were only ‘discovered’ by Europeans in 1975, when a Polish

¹⁷ Susan Stanford Friedman, *Planetary Modernisms: Provocations on Modernity Across Time* (New York: Columbia University Press, 2015); and Laura Doyle and Laura Winkiel, eds., *Geomodernisms: Race, Modernism, Modernity* (Bloomington: Indiana University Press, 2005).

¹⁸ Vadde, “Scalability.”

¹⁹ Dabiri, *Don’t Touch My Hair*, 21.

²⁰ Claudia Zaslavsky, *Africa Counts: Number and Pattern in African Cultures* (Boston: Prindle, Weber and Schmidt, 1973). Written principally for schoolteachers of mathematics as an educational tool, Zaslavsky undercuts many dominant narratives that primitivise African intellectual culture by severing it from any discussions of mathematical development and thought. In his contributions, Eglash suggests how these complex presentations of patternicity and recursion anticipate key tenets of computing. Ron Eglash, *African Fractals: Modern Computing and Indigenous Design* (New Jersey: Rutgers University Press, 1999).

²¹ Dabiri, *Don’t Touch My Hair*, 227ff.

mathematician, Benoit Mandelbrot, invented the word.”²² Mandelbrot’s fractals, Dabiri is well aware, were developed using the scandalous re-imagination of infinity by Georg Cantor in the mid-to-late 1800s that served as a catalyst for the changes in the concept of number (and indeed space) in modern mathematics thereafter.²³ Upsetting standard timelines in the history of mathematics, Dabiri expresses the dichotomy in somewhat colourful prose: “Until the disruptive Cantor came along,”²⁴ she writes, “since Aristotle, European mathematicians had disregarded the concept of infinity as basically too much of a head-fuck to contend with. Yet Africans have been casually repping it throughout their design culture for centuries.”²⁵ Not only do these important studies challenge pre-conceived ideas of European “discoveries” in mathematical modernisation, Dabiri also bridges with remarkable ease mathematical ideas and questions of design and creativity. In this broader context, it is simply more natural to do so, and this should not be surprising, because symmetry, pattern, recursion, and infinitude are explicitly aesthetic concerns as well. Importantly, Dabiri is not alone in her efforts, for more recent scholarship in the history of mathematics has seen a renewed interest in the intellectual labour of Zaslavsky and has begun to challenge the restrictive standards of the European mathematical canon, which marginalise alternative forms of mathematical thought from outside of the Western world.²⁶ While the use of the term “modernism” in a mathematical sense becomes ever more fraught, in each and every case, the proximity between mathematics and aesthetics and creativity is significantly smaller than in the more dominant discourses using Western sources alone. As such, while it is a no doubt monumental task, by better relating scholarly efforts both in literary criticism and in the history of mathematics, another rich, stimulating and diverse comparison of mathematics and creative arts could feasibly arise.

To conclude, this dissertation began with a discussion of various manifestations of lines in the sand, from those of ancient etchings in the ground by Archimedes, to temporal ones in the history of geometry that soon slipped into ideological ones with “Deutsche Mathematik.” These

²² Ibid., 224. This echoes of course the issue of names and naming in Weigel’s discussion of the Waldseemüller map in Chapter 2.

²³ While not naming them until 1975, Mandelbrot first draws attention the structures in his famous paper “How Long Is the Coast of Britain? Statistical Self-Similarity and Fractional Dimension,” *Science* 156 (1967): pp. 636-638. With some serendipity, Mandelbrot’s work is also heavily indebted to the dimension analysis of Felix Hausdorff, an area he explored through the 1920s on the back of his topological studies.

²⁴ Dabiri, *Don’t Touch My Hair*, 209.

²⁵ Ibid., 226.

²⁶ Karine Chemla has been particularly pro-active with respect to Chinese mathematical traditions. See, for example, “Documenting a process of abstraction in the mathematics of ancient China” in *Studies in Chinese Language and Culture*, ed. Christoph Anderl and Halvor Eifring (Oslo: Hermes Academic Publishing, 2006), pp. 169-194; and *The History of Mathematical Proof in Ancient Traditions* (Cambridge: Cambridge University Press, 2012). For studies into Islamic practice, see Jay Bonner, *Islamic Geometric Patterns: Their Historical Development and Traditional Methods of Construction* (New York: Springer, 2017).

then set up the particular line in the sand that this thesis sought to problematise: the disciplinary one that maps onto the divide between Snow's "two cultures," separating mathematics and the empirical sciences (often collectivised as STEM) from the humanities. At this stage, following an extensive exercise in uncovering common moments of philosophical influence behind modernist art and modern mathematics and exploring parity of spatial expression across them, it might be asked: what has become of this line? It has evidently *not* been erased, and this ultimately was not the aim of this thesis, which knowingly says very little about the workings of the natural sciences. By way of analogy, consider for a moment a novel from a much more recent context than the epoch covered in this dissertation: Northern Irish writer Anna Burns' *Milkman* 2018. While a discussion as to the novel's potentially neo-modernist nature, as has been proposed by scholars in light of certain stylistic features and formal complexity, will not be carried forward here, there are instances of overlap with this many ideas in thesis. Set in an anxiety-inducing state of permanent brinkmanship and knife-edge tension in an unnamed city that is often taken to be mid-1970s Belfast, *Milkman* is no stranger to ideological and arbitrary lines in the sand, or to empty, desolate and perplexing spaces of such abstraction that they can only be described in temporal terms, like "the ten-minute area," or to the curious functions of names and naming.²⁷ For now, however, let us consider the musings of the incisive narrator cited at the beginning of this conclusion, in which she diagnoses an apparently wide-spread problem in her dystopian environment: "the wrong-spouse business." In her mind, many of the characters around, from her parents, third brother and tablets girl's sister to potentially herself with maybe-boyfriend, are in the wrong marriage or relationship. Now, at the close of this dissertation, is it possible that something analogous is afoot in this cross-disciplinary account? At risk of being overly provocative, perhaps the story of mathematics is that, at a certain point, it came to realise that its age-old marriage to physics and natural sciences was in fact the *wrong* one. With little common *Grund* left after the disruptive events of the mid-1800s, mathematical modernism might be viewed as something of a divorce (however amicable) and subsequent discovery of the potentially *right* spouse in the arts. The mathematician, as was seen here, proved to be at her most productive, imaginative and boundlessly creative in a new relationship. Far from the erasure of a line, perhaps mathematics has simply crossed one, recognising that it would likely flourish with a new spouse, one who recognises mathematics for what it is: *reine Geisteswissenschaft*.

²⁷ "The banned names were understood to have become infused with the energy, the power of history, the age-old conflict, enjoinders and resisted impositions as laid down long ago in this country by that country, with the original nationality of the name now not in the running at all." Burns, *Milkman*, 23.

Bibliography

- Agamben, Giorgio. *Homo Sacer: Sovereign Power and Bare Life*, translated by Daniel Heller-Roazen. Stanford: Stanford University Press, 1998.
- . *The Fire and the Tale*. Translated by Lorenzo Chiesa. Stanford: Stanford University Press, 2017.
- Aichele, Kathryn Porter. *Paul Klee: Poet/Painter*. Rochester, NY: Camden House, 2006.
- Albrecht, Andrea. “Mathematische und ästhetische Moderne: Zu Robert Musil’s Essay ‘Der mathematische Mensch.’” *Scientia Poetica* 12 (2008): 218-251.
- . *Die Mathematik im ‘Diesseits der Kultur’: Literaturwissenschaftliche und wissenschaftsgeschichtliche Studien zur kulturellen Repräsentation des Mathematischen*. Manuscript, Universität Freiburg, 2011.
- Anderson, Susan C. “Otto Weininger’s Masculine Utopia.” *German Studies Review* 19, no. 3 (1996): 433-453.
- Anz, Thomas. “Über einige Missverständnisse und andere Fragwürdigkeiten in Anke-Marie Lohmeiers Aufsatz ‘Was ist eigentlich modern?’” *Internationales Archiv für Sozialgeschichte der deutschen Literatur* 33, no. 1 (2008): 227-232.
- . *Literatur des Expressionismus*. Stuttgart and Weimar: J. B. Metzler Verlag, 2010.
- Arana, Andrew. “Review of Jeremy Gray’s *Plato’s Ghost*.” *Philosophia Mathematica* 20, no. 2 (2012): 252-255.
- Aschheim, Steven. *The Nietzsche Legacy in Germany, 1890-1990*. Berkeley and London: University of California Press, 1994.
- Austad, Jonathan. “From Dada to Nada.” In *Paris in American Literatures: On Distance as a Literary Resource*, edited by Jeffrey Herlihy-Mera and Vamsi K. Koneru, 53-68. Madison: Fairleigh Dickinson University Press, 2013.
- Bachmann, Ingeborg. *Wir müssen wahre Sätze finden. Gespräche und Interviews*. Munich: Piper Verlag, 1983.
- Bannister, Floris. “Revolutions in Time, Space, and Art.” *UNIversitas* 7, no. 1 (2012): 1-6.
- Barron, Stephanie, ed. *Degenerate Art: The Fate of the Avant-Garde in Nazi Germany*. New York: Harry N. Abrams Inc., 1991.
- Barrow-Green, June, Jeremy Gray, and Robin Wilson. *The History of Mathematics: A Source-Based Approach, Volume 2*. Rhode Island: MAA Press, 2022.
- Bay-Cheng, Sarah and Barbara Cole, eds. *Poets at Play: An Anthology of Modernist Drama*. Cranbury, NJ: Associated University Presses, 2010.
- Bayer, Thora Ilin. *Cassirer’s Metaphysics of Symbolic Forms: A Philosophical Commentary*. New Haven: Yale University Press, 2008.
- Beller, Steven. “How Modern was Viennese Modernism? The Historical Context of Otto Weininger’s Critique of Modernity.” *German Politics and Society* 14, no. 4 (1996): 83-98.
- Benjamin, Walter. *Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit*. Frankfurt am Main: Suhrkamp, 2003.

- Bergmann, Birgit, Moritz Epple, and Ruti Ungar, eds. *Transcending Tradition: Jewish Mathematicians in German-Speaking Academic Culture*. Berlin and Heidelberg: Springer, 2012.
- Bernstein, Eckard. *Culture and Customs of Germany*. Connecticut: Greenwood Press, 2004.
- Biagioli, Francesca. *Space, Number, and Geometry from Helmholtz to Cassirer*. Cham: Springer International, 2016.
- Biro, Matthew. *The Dada Cyborg: Visions of the New Human in Weimar Berlin*. Minneapolis: University of Minnesota Press, 2009.
- Black, Jeremy. *Maps and Politics*. London and Chicago: University of Chicago Press, 1997.
- Blasber, Cornelia. "A City 'Under Glass': Vienna in Robert Musil's *The Man without Qualities*." In *Vienna: The World of Yesterday*, edited by Stephen Erich Bronner and F. Peter Wagner, 150-167. New York: Humanity Books, 1999.
- Blåsjö, Viktor. "Rationalism 2.0: Kant's Philosophy of Geometry." November 18, 2021. In *Intellectual Mathematics*, produced by Viktor Blåsjö, podcast, MP3 audio, 29:59.
- . *Transcendental Curves in the Leibnizian Calculus*. Cambridge, MA: Elsevier, 2017.
- Blum, Mark E. *Phenomenology and Historical Thought: Its History as a Practice*. Berlin: Walter de Gruyter, 2022.
- Bonner, Jay. *Islamic Geometric Patterns: Their Historical Development and Traditional Methods of Construction*. New York: Springer, 2017.
- Booth, Wayne C. *The Rhetoric of Fiction*. Chicago and London: University of Chicago Press, 2010.
- Boswell, Peter W., ed. *The Photomontages of Hannah Höch*. Minneapolis: Walker Art Center and University of Michigan Press, 1996.
- Boyer, Carl, and Uta Merzbach. *The History of Mathematics*. New Jersey: Wiley, 2011.
- Bredeck, Elizabeth. "Fritz Mauthners Nachlese zu Nietzsches Sprachkritik." *Nietzsche-Studien* 13, no. 2 (1984): 587-599.
- Brieskorn, Egbert, ed. *Felix Hausdorff zum Gedächtnis — Aspekte seines Werkes, Band I*. Munich: Teubner Verlag, 2013.
- Brits, Baylee. *Literary Infinities: Number and Narrative in Modern Fiction*. London: Bloomsbury, 2018.
- Broch, Hermann. *Das Dichterische Werk: Kommentierte Werkausgabe. Teil I*, edited by Paul Michael Lützeler. Frankfurt am Main: Suhrkamp, 2011.
- Brown, James Robert. *Philosophy of Mathematics: A Contemporary Introduction to the World of Proofs and Pictures*. London and New York: Routledge, 2010.
- Bru, Sascha. *The European Avant-Gardes, 1905-1935: A Portable Guide*. Edinburgh: Edinburgh University Press, 2018.
- Brubaker, Anna. "'Numbers Have Such Pretty Names': Gertrude Stein's Mathematical Poetics." In *The Palgrave Handbook of Literature and Mathematics*, edited by Robert Tubbs, Nina Engelhardt, and Alice Jenkins, 339-360. Cham: Palgrave Macmillan, 2021.
- Burns, Anna. *Milkman*. London: Faber and Faber, 2018.
- Byrne, Oliver. *The First Six Books of the Elements of Euclid in Which Coloured Diagrams and Symbols Are Used Instead of Letters for the Greater Ease of Learners*, edited by Werner Oechslin. Cologne: Taschen Bibliotheca Universalis, 2017.
- C.P. Snow, *The Two Cultures*. Cambridge: Cambridge University Press, 1998.

- Cabanne, Pierre. *Dialogues with Marcel Duchamp*. New York: Viking Press, 1971.
- Cassirer, Ernst. *Substanzbegriff und Funktionsbegriff*. Berlin: Verlag von Bruno Cassirer, 1910.
- Cellucci, Carlo. *Rethinking Logic: Logic in Relation to Mathematics, Evolution, and Method*. Dordrecht, Heidelberg and New York: Springer, 2013.
- Chemla, Karine. "Documenting a process of abstraction in the mathematics of ancient China." In *Studies in Chinese Language and Culture*, edited by Christoph Anderl and Halvor Eifring, 169-194. Oslo: Hermes Academic Publishing, 2006.
- . *The History of Mathematical Proof in Ancient Traditions*. Cambridge: Cambridge University Press, 2012.
- Cheng, Eugenia. *Beyond Infinity: An Exploration to the Outer Limits of the Mathematical Universe*. London: Profile Books, 2017.
- . *$x + y$: A Mathematician's Manifesto for Rethinking Gender*. London: Profile Books, 2020.
- Cirafici, Alessandra. "Rappresentazione e processi noetici: 'magnifica evidenza' del disegno / Representation and Noetic Processes: 'Beautiful Evidence' of Drawing." In *Elogio della teoria. Identità delle discipline del disegno e del rilievo / In Praise of Theory. The Fundamentals of the Disciplines of Representation and Survey*, edited by Monica Filippa and Laura Carlevaris (Rome: Gangeni Editore spa, 2012).
- Collier, Jo Leslie. *From Wagner to Murnau: The Transposition of Romanticism from Stage to Screen*. Ann Arbor: UMI Research Press, 1988.
- Colyvan, Mark. *An Introduction to the Philosophy of Mathematics*. Cambridge and New York: Cambridge University Press, 2012.
- Corry, Leo. "Development of the Idea of Proof." In *The Princeton Companion to Mathematics*, edited by Timothy Gowers, June Barrow-Green, and Imre Leader, 129-142. Princeton and Oxford: Princeton University Press, 2008.
- . "How Useful Is The Term 'Modernism' for Understanding the History of Early Twentieth-Century Mathematics?" In *Modernism in the Sciences, ca. 1900-1940*, edited by Moritz Epple and Falk Mueller. Berlin: Akademie Verlag, forthcoming.
- Cox, Christoph. *Nietzsche: Naturalism and Interpretation*. Berkeley: University of California Press, 1999.
- Dabiri, Emma. *Don't Touch My Hair*. New York and London: Penguin Random House, 2019.
- De Budt, Hanna. "Polarisierung, Parzellierung und Emotionalität bei der vergessenen Autorin Mela Hartwig: Eine genderkritische Motivanalyse." Thesis, University of Ghent, Belgium, 2016.
- De Duve, Thierry. "A Critique of Pure Modernism." In *The Duchamp Effect*, edited by Martha Buskirk and Mignon Nixon, 93-129. Cambridge, MA: MIT Press, 1999.
- . Thierry. *Pictorial Nominalism: On Marcel Duchamp's Passage from Painting to the Readymade*. Minneapolis: University of Minnesota Press, 2005.
- De Toffoli, Silvia. "What are Mathematical Diagrams?" *Synthese* 200, no. 1 (2022): 1-29.
- Dick, Auguste. *Emmy Noether, 1882-1935*. Boston: Birkhäuser, 1981.
- Dicker, Barnaby. "Review: *Dada and Beyond*." *Modern Language Review* 8, no. 4 (2013): 1287-1289.
- Dickermann, Leah Brigid Doherty, Centre Georges Pompidou, National Gallery of Art (U.S.), Museum of Modern Art (New York, N.Y.). *Dada: Zurich, Berlin, Hannover,*

- Cologne, New York, Paris. Washington: National Gallery of Art and D.A.P Press, 2006.
- Diethe, Carol. *Nietzsche's Sister and the Will to Power: A Biography of Elizabeth Förster-Nietzsche*. Urbana and Chicago: University of Illinois Press, 2003.
- Donahue, Neil H., ed. *A Companion to the Literature of German Expressionism*. New York: Camden House, 2005.
- Doyle, Arthur Conan. *A Study in Scarlet*. New York: Cosmico, 2011.
- Doyle, Laura and Laura Winkiel. *Geomodernisms: Race, Modernism, Modernity*. Bloomington: Indiana University Press, 2005.
- Dyck, Martin. *Novalis and Mathematics: A Study of Friedrich von Hardenberg's Fragments on Mathematics and its Relation to Magic, Music, Religion, Philosophy, Language, and Literature*. New York: AMS Press, 1969.
- Ebner, Christopher. *Sprachskepsis und Sprachkrise: Fritz Mauthners Sprachphilosophie im Kontext der Moderne*. Hamburg: Diplomica Verlag, 2014.
- Ebner, Ferdinand. *Das Wort und die geistigen Realitäten*. Innsbruck: Brenner-Verlag, 1921.
- Eglash, Ron. *African Fractals: Modern Computing and Indigenous Design*. New Jersey: Rutgers University Press, 1999.
- Eisner, Lotte. *Die dämonische Leinwand*. Frankfurt am Main: Fischer Taschenbuch Verlag, 1980.
- *F.W. Murnau*. Paris: Le Terrain Vague, 1964.
- *Murnau*. London: Seeker and Warburg, 1973.
- Elam, Kimberley. *Geometry of Design: Studies in Proportion and Composition*. New York: Princeton Architectural Press, 2001.
- Elger, Dietmar. *Dadaism*. London and Cologne: Taschen, 2004.
- Ellison, Ian. *Late Europeans and Melancholy Fiction at the Turn of the Millennium*. Cham: Palgrave MacMillan, 2022.
- Elsaesser, Thomas. *Weimar Cinema and After: Germany's Historical Imaginary*. London and New York: Routledge, 2000.
- Engelhardt, Nina. "Modern by numbers: modern mathematics as a model for literary modernism." In *Being Modern: The Cultural Impact of Science in the Early Twentieth Century*, edited by Robert Bud, Paul Greenhalgh, Frank James and Morag Shiach, 169-187. London: UCL Press, 2018.
- *Modernism, Fiction and Mathematics*. Edinburgh: Edinburgh University Press, 2019.
- Epple, Moritz. "Felix Hausdorff's Considered Empiricism." In *The Architecture of Modern Mathematics*, edited by Jeremy Gray and José Ferreirós, 263-290. Oxford: Oxford University Press, 2006.
- "Styles of Argumentation in Late 19th-Century Geometry and the Structure of Mathematical Modernity." In *Analysis and Synthesis in Mathematics: History and Philosophy*, edited by Marco Panza and Michael Otte, 177-198. Dordrecht: Kluwer, 1997.
- Euclid. *The Thirteen Books of the Elements*, edited by Thomas Heath, translated by Thomas Heath. Cambridge: Cambridge University Press, 1968.
- Eves, Howard. *Foundations and Fundamental Concepts of Mathematics*. New York: Dover, ³1997.

- Eysteinnsson, Astradur. *The Concept of Modernism*. Ithaca and London: Cornell University Press, 1992.
- Fähnders, Walter. “Über zwei Romane, die 1933 nicht erscheinen durften. Mela Hartwigs *Bin ich ein überflüssiger Mensch?* und Ruth Landshoff-Yorcks *Roman einer Tänzerin*.” In *Regionaler Kulturraum und intellektuelle Kommunikation vom Humanismus bis ins Zeitalter des Internet*, edited by Axel E. Walter, 161-190. Amsterdam and Atlanta: Rodopi, 2004.
- Ferreirós, José. “The Crisis in the Foundations of Mathematics.” In *The Princeton Companion to Mathematics*, edited by Timothy Gowers, June Barrow-Green, and Imre Leader, 142-156. Princeton and Oxford: Princeton University Press, 2008.
- Fletcher, Angus. *The Topological Imagination: Spheres, Edges and Islands*. Cambridge, MA: Harvard University Press, 2016.
- Forcer, Stephen. “Beyond Mental: Avantgarde Culture and War.” In *Aftermath: Legacies and Memories of War in Europe, 1918–1945–1989*, edited by Nicholas Martin, Tim Houghton and Pierre Purseigle, 85-108. Surrey: Ashgate, 2014.
- . *Dada as Text, Thought and Theory*. Cambridge and New York: Legenda, 2017.
- Foucault, Michel. “Of Other Spaces,” translated by Jan Miskowiec. *Diacritics* 16, no. 1 (1986): 22-27.
- Fraisl, Bettina. Afterword to *Bin ich ein überflüssiger Mensch?*. Graz: Droschl, 2001.
- . Afterword to *Das Weib ist ein Nichts*. Graz: Literaturverlag Droschl, 2002.
- . *Körper und Text: (De-)Konstruktionen von Weiblichkeit und Leiblichkeit bei Mela Hartwig*. Vienna: Passagen Verlag, 2002.
- Freeman, Joel. “Ernst Bloch and Hugo Ball: Toward an Ontology of the Avant-Garde.” In *Dada Culture: Critical Texts on the Avant-Garde*, edited by Dafydd Jones, 223-253. Amsterdam and New York: Rodopi, 2006.
- Freud, Sigmund. *Das Unheimliche*, edited by Oliver Jahraus. Stuttgart: Reclam, 2020.
- Freudenthal, Gideon. “The Missing Core of Cassirer’s Philosophy: Homo Faber in Thin Air.” In *Symbolic Forms and Cultural Studies: Ernst Cassirer’s Theory of Culture*, edited by Cyrus Hamlin and John Michael Krois, 203-226. New Haven: Yale University Press, 2004.
- Friedman, Michael. “Kant on Geometry and Experience.” In *Mathematizing Space: The Objects of Geometry from Antiquity to the Early Modern Age*, edited by Vincenzo De Risi, 275-309. Cham: Springer International, 2015.
- . “Kant’s Theory of Geometry.” *The Philosophical Review* 94, no. 4 (1985): 455-506.
- Friedman, Susan Stanford. *Planetary Modernisms: Provocations on Modernity Across Time*. New York: Columbia University Press, 2015.
- Galison, Peter. “Aufbau/Bauhaus: Logical Positivism and Architectural Modernism.” *Critical Inquiry* 16 (1990): 709-752.
- Gamard, Elizabeth Burns. *Kurt Schwitters Merzbau: The Cathedral of Erotic Misery*. New York: Princeton Architectural Press, 2000, 137.
- Gehler, Fred, and Ulrich Kasten. *Friedrich Wilhelm Murnau*. Berlin: Henschelverlag Kunst und Gesellschaft, 1990.
- Genecov, Max. “The Man Behind the New Man.” *JSTOR Daily*, October 10, 2018.

- George, Alys X. *The Naked Truth: Viennese Modernism and the Body*. Chicago and London: University of Chicago Press, 2021.
- Gertrude Stein. *Writings, Volume 1: 1903–1932*, edited by Catharine R. Stimpson and Harriet Chessman. New York: Library of America, 1998.
- Gomel, Elana. *Narrative Space and Time: Representing Impossible Topologies in Literature*. New York and London: Routledge, 2014.
- Gooding-Williams, Robert. “Zarathustra’s Three Metamorphoses.” In *Nietzsche as Postmodernist: Essays Pro and Contra*, edited by Clayton Koelb, 231-246. Albany, NY: State University of New York Press, 1990.
- Gray, Jeremy. “Geometry.” In *The Princeton Companion to Mathematics*, edited by Timothy Gowers, June Barrow-Green, and Imre Leader, 83-95. Princeton and Oxford: Princeton University Press, 2008.
- . *Plato’s Ghost: The Modernist Transformation of Mathematics*. Princeton, NJ: Princeton University Press, 2008.
- Greaney, John. *The Distance of Irish Modernism*. London: Bloomsbury Academic, 2022
- Greenberg, Clement. “Modernist Painting.” In *The Collected Essays and Criticism, Volume 4: Modernism with a Vengeance, 1957-1969*, edited by John O’Brian, 85-93. Chicago: University Of Chicago Press, 1985.
- Grimm, Jacob and Wilhelm. “Sneewittchen, nach Grimm.” In *Das Buch Der Schönsten Kinder- und Volksmärchen, Sagen und Schwänke*, edited by Ernst Lausch, 10-12. Leipzig: Otto Spamer, 1891.
- Gropius, Walter. “Idee und Aufbau des staatlichen Bauhauses.” In *Staatliches Bauhaus Weimar 1919-1923*, edited by Walter Gropius, 7-18. Munich and Weimar: Bauhaus Verlag, 1923.
- Günzel, Stephan. “Spatial Turn-Topographical Turn-Topological Turn.” In *Spatial Turn: Das Raumparadigma in den Kultur- und Sozialwissenschaften*, edited by Jörg Döring and Tristan Thielmann, 219-237. Bielefeld: Transcript, 2009.
- Habermas, Jürgen. “Modernity: An Incomplete Project.” In *Postmodern Culture*, edited by Hal Foster, 3-15. London: Pluto, 1985.
- Hanna, Robert. *Cognition, Content, and the A Priori: A Study in the Philosophy of Mind and Knowledge*. Oxford: Oxford University Press, 2015.
- Haaparanta, Leila. “The Relations between Logic and Philosophy, 1874-1931,” in *The Development of Modern Logic*, edited by Leila Haaparanta, 222-261. New York: Oxford University Press, 2009.
- Hartwig, Mela. *Bin ich ein überflüssiger Mensch?*. Graz: Droschl Verlag, 2001.
- . *Das Weib ist ein Nichts*. Graz: Droschl Verlag, 2002.
- Hausdorff, Felix. Correspondence in “Kommentar zu ‘Sprachkritik.’” *Felix Hausdorff - Gesammelte Werke Band VIII: Literarisches Werk*, edited by Friedrich Vollhardt and Udo Roth, 581-658. Berlin, Heidelberg and New York: Springer, 2010.
- . “Das Raumproblem.” In *Felix Hausdorff - Gesammelte Werke, Band VI: Geometrie, Raum und Zeit*, edited by Moritz Epple, 279-303. Berlin, Heidelberg and New York: Springer, 2021.
- . *Grundzüge der Mengenlehre*. Leipzig: Veit and Comp, 1914.

- Heath, Thomas. Introduction to *The Thirteen Books of the Elements*, edited by Thomas Heath, translated by Thomas Heath, 1-143. Cambridge: Cambridge University Press, 1968.
- Heidegger, Martin. *Nietzsche, Band II*. Pfullingen: Günther Neske Verlag, 1961.
- Henderson, Linda. "Abstraction, the Ether, and the Fourth Dimension: Kandinsky, Mondrian, and Malevich in Context." *Internalia Magazine* 61 (2020): <https://www.interaliomag.org/issue/thought-forms>.
- . *The Fourth Dimension and Non-Euclidean Geometries in Modern Art*. Cambridge, MA: MIT Press, 1998.
- Hervás y Heras, Josenia. *Las mujeres de la Bauhaus: de lo bidimensional al espacio total*. Buenos Aires: Diseño Editorial, 2015.
- Hilbert, David. "Über das Unendliche." *Mathematische Annalen* 95, no. 1 (1926): 161-190.
- . *Grundlagen der Geometrie*. Leipzig: Teubner Verlag, 1903.
- . *The Foundations of Geometry*, translated by E.J. Townsend. La Salle: Open Court Publishing, 1950.
- Hill, Jess. *See What You Made Me Do: Power, Control and Domestic Abuse*. Carlton, Australia: Black Inc., 2019.
- Hintikka, Jaakko. "Kant on the Mathematical Method." *The Monist* 51, no. 3 (1967): 352-375.
- Hofmann, E.T.A. *Der Sandmann*. Stuttgart: Reclam, 2003.
- Jackson, Kevin. *Nosferatu (1922): Eine Symphonie des Grauens*. London: Bloomsbury, 2018.
- James, David. *The Legacies of Modernism: Historicising Postwar and Contemporary Fiction*. Cambridge: Cambridge University Press, 2012.
- Janik, Allan, and Stephen Edelston Toulmin. *Wittgenstein's Vienna*. New York: Simon and Schuster, 1973.
- Jenkins, Alice. "Non-Normative Euclidean: Victorian Literature and the Untaught Geometer." In *The Palgrave Handbook of Literature and Mathematics*, edited by Robert Tubbs, Nina Engelhardt, and Alice Jenkins, 81-96. Cham: Palgrave Macmillan, 2021.
- Jones, Dafydd. *Dada 1916 in Theory: Practices of Critical Resistance*. Liverpool: Liverpool University Press, 2014.
- ed., *Dada Culture: Critical Texts on the Avant-Garde*. Amsterdam and New York: Rodolpi, 2006.
- Jongsma, Calvin. "Plato's Ghost: The Modernist Transformation of Mathematics (Book Review)." *Perspectives on Science and Christian Faith* 61, no. 4 (2009): 265-266.
- Joyce, James. *Ulysses*. St Ives: Wordsworth Classics, 2010.
- Jung, Carl. *The Quotable Jung*, edited by Judith R. Harris. Princeton: Princeton University Press, 2016.
- Kafka, Franz. *Die Verwandlung*. In *Die Erzählungen*, edited by Roger Hermes, 96-161. Frankfurt am Main: Suhrkamp, ¹¹2010.
- . *In der Strafkolonie*. In *Die Erzählungen*, edited by Roger Hermes, 164-198. Frankfurt am Main: Suhrkamp, ¹¹2010.
- . *The Metamorphosis and Other Stories*, edited by Richie Robertson, translated by Joyce Crick. Oxford: Oxford University Press, 2009.

- Kampits, Peter. "Der Sprachkritiker Fritz Mauthner: Vorläufer der ordinary-language-theory oder Nachfolger Nietzsches?" *Modern Austrian Literature* 23, no. 2 (1990): 23-39.
- Kandinsky, Wassily. "Die Grundelemente der Form." In *Staatliches Bauhaus Weimar 1919-1923*, edited by Walter Gropius, 26-27. (Munich and Weimar: Bauhausverlag, 1923).
- . *Punkt und Linie zur Fläche*. Munich: Verlag Albert Langen, 1926.
- Kant, Immanuel. *Critique of Pure Reason*, edited and translated by Paul Guyer and Allen Wood. Cambridge: Cambridge University Press, 1998.
- . *Kritik der reinen Vernunft*. Edited by Jens Timmermann and Heiner Klemme. Hamburg: Felix Meiner Verlag, 1998.
- Kellner, Douglas, and Stephen Eric Bronner. *Passion and Rebellion: The Expressionist Heritage*. New York: J.F. Bergin, 1983.
- Kindt, Tom. *Unzuverlässiges Erzählen und literarische Moderne*. Berlin: Walter de Gruyter, 2008.
- Klein, Felix. *Das Erlangener Programm: Vergleichende Betrachtungen über neuere geometrische Forschungen*, edited by Hans Wußing. Leipzig: Akademische Verlagsgesellschaft, 1974.
- . *The Evanston Colloquium: Lectures on Mathematics*. New York: American Mathematical Society, 1911.
- Klüger, Ruth. *weiter leben: Eine Jugend*. Munich: Deutscher Taschenbuchverlag, 1992.
- Knoch, Habbo. *Grandhotels: Luxusräume und Gesellschaftswandel in New York, London und Berlin um 1900*. Göttingen: Wallstein Verlag, 2016.
- Knorr, Wilbur Richard. *The Ancient Tradition of Geometric Problems*. New York: Dover Publications, 1993.
- Kosmann-Schwarzbach, Yvette. *The Noether Theorems: Invariance and Conservation Laws in the Twentieth Century*, translated by Bertram E. Schwarzbach. New York, Dordrecht, Heidelberg and London: Springer, 2010.
- Kracauer, Siegfried. *From Caligari to Hitler: A Psychological History of German Film*. New Jersey: Princeton University Press, 1947.
- Kramer, Andreas. "Speaking Dada: The Politics of Language." In *Dada and Beyond, Vol. 1: Dada Discourses*, edited by Elza Adamowicz and Eric Robertson, 201-214. Amsterdam and New York: Rodopi, 2011.
- Kranz, Philipp. "The Journal 'Deutsche Mathematik' (1936-1942/44)." *History of Mathematics in Germany, 1920–1960* 3 (2010): 132-134.
- Kraus, Karl. *Ausgewählte Schriften Band IV: Pro domo et mundo*. Munich: Albert Langen, 1912.
- Krukowski, Lucian. "Aufbau and Bauhaus: A Cross-realm Comparison." *The Journal of Aesthetics and Art Criticism* 50:3 (1992): 197-209.
- Landsman, Klaas. *Foundations of Quantum Theory: From Classical Concepts to Operator Algebras*. Cham: Springer International, 2017.
- Le Guin, Ursula. "The Carrier Bag Theory of Fiction." In *Dancing at the Edge of the World: Thoughts on Words, Women, Places*, 165-170. New York: Grove Press, 1989.
- Leahy, Caitriona. *Der wahre Historiker: Ingeborg Bachmann and the Problem of Witnessing History*. Würzburg: Königshausen and Neumann, 2007.
- Ledermann, Leon M., and Christopher T. Hill. *Symmetry and the Beautiful Universe*, 21. New York: Prometheus Books, 2008.

- Lehnigk, Siegfried Horst. *Eine deutsche Katastrophe: 1933-1940*. Landau: Verlag Empirische Pädagogik, 2010.
- Lewis, Peter B. *Arthur Schopenhauer*. London: Reaktion Books, 2012.
- Loew, Katherina. *Special Effects and German Silent Film: Techno-Romantic Cinema*. Amsterdam: Amsterdam University Press, 2021.
- Lofts, S.G. *Ernst Cassirer: A "Repetition" of Modernity*. Albany: State University of New York Press, 2000.
- Lohmeier, Anke-Marie. "Was ist eigentlich modern? Vorschläge zur Revision literaturwissenschaftlicher Modernebegriffe." *Internationales Archiv für Sozialgeschichte der deutschen Literatur* 32, no. 1 (2007): 1-15.
- Lorde, Audré. *Sister Outsider*. London and New York: Penguin, 2019.
- Lupton, Ellen. "Reading Isotype." In *Design Discourse: History, Theory and Criticism*, edited by Victor Margolin, 145-156. Chicago: University of Chicago Press, 1989.
- Lyons, Martyn. *The Typewriter Century: A Cultural History of Writing Practices*. Toronto, Buffalo and London: University of Toronto Press, 2021.
- Mandelbrot, Benoit. "How Long Is the Coast of Britain? Statistical Self-Similarity and Fractional Dimension." *Science* 156 (1967): 636-638.
- Mangus, Bernd and Kathleen M. Higgins, eds. *The Cambridge Companion to Nietzsche*. Cambridge, U.K. and New York: Cambridge University Press, 1996.
- Mauelshagen, Franz. "Disaster and Political Culture in Germany Since 1500." In *Natural Disasters, Cultural Responses: A World History*, edited by Christof Mauch and Christian Pfister, 58. Lanham: Lexington Books, 2009.
- Mauthner, Fritz. *Beiträge zu einer Kritik der Sprache. Band I: Sprache und Psychologie*. Stuttgart: J.G. Cotta'sche Buchhandlung, 1901.
- McBride, Patrizia. *The Chatter of the Visible: Montage and Narrative in Weimar Germany*. Ann Arbor: University of Michigan Press, 2016.
- McNally, Raymond T., and Radu Florescu. *In Search of Dracula: The History of Dracula and Vampires*. Boston and New York: Houghton Mifflin Company, 1994.
- Mehigan, Tim. *Robert Musil and the Question of Science: Ethics, Aesthetics, and the Problem of the Two Cultures*. Rochester, NY: Camden House, 2020.
- Mehrtens, Herbert. "The Social System of Mathematics and National Socialism: A Survey." *Sociological Inquiry* 57, no. 2 (1987): 159-182.
- Mehrtens, Herbert. *Moderne-Sprache-Mathematik: Eine Geschichte des Streits um die Grundlagen der Disziplin und des Subjekts formaler Systeme*. Frankfurt am Main: Suhrkamp, 1990.
- Mendrick, Heather. *Masculinities in Mathematics*. Maidenhead: Open University Press, 2006.
- Michel, Nicolas. "Mathematical Selves and the Shaping of Mathematical Modernism: Conflicting Epistemic Ideals in the Emergence of Enumerative Geometry (1864–1893)." *Isis: Journal of the History of Science Society* 112, no. 1 (2021): 68-92.
- Mikkonen, Kai. "Theories of Metamorphosis: From Metatropé to Textual Revision." *Style* 30, no. 2 (1996): 309-340.
- Moles, Alistair. "Nietzsche's Eternal Recurrence as Riemannian Cosmology." *International Studies in Philosophy* 21, no. 2 (1989): 21-35.

- Mongré, Paul. "Das Chaos in kosmischer Auslese." In *Felix Hausdorff - Gesammelte Werke, Band VII: Philosophisches Werk*, edited by Werner Stegmaier, 587-808. Berlin, Heidelberg and New York: Springer, 2004.
- . "Der Wille zur Macht." In *Felix Hausdorff - Gesammelte Werke, Band VII: Philosophisches Werk*, edited by Werner Stegmaier, 903-909. Berlin, Heidelberg and New York: Springer, 2004.
- . "Nietzsches Lehre von der Wiederkunft des Gleichen." In *Felix Hausdorff - Gesammelte Werke, Band VII: Philosophisches Werk*, edited by Werner Stegmaier, 895-902. Berlin, Heidelberg and New York: Springer, 2004.
- . "Sant'Ilario: Gedanken aus der Landschaft Zarathustras." In *Felix Hausdorff - Gesammelte Werke, Band VII: Philosophisches Werk*, edited by Werner Stegmaier, 85-473. Berlin, Heidelberg and New York: Springer, 2004.
- . "Sprachkritik." In *Felix Hausdorff - Gesammelte Werke, Band VIII: Literarisches Werk*, edited by Friedrich Vollhardt and Udo Roth, 549-580. Berlin, Heidelberg and New York: Springer, 2010.
- Moore, Asher. "Rationalism, Empiricism and the A Priori." *The Philosophical Quarterly* 9, no. 36 (1959): 250-258.
- Moriarty, Clare. "'Tine and Form': The Geometric Philosophy Underlying Oliver Byrne's Elements." *Leonardo* 56, no. 2 (2023): 151-158.
- Morse, Marston. "Mathematics and the Arts." *Bulletin of the Atomic Scientists* 15, no. 2 (1959): pp. 55-59.
- Murphy, Richard. *Theorizing the Avant-Garde: Modernism, Expressionism, and the Problem of Postmodernity*. Cambridge: Cambridge University Press, 2004.
- Musil, Robert. "Der mathematische Mensch." In *Robert Musil: Gesammelte Werke, Band VIII*, edited by Adolf Frise, 1004-1006. Hamburg: Rowohlt, 1978.
- . *Der Mann ohne Eigenschaften*. Cologne: Anaconda Verlag, 2013.
- . *The Man Without Qualities, Vol. 1*, translated by Sophie Wilkins. New York: Vintage International, 1995.
- Netz, Reviel. *The Shaping of Deduction in Greek Mathematics: A Study in Cognitive History*. Cambridge: Cambridge University Press, 2004.
- Newton, Isaac. *The Mathematical Principles of Natural Philosophy, Vol. 1*, translated by A. Motte, edited by W. Davis. London: H.D. Symonds, 1803.
- Nietzsche, Friedrich. *Also sprach Zarathustra*. Stuttgart: Reclam, 1994.
- . "Die fröhliche Wissenschaft." In *Friedrich Nietzsche: Sämtliche Werke, Kritische Studienausgabe, Band 3*, edited by Giorgio Colli and Mazzino Montinari, 342-651. Munich, Berlin and New York: Deutscher Taschenbuch Verlag and Walter De Gruyter, 1999.
- . "Menschliches, Allzumenschliches I." In *Friedrich Nietzsche: Sämtliche Werke, Kritische Studienausgabe, Band 2*, edited by Giorgio Colli und Mazzino Montinari, 9-365. Berlin and New York: Walter de Gruyter, Munich: Deutsche Taschenbuch Verlag, 1988.
- . "Über Wahrheit und Lüge im außermoralischen Sinne." *Friedrich Nietzsche: Sämtliche Werke, Kritische Studienausgabe, Band 1*, edited by Giorgio Colli und Mazzino Montinari, 873-890. Munich, Berlin and New York: Deutscher Taschenbuch Verlag and Walter de Gruyter, 1988.

- *The Gay Science*, ed. Bernard Williams, translated by Josefine Nauckhoff. Cambridge: Cambridge University Press, 2001.
- *Thus Spoke Zarathustra*, edited by Adrian Del Caro and Robert Pippin, translated by Adrian Del Caro. Cambridge: Cambridge University Press, 2006.
- Nünning, Ansgar. “Unreliable, Compared to What? Towards a Cognitive Theory of Unreliable Narration.” In *Grenzüberschreitungen: Narratologie im Kontext*, edited by Walter Grünzweig and Andreas Solbach 53-74. Tübingen: Gunter Narr Verlag, 1999.
- Oechslin, Werner, ed. “‘To facilitate their acquirement’: Oliver Byrne’s The First Six Books of the Elements of Euclid.” In *The First Six Books of the Elements of Euclid in Which Coloured Diagrams and Symbols Are Used Instead of Letters for the Greater Ease of Learners*. 321-375. Cologne: Taschen Bibliotheca Universalis, 2017.
- Painitz, Sarah. “Lunacy and the Law: Mela Hartwig’s *The Crime and The Fantastical Paragraph*.” In *Crime and Madness in Modern Austria: Myth, Metaphor and Cultural Realities*, edited by Rebecca S. Thomas, 117-135. Newcastle: Cambridge Scholars Publishing, 2008.
- Parsons, Charles. *From Kant to Husserl*. Cambridge MA and London: Harvard University Press, 2012.
- Perutz, Leo. *Zwischen neun und neun*. Munich: Deutscher Taschenbuch Verlag, 2019.
- Pinkney, Tony. Foreword to Raymond Williams, *The Politics of Modernism: Against the New Conformists*. London: Verso, 2007.
- Plotnitsky, Arkady. “Adventures of the Diagonal: Non-Euclidean Geometries and Narrative.” In *Circles Disturbed: The Interplay of Mathematics and Narrative*, edited by Apostolos Doxiadis and Barry Mazur, 407-445. Princeton, NJ: Princeton University Press, 2012.
- *Logos and Alogon: Thinkable and the Unthinkable in Mathematics, from the Pythagoreans to the Moderns*. Cham: Springer Nature, 2023.
- Polt-Heinzl, Evelyn. “Mela Hartwigs Fallgeschichten. Korrekturen zum Thema Hysterie.” In *Literatur und Kultur im Österreich der Zwanziger Jahre*, edited by Primus-Heinz Kucher, 211-226. Bielefeld: Aisthesis Verlag, 2007.
- Puchner, Martin. *Poetry of the Revolution: Marx, Manifestos, and the Avant-gardes*. Princeton and Oxford: Princeton University Press, 2006.
- Pulsifer, Rebecah. “Adding Mathematics to Modernist Studies.” *Journal of Modern Literature* 43, no. 2 (2020): 186-189.
- Purkert, Walter. “The Double Life of Felix Hausdorff/Paul Mongré.” *The Mathematical Intelligencer* 30, no. 4 (2008): 37-50.
- Rabaté, Jean Michel. *1913: The Cradle of Modernism*. Oxford: Blackwell Publishing, 2007.
- and Angeliki Spiropoulou. *Historical Modernisms: Time, History and Modernist Aesthetics*. London: Bloomsbury Academic, 2022.
- Rada, Uwe. *Die Elbe: Europas Geschichte im Fluss*. Munich: Sieglar Verlag, 2013.
- Ragland, Ellie, and Dragan Milovanovic, eds. *Lacan: Topologically Speaking*. New York: Other Press, 2004.
- Riemann, Bernhard. “Über die Hypothesen, welche der Geometrie zu Grunde liegen.” *Abhandlungen der Königlichen Gesellschaft der Wissenschaften* 13 (1868): 133-152.

- Ritson, Katie. "Engineering the Anthropocene: Technology, Ambition, and Enlightenment in Theodor Storm's *Der Schimmelreiter*." In *Readings in the Anthropocene: The Environmental Humanities, German Studies, and Beyond*, edited by Sabine Wilke and Japhet Johnstone, 222-242. London and New York: Bloomsbury Academic, 2017.
- Rockmore, Tom. "Lukács as Leninist." In *The Palgrave Handbook of Leninist Political Philosophy*, edited by Tom Rockmore and Norman Levine, 281-310. London: Palgrave Macmillan, 2018.
- Rowe, David E. *Emmy Noether – Mathematician Extraordinaire*, xx. Cham: Springer International, 2021.
- Rowe, David, and Mechthild Koreuber. *Proving It Her Way: Emmy Noether, a Life in Mathematics*, viii. Cham: Springer International, 2020.
- . "‘Jewish Mathematics’ at Göttingen in the Era of Felix Klein." *Isis* 77, no. 3 (1986): 422-449.
- . "The Göttingen Response to General Relativity and Emmy Noether's Theorems." In *The Symbolic Universe: Geometry and Physics 1890-1930*, edited by Jeremy Gray, 189-232. Oxford: Oxford University Press, 1999.
- Rushdie, Salman. *The Satanic Verses*. London: Viking and Penguin inc., 2000.
- Schaberg, William H. *The Nietzsche Canon: A Publication History and Biography*. Chicago: University of Chicago Press, 1995.
- Schaffner, Anna Katharina. "Assaulting the Order of Signs." In *Dada Culture: Critical Texts on the Avant-Garde*, edited by Dafydd Jones, 117-135. Amsterdam and New York: Rodolpi, 2006.
- Schirmer, Gisela. *Käthe Kollwitz und die Kunst ihrer Zeit: Positionen zur Geburtenpolitik*. Weimar: VDG, 1998.
- Schmidt, Gary. "Performing in Handcuffs: Leo Perutz's *Zwischen neun und neun*." *Modern Austrian Literature* 43, no. 1 (2010): 1-22.
- Schmölzer, Hilde. *Frauen um Karl Kraus*. Klagenfurt: Kitab, 2015.
- Schnapper, Ernst. "The Three Crises in Mathematics: Logicism, Intuitionism and Formalism." *Mathematics Magazine* 52, no. 4 (1979): 207-216.
- Scholz, Erhard. "Felix Hausdorff." In *The Princeton Companion to Mathematics*, edited by Timothy Gowers, June Barrow-Green, and Imre Leader, 792-793. Princeton and Oxford: Princeton University Press, 2008.
- Schopenhauer, Arthur. *Sämtliche Werke*, Band 11, edited by Paul Deussen. Munich: R. Piper and Co., 1916.
- Schwitters, Kurt. *Kurt Schwitters* (London: Tate Gallery, 1985).
- . *Kurt Schwitters. Das Literarische Werk, Band V: Manifeste und kritische Prosa*, edited by Friedhelm Lach. Cologne: DuMont, 1981.
- Sebastian, Thomas. *The Intersection of Science and Literature in Musil's 'The Man Without Qualities'*. Rochester, NY: Camden House, 2005.
- Segal, Sanford L. *Mathematicians under the Nazis*. Princeton and Oxford: Princeton University Press, 2003.
- Sengoopta, Chandak. *Otto Weininger: Sex, Science, and Self in Imperial Vienna*. Chicago and London: University of Chicago Press, 2000.

- Seung, K.T. *Kant: A Guide for the Perplexed*. London and New York: Continuum, 2007.
- Shakespeare, William. *Romeo and Juliet*. London: Penguin, 1988.
- Shapere, Dudley. *Reason and the Search for Knowledge: Investigations in the Philosophy of Science*. Dordrecht, Boston and Lancaster: D. Reidel Publishing Company, 1984.
- Siegmund-Schultze, Reinhard. “‘Not in possession of any Weltanschauung’: Otto Neugebauer’s Flight from Nazi Germany and His Search for Objectivity in Mathematics, in Reviewing, and in History.” In *A Mathematician’s Journeys: Otto Neugebauer and Modern Transformations of Ancient Science*, edited by A. Jones, C. Proust, and J. Steele, 61-105. Cham: Springer International, 2016.
- . *Mathematicians Fleeing from Nazi Germany: Individual Fates and Global Impact*. Princeton and Oxford: Princeton University Press, 2009.
- Siltanen, Samuli. *Step into the World of Mathematics: Math Is Beautiful and Belongs to All of Us*, 109ff. Cham: Springer Nature, 2021.
- Silverman, Lisa. *Becoming Austrians: Jews and Culture Between the World Wars*. Oxford: Oxford University Press, 2012.
- Simons, Peter. “Formalism.” In *The Philosophy of Mathematics*, edited by Andrew D. Irvine, 291-310. Amsterdam: Elsevier and North Holland, 2009.
- Smith, Zadie. *Feel Free*. London: Penguin, 2018.
- Stamm, Ulrike. “Die Nullität der Frau und der Einspruch gegen das autonome Subjekt. Mela Hartwigs Roman *Das Weib ist ein Nichts*.” In *City Girls. Bubiköpfe und Blaustrümpfe in den 1920er Jahren*, edited by Alexandra Tacke and Julia Freytag, 55- 69. Cologne, Weimar and Vienna: Böhlau, 2011.
- Stašková, Alice, Anne Hultsch, Klaus Schenk, eds. *Experimentelle Poesie in Mitteleuropa: Texte-Kontexte-Material-Raum*. Göttingen: VandR Unipress, 2016.
- Stegmaier, Werner, ed. Foreword to *Felix Hausdorff - Gesammelte Werke, Band VII: Philosophisches Werk*. Berlin, Heidelberg and New York: Springer, 2011.
- Stein, Gertrude. *Writings, Volume 1: 1903–1932*, edited by Catharine R. Stimpson and Harriet Chessman (New York: Library of America, 1998).
- Stoehr, Ingo Roland. *German Literature of the Twentieth Century: From Aestheticism to Postmodernism*. New York: Camden House, 2001.
- Storm, Theodor. *Der Schimmelreiter*. Munich: Deutscher Taschenbuch Verlag, ⁵2004.
- Strong, Tracy B. *Friedrich Nietzsche and the Politics of Transfiguration*. Urbana and Chicago: University of Illinois Press, 2000.
- Storm, Theodor, *The Rider on the White Horse: And Selected Stories*, translated by James Wright. New York: NYBR Classics, 2009.
- Sutherland, W.A. *Introduction to Metric and Topological Spaces*. Oxford: Oxford University Press, 1975.
- Sutil, Nicolas. “Mathematics in Motion: A Comparative Analysis of the Stage Works of Schlemmer and Kandinsky at the Bauhaus.” *Dance Research: The Journal of the Society for Dance Research* 32, no. 1 (2014): 23-42.
- Sutton, Andrew. *Ruler and Compass: Practical Geometric Constructions*. London: Wooden Books, 2009.

- Tabak, John. *Geometry: The Language of Space and Form*. New York: Facts on File, 2004.
- Thiher, Allen. *Understanding Robert Musil*. Columbia, SC: University of South Carolina Press, 2009.
- Thompson, Laure and David Mimno. "Computational Cut-Ups: The Influence of Dada." *The Journal of Modern Periodical Studies* 8, no. 2 (2017): 179-195.
- Timpano, Nathan. *Constructing the Viennese Modern Body: Art, Hysteria and the Puppet*. New York and London: Routledge, 2017.
- Tobies, Renate. "*Aller Männerkultur zum Trotz*": *Frauen in Mathematik, Naturwissenschaften und Technik*, 56. Frankfurt am Main: Campus Verlag, 2008.
- Tsai, Jamie. "Pixel Pirates." In *Dada Data: Contemporary Art Practice in the Era of Post-Truth Politics*, edited by Sarah Hegenbart and Mara-Johanna Kölmel, 265-279. London: Bloomsbury Visual, 2023.
- Tubbs, Robert, Nina Engelhardt, and Alice Jenkins, eds. *The Palgrave Handbook of Literature and Mathematics*. Cham: Palgrave Macmillan, 2021.
- Tzara, Tristan. "Manifest Dada 1918." In *Dada Almanach*, edited by Richard Huelsenback. Berlin: Erich Reiss Verlag, 1920.
- Uebel, Thomas. *Overcoming Logical Positivism from Within*. Amsterdam: Brill, 2021.
- Ulfers, Friedrich, and Mark Daniel Cohen. "Zarathustra, the Moment, and Eternal Recurrence of the Same: Nietzsche's Ontology of Time." In *Nietzsche's Thus Spoke Zarathustra: Before Sunrise*, edited by James Luchte, 75-90. London: Bloomsbury, 2011.
- Umland, Anne. "Dada in the Collection: A Permanent Paradox." In *Dada in the Collection of the Museum of Modern Art*, edited by Anne Umland and Adrian Sudhalter, 14-41. New York: The Museum of Modern Art New York, 2008.
- Vadde, Aarthi. "Scalability." *Modernism/Modernity Print+* 2, no. 4 (2018): <https://doi.org/10.26597/mod.0035>.
- Vanzo, Alberto. "Empiricism and Rationalism in Nineteenth-Century Histories of Philosophy." *Journal of the History of Ideas* 77, no. 2 (2016): 253-282.
- Vollhardt, Friedrich, and Udo Roth, eds. "Kommentar zu 'Sprachkritik'." *Felix Hausdorff - Gesammelte Werke Band VIII: Literarisches Werk*, edited by Friedrich Vollhardt and Udo Roth, 581-658. Berlin, Heidelberg and New York: Springer, 2010.
- Vollmer, Hartmut. *Liebes(ver)lust: Existenzsuche und Beziehungen von Männern und Frauen in deutschsprachigen Romanen der zwanziger Jahre*. Oldenburg: Iger Verlag, 1998.
- Walker, Mark. *Nazi Science: Myth, Truth and the German Atomic Bomb*. New York: Springer US, 1995.
- Wardhaugh, Benjamin. *Encounters with Euclid: How an Ancient Greek Geometry Text Shaped the World*. Princeton, NJ: Princeton University Press, 2021.
- Weigel, Sigrid. "Zum 'topographical turn'. Kartographie, Topographie und Raumkonzepte in den Kulturwissenschaften." *KulturPoetik* 2, no. 2 (2002): 151-165.
- Weininger, Otto. *Geschlecht und Charakter*. Vienna and Leipzig: Wilhelm Braumüller Verlag, 1920.
- . *Sex and Character*, translated by William Heinemann. London and New York: W. Heinemann and G.P. Putnam's Sons, 1906.

- Wende, Petra Maria. "Eine vergessene Grenzgängerin zwischen den Künsten: Mela Hartwig 1893 Wien – 1967 London." *Ariadne* 13 (1997): 31-37.
- Wicks, Robert. "Plato's Conception of Time at the Foundation of Schopenhauer's Philosophy." In *Brill's Companion to German Platonism*, edited by Alan Kim, 192-215. Leiden and Boston: Brill, 2019.
- Wigner, Eugene. "The Unreasonable Effectiveness of Mathematics in the Natural Sciences." *Communications on Pure and Applied Mathematics* 13 (1960): 1–14.
- Willems, Gottfried. *Die Geschichte der deutschen Literatur, Band V: Moderne*. Vienna, Cologne and Weimar: Böhlau Verlag, 2015.
- Wittgenstein, Ludwig. *Tractatus Logico-Philosophicus*. London and New York: Routledge, 2013.
- . *Tractatus logico-philosophicus, Logisch-philosophische Abhandlung*. Frankfurt am Main: Suhrkamp, 2003.
- Woolf, Virginia. *A Passionate Apprentice: The Early Journals, 1897-1909*, edited by Mitchell A. Leaska. San Diego: Harcourt Brace Jovanovich, 1991.
- Zaslavsky, Claudia. *Africa Counts: Number and Pattern in African Cultures*. Boston: Prindle, Weber and Schmidt, 1973.
- Zimmermann, Reinhard. "Early Imprints and Influences." In *Kandinsky: The Path to Abstraction*, edited by Hartwig Fischer and Sean Rainbird, 18-42. London: Tate Modern, 2006.

Filmography

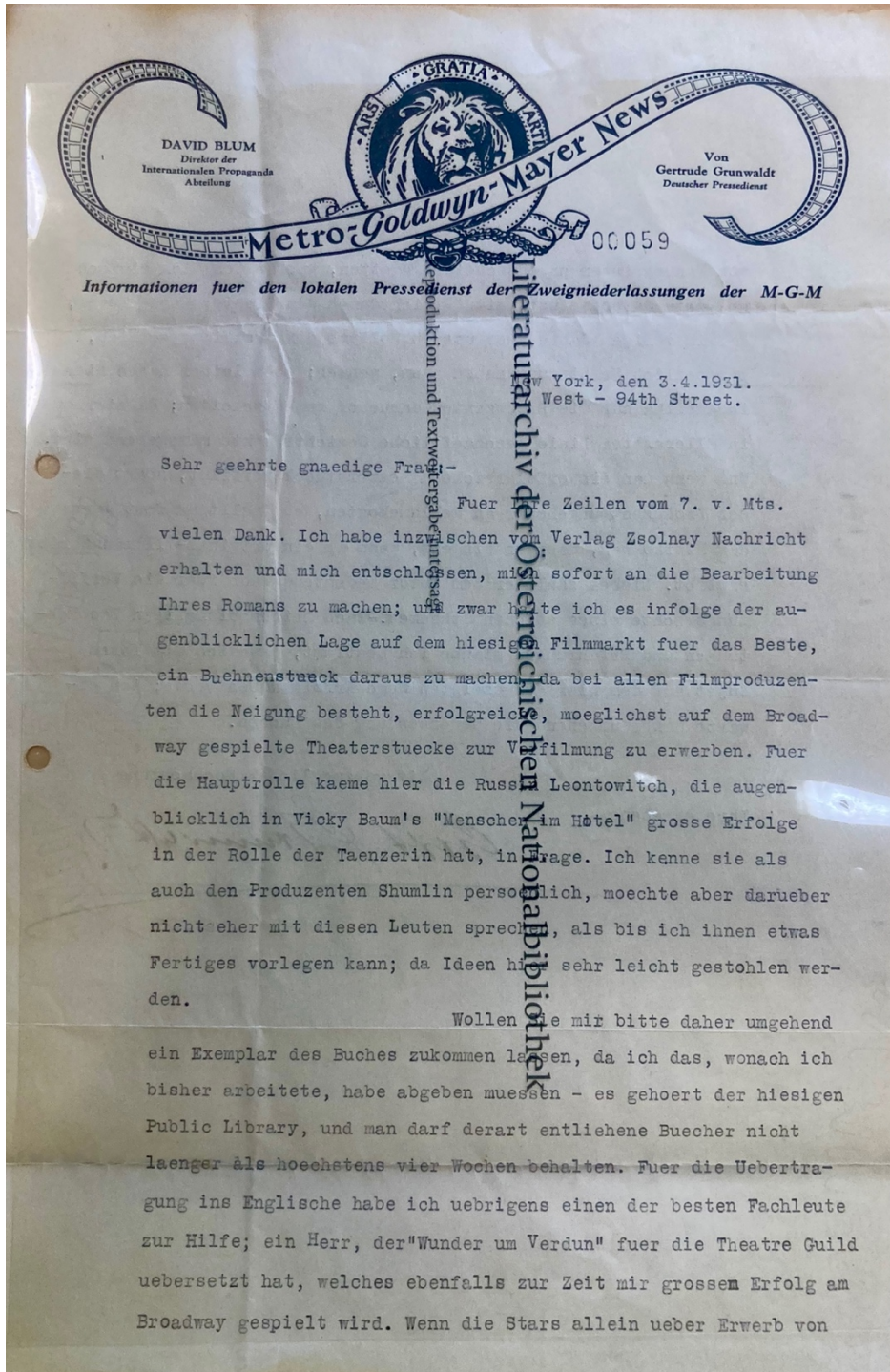
- A Trip to Infinity*, directed by Jonathan Halperlin and Drew Takahashi. Makemake and Room 608, 2022.
- Der letzte Mann*, directed by F.W. Murnau. UFA, 1924. Film
- Metropolis*, directed by Fritz Lang. UFA, 1927.
- Snow White and the Seven Dwarfs*, directed by David Hand *et al.* Walt Disney, 1937.
- The Wizard of Oz*, directed by Victor Fleming. Metro-Goldwyn-Mayer, 1939.

Web Sources

- "Death of Archimedes Illustrations," Math at NYU, Last modified October 12, 2022, <https://math.nyu.edu/~crorres/Archimedes/Death/DeathIllus.html>.
- Hurezanu, Daniela. "Mela Hartwig's novel *Am I a Redundant Human Being*." *Words Without Borders*, September 1, 2010, <https://wordswithoutborders.org/book-reviews/mela-hartwigs-am-i-a-redundant-human-being/>.
- "Vasily Kandinsky Composition 8." Guggenheim. Last modified September 29, 2023, <https://www.guggenheim.org/artwork/1924>.

Appendices

Appendix A: Correspondence from Gertrude Grunwaldt at Metro-Goldwyn-Mayer, New York regarding a possible film adaptation of *Das Weib ist ein Nichts*, dated 3rd April 1931. Archived in the Literaturarchiv of the Österreichische Nationalbibliothek, Vienna. Accessed 7th September 2023.



Appendix B: Paul Zsolnay Verlag's rejection letter to Mela Hartwig concerning *Bin ich ein überflüssiger Mensch?*, dated 24th April 1931. Archived in the Literaturarchiv of the Österreichische Nationalbibliothek, Vienna. Accessed 7th September 2023.

Wir sind Ihnen dankbar für die Mitteilung, dass wir
wenn im Verlauf des Jahres kein schicksalhaftes Werk von Ihnen vor-
liegt, dann an die Publikation arbeiten werden.
Über all diese Dinge möchten wir gerne mit Ihnen
sprechen und gestatten uns die Anfrage, wann Sie etwa Mitte
Mai - wir verzeihen jetzt auf einige Wochen nach Berlin - nach Wien
kommen könnten.
Wien, 24.IV.1931
G/B
Mit dem Ausdruck besonderer Verehrung
Frau

Mela Hartwig

Goesting bei Graz
Schulweg 342

Sehr verehrte gnädige Frau!

Wir bitten Sie nochmals um Entschuldigung, dass
sich unsere Stellungnahme zu Ihrem Roman "Ich bin ein überflüssiger
Mensch" so sehr verzögert hat.

Wir haben Ihren interessanten Roman, der uns Ihr
dichterisches Können auf einer neuen Ebene zeigt, mit starkem Interesse
und mit größter innerer Anteilnahme gelesen und freuen uns, dass es
Ihnen gelungen ist, Ihren bisherigen Stil zu grösserer Klarheit und
Reife zu veredeln.

Allerdings müssen wir Ihnen gestehen, dass wir
nicht recht wissen, wie wir uns diesem Buch gegenüber verhalten sollen.
Es handelt sich - darüber sind auch Sie sich wohl klar - um ein absolut
publikumsunwirksames und abseitiges Werk, das in der heutigen Zeit einem
heutigen Publikum vorzulegen einen sicheren Misserfolg bedeuten würde.
Wir möchten sehr gerne, sehr verehrte gnädige Frau, mit Ihnen gemeinsam
besprechen, welche Schritte wir für Ihr Werk unternehmen sollen - wir
halten es z.B. für sehr aussichtsreich, das Werk einige Male vorabdrucken
zu lassen, im Berliner "Vorwärts" etwa, etc. damit es popularisiert
./.