Cyber-Nations

The Cold War Contest for Cybernetics and Automation in the US, the USSR, and Divided Germany

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Contents

Short Abstract 2
Long Abstract 2
Introduction 5
Cybernetics, Automation, Cybernation, and Industry Robots - A word on terminology 9
Pillars of the Argument 14
Intervention in the Literature 17
Transnational and Comparative History: A Fruitful Analytical Tension 25
The Source Base 27
The Structure of the Argument 32
A Future That Never Was? 35
Postwar America – Automation in an Age of Affluence 37
The Birth of Cybernetics 42
From Cybernation to a Guaranteed Annual Income 50
Frenzied Cybernation? Predictions versus Empirical Reality 60
Grassroots Initiatives and the Guaranteed Annual Income Newsletter 70
Conclusion 75
From Fear to Free Time – From the Keyboard to the Canvas in West Germany 78
American Science in Post-Fascist Germany 82
Automation and Organized Labor in the FRG 95
Cybernetic Humanities and The Dawn of Information Aesthetics 103
The Moment of Cybernetic Art: Generative Aesthetics and Computer Art in the 1960s 114
Conclusion 128
Soviet Cybernetics and the Quest for an Automated Socialist Future 130
Cybernetics in the Soviet Union: A Troubled Birth 134
Cybernetics, Socialist Abundance, and a Soviet Internet 143
Soviet Cybernetics: A Field of Cold War Intrigue 152
Conclusion 164
From Cybernetics to Industry Robots in the German Democratic Republic 166
Socialist Modernity and East German Cybernetics, 1960-1971 170
A Cybernetic Afterlife: Industry Robots and Microelectronics in the Honecker Era 189
“Same technology, two worlds:” The Propaganda Model for Industry Robots in the 1980s . 207

Conclusion 214
Epilogue 217
A Cybernetic Legacy or a Cybernetic Present? 217
Bibliography 231
Unpublished Primary Sources 231
Published Primary Sources 232
Secondary Sources 243
Unpublished Theses 257

Short Abstract

This dissertation explores how the United States, the USSR, and a divided Germany responded to the new science of cybernetics during the postwar. Invented by the MIT mathematician, Norbert Wiener, cybernetics offered a new quantitative framework for studying feedback loops across physical, biological, and sociological systems. The potential economic applications of cybernetics promised a future of increased mechanization which threatened to undermine the role of labor in both capitalist and socialist systems. The present study examines how thinkers across the Cold War divide received cybernetic ideas and developed socio-political, economic, and artistic responses to automation and productivity enhancements. Each chapter offers a case study focused on a particular state (The United States, the Federal Republic of Germany, the Soviet Union, and the German Democratic Republic), and analyzes socialist and liberal responses to cybernetic ideas. The wide-ranging applicability of cybernetic concepts prompted varied responses, which ranged from early forms of digital art in West Germany to proposals for networked computer systems in the Soviet Union. Through tracing cybernetic reception across ideological and geographic boundaries, this dissertation aims to uncover an important moment of cybernetic radicalism in the 1960s. This perspective provides much-needed historical context for current concerns about the dominance of big tech and potential changes in twenty-first century labor practices.

Long Abstract

The present study offers a new account of postwar cybernetics and automation as a conceptual battleground between the two ideological poles of the Cold War. Although cybernetics began life as a scientific concept, its importance can only be understood in the context of its economic and social implications in both capitalist and communist societies. Unlike other Cold War-era rivalries, the clash over cybernetics was distinguished by its potential to challenge accepted beliefs about labor, the role of work, economic organization, and political authority. The cybernetic rivalry was not about world-destroying weapons or reaching the moon. Rather, it was about reimagining the relationship between new technologies, economic productivity, and the role of work across conflicting political systems.

Although states on both sides of the Iron Curtain pursued similar automation technologies throughout the postwar period, the social and economic implications cybernetic advances diverged significantly. This study will highlight the different meanings of cybernetics in an ideologically fractured world, through case studies of the United States, the Soviet Union, the German Federal Republic, and the German Democratic Republic. By comparing the two superpowers alongside two of their most important satellites, it is possible to trace the many divergences and common threads around ideas of automation and economic progress.

For politicians and economists in capitalist countries like the United States and the Federal Republic of Germany, the pursuit of automation technologies was viewed as an important tool for maintaining an economic advantage over the socialist East. But in a free-market system driven by a competitive labor market, widespread automation also carried the risk of technological unemployment. The free market's guarantee of high growth and low unemployment was difficult to reconcile with predictions of a highly automated future. In the East, the concept of cybernetics underwent a drastic evolution from a disreputable bourgeois idea to a central pillar for improved economic productivity and competitiveness. For socialist planners and party ideologues in states like the Soviet Union and the German Democratic Republic, industry robots and automation

technologies held the key to closing the productivity gap and asserting the viability of socialist economic organizing. Inside socialist regimes, where job guarantees formed the bedrock of their economic system, unemployment arising from cybernetics was never a concern. Marxist-Leninist principles circumscribed the possibility for labor market dislocations, and a powerful, beneficent state was in place to ensure the fruits of technological advancement were shared across all swathes of society.

The chronological core of this study is the 1960s, and this dissertation offers a new perspective on radicalism from this decade. In both socialist and liberal contexts, philosophers, artists, and commentators drew inspiration from cybernetic technologies to call for radical socio-political reforms. In the GDR, the works of Georg Klaus represented a highpoint in a new form of socialist critique, which recast Marx as a proto-cybernetic thinker. In the United States, the cybernation theorists who wrote the Triple Revolution Report, such as Robert Theobald and Donald Michael, drew on cybernetic developments to call for a guaranteed annual income to alleviate poverty and prevent unemployment. Technological radicalism is frequently omitted from traditional readings of the decade, and this project aims to reassert the importance of cybernetic reformists for our understanding of the 1960s.

This study is devoted to uncovering how technological change and the prospect of a highly automated economy was conceptualized both within and across Cold War societies. This approach will consciously challenge any monolithic conception of the socialist East by examining disagreement between scientists within the Soviet Union and exploring how the German Democratic Republic pursued its own plan for industrial roboticization which diverged in meaningful ways from related plans in the Soviet Union. By the same token, the study will resist the temptation to view the postwar United States as a capitalist utopia in which the promise of growth quelled social dissent. By reading congressional testimony alongside the pamphlets of student organizers in the 1960s, a new landscape of dissent around the themes of automation and fair work will be brought to light. Outside of the United States, the Federal Republic of Germany provides another example of a growing liberal state in which the twinned promise and threat of automation generated diverse responses from within labor unions, industry leaders, and political representatives.

Through analyzing the idea of cybernetics and automation in varied postwar political contexts, this study breaks new ground by uncovering how the understanding of technological and economic progress was contingent on ideological imperatives and political dictates. Three central themes emerge from this inquiry which guide the study.

Theme One. Although industrial and government leaders sought similar economic goals through the use of cybernetic technologies, the social consequences of cybernated economies were understood very differently in the East and West. The potential for increased productivity, improved worker safety, and higher economic output through automated processes excited economic leaders in the US, USSR, GDR, and FRG. Despite these similar goals, cybernation in the West was dogged by concerns about widespread technological unemployment. Technological advances were perceived by many politicians, businesspeople, and workers as a threat to American stability if the predictions for a highly automated future came true. This contrasted starkly with rhetoric in the Soviet Union and the GDR in which party leaders and economic planners extolled the virtues of automation as a means to improve labor allocation and spare humans from the most dangerous and menial of professions. Whereas the pursuit of automation in the West was viewed by detractors as an enhanced form of capitalist exploitation, the state economic apparatus in the socialist East saw automation as a potential cure for the privations of command-control economies.

Theme Two. The prospect of widespread automation through cybernetic technologies challenged the ideological bedrock of both liberal capitalism and communism by reconceptualizing the importance of labor. In the communist context, the preeminent position afforded to the proletariat in orthodox Marxism enshrined the worker as the foundational unit in a true communist society. In the capitalist tradition as well, work was a method of social belonging and the key to upward mobility. The ultimate goal of automation therefore threatened the very core of political and social organization in both systems. This challenge to the capitalist system prompted myriad reactions within the United States and West Germany, which ranged from tempered optimism to quasi-eschatological speculation. For Soviet and East German ideologues, increased automation became closely linked with new visions of a communist utopia rooted in the belief that government oversight would ensure equitable distribution of the new usufruct. Interestingly, however, contemplation of a distant future by both liberal and socialist thinkers gave rise to strikingly similar visions of a post-work world. Although significant differences existed on the path to post-work, thinkers on both sides of the Iron Curtain shared similar views on the ultimate shape of a flourishing, abundant economy.

Theme three. Cybernation was an important space for economic and social differentiation in the Cold War. The analysis of government papers from the American, German, and Soviet contexts reveals how political leaders viewed cybernation as a way to distinguish their respective ideological regimes from that of their opponents. Economic and technological considerations were certainly paramount, but political leaders and even scientists invoked cybernetics as a theme to showcase the superiority of their respective ideological system. Although research into cybernetics and economic writing about automation and the economy were frequently sponsored by government entities, discussion of cybernetics frequently crossed borders. International conferences on robotics, automation, and cybernetics drew participants from across the world and provided opportunities for collaboration, as well as gossip and showboating about new technological developments. Detailed accounts of international meetings between international scientists of different ideological stripes provide a fascinating window onto the political meaning of cybernetics in international contexts. By considering transnational exchanges about the political meaning of cybernetics, alongside national scientific and economic programs, this study offers new perspectives on how economic and scientific ideas were transmitted within and across Cold War boundaries.

Introduction

> …the capabilities and potentialities of these devices are unlimited. They contain extraordinary implications for the emancipation and enslavement of mankind.
>
> - Donald Michael, *Cybernation: The Silent Conquest* (1962)[1]

From 1950 to 1989, an unprecedented technological competition raged between the capitalist West and socialist East. Scientists and spies were recruited for the cause, government laboratories and private industry were mobilized, new fields of academic study were created from scratch, and the promise of a technological victory excited and terrified political leaders on both sides of the Iron Curtain. It was a competition over the course of future economic growth and political viability.

Unlike its more famous cousin, the Space Race, the Cold War rivalry over cybernetics and automation was very much a terrestrial concern. Cybernetics and the related concepts of industry robots, automation, and cybernation were major instigators of technological innovation, policy development, philosophical debates, and even artistic movements in both West and East. The term cybernetics first emerged with the 1948 publication of Norbert Wiener's pioneering text, *Cybernetics: Or Control and Communication in the Animal and the Machine*.[2] In his pathbreaking work, the MIT mathematician proposed a new framework for conceptualizing feedback loops which was generalizable across biological and mechanical systems. The publication of Wiener's work gave birth to a new field of academic inquiry, which influenced early computer science, computational biology, and numerous other fields, but cybernetics was never solely an academic subject. The concept of self-regulating machines that automatically responded to external stimuli

[1] Donald Michael, "Cybernation: The Silent Conquest" (Santa Barbara: Center for the Study of Democratic Institutions, 1962), 8.
[2] Norbert Wiener, *Cybernetics: Or, Control and Communication in the Animal and the Machine*, 2nd ed. (New York: MIT Press, 1961).

was a central focus of Wiener's research, and almost immediately after his book appeared in 1948, commentators in the United States and the Soviet Union began speculating on the economic, social, and political implications of this new science. From 1948 onward, the concept of a highly automated future permeated public discourse and emerged as a divisive field of Cold War competition.

The present study offers a new account of postwar cybernetics and automation as a conceptual battleground between the two ideological poles of the Cold War. Cybernetics began life as a scientific concept, but its importance can only be understood in the context of its economic and social implications in both capitalist and communist societies. Unlike other Cold War-era rivalries, the clash over cybernetics was distinguished by its potential to challenge accepted beliefs about labor, the role of work, economic organization, and political authority. The cybernetic rivalry was not about world-destroying weapons or reaching the moon. Rather, it was about reimagining the relationship between new technologies, economic productivity, and the role of work within capitalism and socialism.

Through case studies of the United States, the Soviet Union, the Federal Republic of Germany, and the German Democratic Republic, this dissertation will highlight the different meanings of cybernetics in an ideologically fractured world. By comparing the two superpowers alongside two of their most important satellites, it is possible to trace the many divergences and common threads around ideas of cybernetics and socio-economic progress. For politicians and economists in liberal countries like the United States and the Federal Republic of Germany, the pursuit of automation technologies was seen as necessary for maintaining an economic advantage

over the socialist East.[3] But in a free-market system driven by a competitive labor market, widespread automation also carried the risk of technological unemployment.[4] The free market's guarantee of high growth and low unemployment was difficult to reconcile with predictions of a highly automated future. The reception of cybernetics was hardly uniform within the West, however. As the case study of the FRG will demonstrate, West German scientists were reticent to embrace the new American science and the field ultimately became an important inspiration for artistic and philosophical projects rather than technological development.[5]

In the East, the concept of cybernetics underwent a drastic transformation from a disreputable bourgeois idea to a central pillar of economic and technological policy by the 1960s.[6] For socialist planners and party ideologues in the Soviet Union and the German Democratic Republic, industry robots and automation technologies held the key to closing the productivity gap and asserting the viability of socialist economic organizing. As Soviet Premier Nikita Khrushchev was quoted as saying: "Integrated mechanization and the automation of production processes constitute the chief and decisive means for ensuring further technical progress in the economy and, on this basis, a new rise in labor productivity, the lowering of cost prices, and the improvement of the quality of products."[7] Inside socialist regimes, where the job guarantee formed the bedrock of a supposedly more just and humane economic system, unemployment arising from cybernetics

[3] See Thomas Rid, *Rise of the Machines: The Lost History of Cybernetics* (Melbourne: Scribe, 2017), 73-112; and Frank Biess, "Modern Angst," in *German Angst: Fear and Democracy in the Federal Republic of Germany* (Oxford: University Press, 2020), 131–57.
[4] For background on the concept of technological unemployment, see Riccardo Campa, "Technological Unemployment : A Brief History of an Idea," *Orbis Idearum* 6, no. 2 (2018), https://doi.org/10.26106/FJPF-2T98.
[5] Philipp Aumann, "The Distinctiveness of a Unifying Science: Cybernetics' Way to West Germany," *IEEE Annals of the History of Computing* 33, no. 4 (April 2011): 17–27.
[6] Slava Gerovitch has written extensively on the early reception of cybernetics in the Soviet Union: Slava Gerovitch, "'Russian Scandals: Soviet Readings of American Cybernetics in the Early Years of the Cold War," *The Russian Review* 60, no. 4 (2001): 545–68 and Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge: MIT Press, 2002).
[7] United States Congress Joint Economic Committee and John Diebold, *New Views on Automation: Papers Submitted to the Subcommittee on Automation and Energy Resources, Joint Economic Committee, Congress of the United States* (Washington: U.S. Government Printing Office, 1960), 125.

was never a pressing concern. Marxist-Leninist principles circumscribed the possibility for labor market dislocations, and a powerful beneficent state was in place to ensure the fruits of technological advancement were shared across all swathes of society.[8]

In analyzing the Soviet Bloc, this study will consciously challenge any monolithic conception of the socialist world by examining disagreements between Soviet scientists and exploring how the German Democratic Republic pursued its own plan for industrial roboticization which diverged from similar Soviet initiatives. By the same token, the study will resist the temptation to view the postwar United States as a capitalist utopia in which economic growth was a panacea to socio-economic challenges. Through reading congressional testimony, intelligence reports, and published debates alongside the pamphlets of student organizers in the 1960s, a new landscape of dissent around the themes of automation and fair work will be brought to light. Outside of the United States, the Federal Republic of Germany provides another example of a growing liberal state in which the twinned promise and threat of automation generated diverse responses from within labor unions, as well as philosophical and artistic communities.

This study also aims to offer a new perspective on the 1960s as an era of technological radicalism. This new perspective highlights how ideas about cybernetics and automation spurred calls for radical social change in both capitalist and socialist contexts. Cybernation theorists in the United States were involved with the New Left and student organizers, but they constituted a distinct group of reformists, who placed greater emphasis on the perils and promise of technological upheaval. In the Socialist Bloc, proposals for a networked Soviet Union and Walter Ulbricht's commitment to socialist modernity represented a form of radicalism that challenged

[8] Jérôme Segal, "Kybernetik in der DDR – Begegnung mit der Marxistischen Ideologie," *Dresdner Beiträge zur Geschichte der Technik und der Technikwissenschaften* 27 (2001): 47-50; Manfred G. Schmidt, "Social Policy in the German Democratic Republic," in *The Rise and Fall of a Socialist Welfare State: The German Democratic Republic (1949-1990) and German Unification (1989-1994)* (Berlin: Springer-Verlag, 2013), 32-38.

basic communist tenets. Technological radicalism was largely distinct from the global protest movement that culminated in 1968 and was often decoupled from other sixties-era reforms, such as calls for increased freedoms and sexual liberation.[9] Like other reforms which captured attention throughout the decade, many of the promises from technological radicals were left unfulfilled. But the potency of arguments around technological change and the widespread interest in automation makes technological radicalism an important aspect of 1960s reform efforts.[10] At base, this project seeks to broaden the traditional view of the decade to include an overlooked group of tech-focused thinkers, who saw cybernetics and automation as an inspiration for foundational social change. Alongside the famous hippies from Berkeley, MIT also offered its own form of sixties radicals.[11]

Cybernetics, Automation, Cybernation, and Industry Robots - A word on terminology

Throughout the period in question, a variety of terms were used to describe how new technologies could displace workers, affect levels of unemployment, and improve economic productivity. The terms cybernation, automation, and roboticization were frequently used interchangeably although each had distinct intellectual lineages. The lack of consistent terminology reflected the highly fluid and rapidly evolving nature of thought around cybernetic ideas throughout the postwar period. This study will try to be as precise as possible when using the above terms to draw attention to interesting semantic patterns which emerged around the effects of technology on labor. This dissertation is not an intellectual history of cybernetics, automation, or cybernetics, but rather a study of how these ideas were received, understood, and modified in different contexts. By taking

[9] James Miller has noted the influence of SDS on aspects of the Triple Revolution Report in James Miller, *Democracy Is in the Streets: From Port Huron to the Siege of Chicago* (Cambridge: Harvard University Press, 1994), 192.
[10] See Howard Brick, *Age of Contradiction: American Thought and Culture in the 1960s* (Ithaca: Cornell University Press, 2000) for a thorough account of American radicalism during the decade.
[11] Thank you to Paul Betts for the Berkeley-versus-MIT formulation.

this approach, we can observe how ideas from cybernetics spawned related concepts like *cybernation* in the American 1960s or *industry robots* in 1970s East Germany.[12] Through drawing attention to this linguistic evolution, this study argues that the idea of cybernetics became more concrete from the 1950s onward as real-world applications for self-regulating technologies were implemented. The linguistic transformation of cybernetics into concepts like cybernation, industry robots, or microelectronics highlights how postwar thinkers came to terms with new technologies and their attendant economic effects.

Because many cognate, but distinct terms will be discussed throughout the text, it is important to offer a brief overview for the reader. As noted above, the idea of cybernetics has a clear lineage which is traceable to Norbert Wiener's work from the 1940s. The ideas behind cybernetics built on many intellectual predecessors, which the historian Thomas Rid has carefully enumerated in his work on the topic, but the idea most relevant for the current study is cybernetics' roots in Wiener's wartime study of missile defense systems.[13] The birth of cybernetics in the aftermath of the Second World War and the infancy of the Cold War imbued the term with two valences: fear and emancipation. The fear valence emerged in the wake of wartime destruction and after the invention and deployment of nuclear weapons in the 1940s. Wiener, who was an avowed pacifist, understood the wide-ranging social and economic impacts of his new discipline, and his 1950 book, *The Human Use of Human Beings*, reflected on the dangers of cybernetic technologies if applied to violent ends.[14] Fear of cybernetics also arose from concerns around technological unemployment, in which cybernetically controlled devices replaced human labor.[15] The second

[12] See Michael, *The Silent Conquest* and Irene Fischer and Karl Hartmann, *Industrieroboter im Sozialismus* (Berlin: Dietz, 1983).
[13] Rid, *Rise of the Machines*, chapter two.
[14] Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (Boston: Houghton Mifflin, 1950).
[15] Wiener.

valence associated with the emancipation emerged in the 1950s when the term was received in the Soviet Union. While cybernetics posed philosophical challenges to Marxist-Leninism, socialist ideologues came to champion cybernetics and emphasize its emancipatory qualities when deployed within a communist framework. [17]

The chapters on the United States and the Soviet Union will examine more closely the evolving meaning of cybernetics, but from the outset, the real-world impact of cybernetics aroused fear, as well as excitement. Although embroiled in ideological conflict from the beginning, cybernetics rapidly established itself as a stand-alone scientific discipline during the 1950s. Mathematicians, biologists, and engineers in the United States, the Soviet Union, and in both Germanys filled the ranks of government and industry-led cybernetic initiatives. There exists a rich body of literature on the scientific development of cybernetics, and its relationship to the burgeoning fields of computer science and information technology which will only be referenced tangentially throughout this study.[18] The present inquiry will instead focus on the social and economic implications of cybernetics and related disciplines.

The term automation also appears frequently in this study. Numerous sources from the Soviet, American, and German contexts track automation as an economic trend resulting in greater utilization of automatic processes - either mechanical or digital - in the production of goods or rendering of services. The term automation does not necessarily entail negative economic consequences, and many accounts from the socialist context promoted automation as a tool for

[17] While other authors have written on Soviet cybernetics in the last few decades, they rely heavily on Gerovitch's work and, with the exception of Peter's *How Not to Network a Nation*, largely rehash the arguments advanced by Gerovitch: see Benjamin Peters, "Normalizing Soviet Cybernetics," *Information & Culture* 47, no. 2 (2012): 145–75; Egle Rindzeviciute, "Purification and Hybridisation of Soviet Cybernetics: The Politics of Scientific Governance in an Authoritarian Regime," *Archiv für Sozialgeschichte* 50 (January 1, 2010): 289-309.

[18] For an overview, see W. Ross Ashby, *An Introduction to Cybernetics* (Eastford: Martino Fine Books, 2015); Stuart A Umpleby, "A History of the Cybernetics Movement in the United States," *Journal of the Washington Academy of Sciences* 91, no. 2 (2005): 54–66; V. N. Sadovskiĭ and Stuart A. Umpleby, *A Science of Goal Formulation: American and Soviet Discussions of Cybernetics and Systems Theory* (New York: Hemisphere, 1991).

economic and social betterment. In the American and West German contexts, discussion of automation was frequently linked with the notion of technological unemployment, through which increased mechanization led to displaced workers. The historian Ricardo Campa has documented the intellectual heritage of "technological employment" back to Adam Smith and David Ricardo, but he calls particular attention to the idea in the 1930s when John Maynard Keynes came to view unemployment through technological innovation as a "new disease."[19] In contrast to the economic conditions of the 1930s when Keynes was writing, economic expansion in the 1950 and 1960s did not quell concerns about technological unemployment in the capitalist West. The concept of losing one's job at the hands of robots forms a central theme in this study and will be explored from the perspective of workers and owners alike.

The term cybernation, first coined in a 1962 report entitled, *Cybernation: The Silent Conquest*, became a touchpoint for new debates about labor and welfare policy in the United States. The term was coined as a combination of the words automation and cybernetics, and its widespread use among policymakers and activists in the 1960s United States reflected the increasingly practical concerns associated with cybernetic technologies. Unlike its intellectual predecessor, cybernetics, cybernation was an explicitly social, economic, and even cultural concept that galvanized a set of thinkers to develop new ideas about wealth distribution and fairness within capitalism. The discursive move from cybernetics to cybernation, which was driven by a group of American intellectuals associated with the 1964 Report on the Triple Revolution, underscores the application of academic concepts like cybernetics into actionable policy proposals.[20] The idea of cybernation generated an outpouring of radical policy initiatives, such as

[19] Campa, "Technological Unemployment. A Brief History of an Idea," 68.
[20] The Ad Hoc Committee on the Triple Revolution, "The Triple Revolution" (Santa Barbara: Center for the Study of Democratic Institutions, 1964).

a guaranteed annual income, and succeeded in bringing the ideas of cybernetics and automation into a broader sphere of public discourse in the 1960s United States.[21]

The final major term to define is industry robots. Although the idea of deploying robots in an industrial setting was discussed widely throughout the postwar period, the term *Industrieroboter* become a particularly important theme in East German economic policy in the 1970s and 1980s. Unlike the academic study of feedback loops, which lay under the aegis of cybernetics or the socio-political concerns of American cybernation theorists, industry robots in East Germany represented a tangible, albeit illusory, solution for poor productivity in the 1970s. The deployment of industry robots and related microelectronic programs in the GDR epitomized the socialist effort to unify economic and social progress.[22] Within East Germany, industry robots were regarded as a solution to endemic labor shortages and talent misallocation, all while improving the conditions of workers.[23] Although the promised benefits of industry robots never materialized in the GDR, widespread use of the term offers further evidence to suggest that language around cybernetics and automation reflected increasingly practical applications by the 1970s and 1980s.

The four terms discussed above - cybernetics, automation, cybernation, and industry robots - appeared in each of the four states covered in this study, and the terms will be used across all the chapters. Nonetheless, individual chapters will emphasize each of these ideas as reflected in the source material from the respective contexts. Although developed in America, cybernetics - both as a field of study and object of popular interest - had wide currency within the USSR, and the chapter on the Soviet Union will draw particular attention to this facet of technology and the

[21] Daniel Bell, *The Coming of Post-Industrial Society: A Venture in Social Forecasting*, Special anniversary ed. (New York: Basic Books, 1999), xxi.
[22] Dorothee Wierling, "Work, Workers, and Politics in the German Democratic Republic," *International Labor and Working Class History* 50, no. 50 (1996): 44–63.
[23] For an insightful overview of the challenges faced by the East German economy, see André Steiner, *Überholen ohne einzuholen: die DDR-Wirtschaft als Fussnote der deutschen Geschichte?* (Berlin: Links Verlag, 2006); André Steiner, *Von Plan zu Plan: eine Wirtschaftsgeschichte der DDR* (Munich: Deutsche Verlags-Anstalt, 2004).

economy. In the American context, the idea of cybernation will receive special attention, and within East Germany industry robots will be discussed extensively. Within the Federal Republic of Germany, the twinned notions of cybernetics and automation attracted particular attention from workers and policy makers, but the application of cybernetic ideas to computer art formed the most important legacy of West German cybernetics. As noted, the above distinctions should not be understood as hard categories, but rather as thematic entry points into the various geographic, political, and socio-economic contexts considered by this study.

Pillars of the Argument

Through placing cybernetics in a rich historical context, this study will break new ground by uncovering how the understanding of technological and economic progress was contingent on ideological imperatives and political dictates. Across the four national case studies, several themes emerge, which guide the argument.

Theme One. Although industrial and government leaders sought similar economic goals from cybernetic applications, the social consequences of cybernated economies were understood very differently in the East and West. The potential for increased productivity, improved worker safety, and higher economic output through automated processes excited economic leaders in the US, USSR, GDR, and FRG as a method to ensure domestic economic stability and as a tool for ideological differentiation in the Cold War. Despite these similar goals, cybernation in the West was dogged by concerns about widespread technological unemployment. Technological advances were perceived by many politicians, businesspeople, and workers as a threat to American stability if the predictions for a highly automated future came true. This contrasted starkly with rhetoric in the Soviet Union and the GDR in which party leaders and economic planners extolled the virtues

of automation as a means to improve labor allocation and spare humans from the most dangerous and menial of professions. Whereas the pursuit of automation in the West was viewed by detractors as an enhanced form of capitalist exploitation, party leaders, ideologues, and economic planners, in the socialist East saw automation as a potential cure for the privations of command-control economies.

Theme Two. The prospect of widespread automation through cybernetic technologies challenged the ideological bedrock of both liberal capitalism and Soviet communism by reconceptualizing the importance of labor. As the historian Anson Rabinbach has noted, the human body was the locus of labor when the theoretical foundations for capitalism and socialism were laid in the eighteenth and nineteenth centuries.[24] In the communist context, the preeminent position afforded to the proletariat in Marx and Engels enshrined the worker as the foundational unit of a true communist society.[25] In the capitalist tradition, work was a method of social belonging and the key to upward mobility. For Smith, Ricardo, and others capitalist theorists, labor was the engine for properly functioning firms, which in turn drove economic growth and stimulated social progress. By the second half of the twentieth century, holding a good job and spending your salary had evolved into a civic virtue in what Lizabeth Cohen has termed a "consumer's republic."[26]

The final goal of automation - a fully automated economy - threatened the very core of political and social organization. This challenge to the capitalist system prompted varied reactions within the United States and West Germany, which ranged from West German workers' tempered optimism to proposals for a guaranteed annual income in the United States. The threat to state

[24] Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (New York: Basic Books, 1990), 7-9.
[25] Karl Marx, *The Communist Manifesto*, 2nd ed. (New York: Norton & Co, 2013), 2-5.
[26] Lizabeth Cohen, *A Consumer's Republic: The Politics of Mass Consumption in Postwar America* (New York: Vintage Books, 2004), introduction.

legitimacy was felt in the socialist East, as well, but the response was very different. For Soviet and East German ideologues, increased automation became closely linked with new visions of a communist utopia rooted in the belief that government oversight would ensure equitable distribution of the new surplus. Once cybernetics had been rehabilitated in the Soviet Union, socialist writers in the USSR and the GDR developed a new body of theoretical literature which reconciled automation with socialist progress by arguing that automation would improve the quality of work and permit a higher living standard for the working classes. Fears around unemployment were absent from socialist discourse both because of the job-guarantee, but also because of an economic reality characterized by labor shortage rather than surplus. Interestingly, however, contemplation of a distant future by both liberal and socialist thinkers gave rise to strikingly similar visions of a post-work world. Although significant differences existed on the path to post-work, thinkers on both sides of the Iron Curtain shared similar views on the ultimate shape of a flourishing, abundant economy.

Theme three. Cybernation was an important space for economic and social differentiation in the Cold War. The analysis of government papers from American, German, and Soviet contexts reveals how political leaders viewed cybernation as a way to distinguish their respective ideological regimes from that of their opponents. Economic and technological considerations were certainly paramount, but political leaders and even scientists invoked cybernetics as a theme to showcase the superiority of their respective ideological system. Although research into cybernetics and studies of automation were frequently sponsored by government entities, discussion of cybernetics frequently crossed borders. International conferences on robotics, automation, and cybernetics drew participants from across the world and provided opportunities for collaboration, as well as gossip and showboating about new technological developments. By considering

transnational exchanges about the political meaning of cybernetics, alongside national scientific and economic programs, this study offers new perspectives on how economic and scientific ideas were transmitted within and across Cold War boundaries.

Intervention in the Literature

As a topic of academic inquiry, cybernetics and its attendant economic and social effects has been studied from a variety of perspectives. For decades, scientists have brought biological, physical, and chemical frameworks to bear on the study of self-regulating systems.[27] As a topic of historical inquiry, automation and cybernetics has received a somewhat scatter-shot treatment in the past three decades. In the aftermath of the Cold War, historians writing in the West began to explore the unique character of Soviet cybernetics, and more recently, historical research on futurity or "futures research" has also approached cybernetics as a field which presented distinctive visions of a human future.[28] The development of cybernation theory, however, has received only scant treatment in the historical literature, and the significant interest in industry robots in the GDR has received surprisingly little coverage considering its importance to East German economic policy in the 1980s.[29]

[27] For early scientific reception of Soviet cybernetics, see, W. G. Cass, "Automation in the Soviet Union," *Nature* 176, no. 4476 (August 1, 1955): 293–95. The history of the future has emerged in the last two decades as an interesting new field in postwar scholarship, and the works of Andersson and Gilman represent important contributions in the European and American contexts respectively: Jenny Andersson, *The Future of the World: Futurology, Futurists, and the Struggle for the Post Cold War Imagination* (Oxford: Oxford University Press, 2018) and Nils Gilman, *Mandarins of the Future: Modernization Theory in Cold War America* (Baltimore: Johns Hopkins University Press, 2003).

[28] In addition to Gerovitch's works cited above, see the works of Benjamin Peters cited in note fourteen.

[29] Ralf Ahrens, "Rationalisierungseuphorie und Innovationsschwäche. Industrieroboter im Werkzeugmaschinenkombinat „Fritz Heckert" um 1980," *Technikgeschichte* 79 (January 1, 2012): 61–78; Rüdiger Hachtmann and Jennifer Walcoff Neuheiser, "Rationalization, Automation, and Digitalization," in *A History Shared and Divided: East and West Germany since the 1970s*, ed. Frank Bösch, (New York: Berghahn Books, 2018), 239–92;

It is worth reflecting on why the themes of cybernetics and automation have yet to receive systematic historical treatment. The most likely reason is found in the unrealized ambition of the cybernetics project. Whereas research into information technology, championed by the likes of Claude Shannon, Alan Turing, and John von Neumann, led to the IT revolution, the promised revolution in manufacturing did not arrive in the form predicted by many cybernation theorists.[30] Although patterns of employment underwent significant transformations in the final decades of the twentieth century, these changes were largely driven by the off-shoring of manufacturing to East Asia and the transition to tertiary service-based economies rather than massive deployment of automation technologies.[31] The fact that many predictions associated with cybernetics were not borne out probably explains its peculiar treatment in the historical literature. But the relative shortcomings of the cybernation project do not mean that the field's implications for social and economic thought were not significant. Indeed, this study hopes to demonstrate that it is more fruitful to study the social and economic understandings of cybernetics than to recreate its own intellectual evolution.

The intellectual historian Anson Rabinbach has written incisively about the relationship between humankind, labor, and machines in his work, *The Human Motor*. This study builds on Rabinbach's notion that the human body has been a "locus of labor" throughout history, but challenges Rabinbach's assertion that widespread use of machines in the post-war period diminished the metaphorical connection between the body and work.[32] The source base for this study suggests instead that the relationship between the human body and labor only increased as

[30] As discussed in chapter one, the American sociologist Daniel Bell, who argued against the cybernation frenzy during the 1960s, remarked vindictively that his predictions had been correct in an edition of *The Coming of Post-Industrial Society* from the late 1990s.
[31] Ronald Kent Shelp, *Beyond Industrialization: Ascendancy of the Global Service Economy* (New York: Praeger, 1981); Thomas L. Friedman, *The World Is Flat: A Brief History of the Twenty-First Century*, 1st ed. (New York: Farrar, Straus and Giroux, 2005).
[32] Rabinbach, *The Human Motor*, 11.

the looming potential of technological unemployment received increasing attention from the 1950s onward. A central focus of Rabinbach's work and an important theme in literature on Taylorism and Fordism was the optimization of human performance within industrial contexts. Charles Maier's important work on this topic has called attention to the application of machine-oriented principles of engineering to human labor as the driving force behind rationalization in the Taylorist and Fordist paradigms.[33]

Although similar language appeared in discussions of cybernetics, this dissertation argues that postwar discourse around automation and unemployment shared only superficial similarities with its Taylorist and Fordist predecessors. As chapter one will demonstrate, even historical actors such as the American industrialist, John Diebold, recognized cybernetics and automation as phenomena distinct from prewar "Detroit automation."[34] Whereas Taylorism and Fordism developed from industrial research into time-saving practices, cybernetics began life as a field of academic study. Furthermore, cybernation was less interested in optimizing human behavior in the factory and was more concerned with replacing humans entirely. This is not to suggest that cybernetics or worries about technological unemployment were unique to the postwar period, but rather to say that postwar concerns about automation had an intellectual heritage distinct from that of Taylorism and Fordism.

By taking a transnational approach to the theme of cybernation, this study differentiates itself from other histories of cybernetics that have focused on the nation-state. The MIT historian Slava Gerovitch has, for instance, produced extraordinary scholarship on the scientific, political, and linguistic development of Soviet cybernetics.[35] His work has shone light on what he calls the

[33] Charles S. Maier, "Between Taylorism and Technocracy: European Ideologies and the Vision of Industrial Productivity in the 1920s," *Journal of Contemporary History* 5, no. 2 (1970): 27–61.
[34] John Diebold, "Automation," *Textile Research Journal* 25, no. 7 (July 1, 1955): 635.
[35] Gerovitch, *From Newspeak to Cyberspeak*, 3.

willful misreading of cybernetic theory by communist ideologues and the mechanisms through which anti-cybernetic propaganda was amplified in the Soviet Union. [36] Gerovitch's work has also revealed the contours of Soviet cybernetic reception once the theory was rehabilitated in the mid-1950s, and his meticulous tracing of cybernetics as a language of scientific discourse provides insight into the way science was conducted within the Soviet state. Rather than rehashing Gerovitch's work on Soviet cybernetics, this study expands Gerovitch's project and examines how American scientists and intelligence officials responded to developments out of the Soviet Union. Gerovitch's work explores how the American science of cybernetics was received within the USSR, but this study focuses instead on how Soviet ideas in cybernetics were received in America. The emphasis on knowledge transfer from the Soviet Union to the United States evidences the deep respect American scientists had for their Soviet colleagues and demonstrates how seriously American intelligence authorities took the cybernetics race.[37] In the words of one American observer from 1960: "the gap [in Soviet cybernetics understanding] is neither large nor based on a lack of understanding of fundamental principles."[38]

This study also expands on Gerovitch's work by placing Soviet cybernetics within a wider context of automation research in the Eastern Bloc.[39] Detailed analysis of East German cybernetic and industry robot initiatives highlights the diverse scientific, philosophical, and economic

[36] Gerovitch, "Russian Scandals," 548-560.
[37] While no scholarship (to this author's knowledge) has studied American intelligence reception of Soviet cybernetics, some work has been done on the Cold War military applications of cybernetics: Antoine Bousquet, "Cyberneticizing the American War Machine: Science and Computers in the Cold War," *Cold War History* 8, no. 1 (February 1, 2008): 77–102.
[38] Edward Feigenbaum, "Soviet Cybernetics and Computer Sciences, 1960," *Communications of the ACM* 4, no. 12 (1961): 573.
[39] Interest in socialist cybernetics outside the Soviet Union has proven a fruitful historiographical trend in recent years and the works of Eden Medina, Egle Rindzeviciute, and Viktor Petrov, stand out as noteworthy contributions: Eden Medina, *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile* (Cambridge: MIT Press, 2011); Egle Rindzeviciute, "Constructing Soviet Cultural Policy: Cybernetics and Governance in Lithuania after World War II," (Linköping: University Electronic Press, 2008); Viktor Petrov, "A Cyber-Socialism at Home and Abroad: Bulgarian Modernisation, Computers, and the World, 1967-1989" (PhD dissertation, Columbia University, 2017).

approaches within the Soviet sphere of influence. Except for a master's dissertation from the University of Georgia, the small, but insightful body of scholarship on East German cybernetics has only been published in German.[40] The works of Jérôme Segal and Frank Dittmann have uncovered an important link between cybernetics and Walter Ulbricht's project of socialist modernity during the 1960s while highlighting the importance of socialist philosophical contributions from the likes of Georg Klaus.[41] In their exclusive focus on the 1960s, however, these studies have overlooked what I call a "cybernetic afterlife," which emerged in the form of industry robots and microelectronics in subsequent decades.

The historical treatment of industry robots in East Germany is very small compared to its Soviet counterpart, but recent scholarship by Ralf Ahrens, Rüdiger Hachtmann, and Reinhold Bauer has offered new insights into the economic goals behind the industry robot and microelectronic initiatives in the late 1970s.[42] These studies underscore the importance of industry robots for the improvement of productivity during a period of serious economic strain. This study seeks to enrich the discussion of East German industry robots by considering the wider social reception of automation initiatives and workers' responses to the robotization initiative. In addition, the historian Dorothee Wierling has documented the extent to which SED rhetoric sought to portray the unity of social and economic policy in the GDR, and the current study will demonstrate how SED ideologues developed new Marxist-Leninist justifications for increasing

[40] Kevin Baker, "Red Helmsman: Cybernetics, Economics, and Philosophy in the German Democratic Republic" (Master's thesis, Georgia State University, 2011).
[41] Segal, "Kybernetik in Der DDR – Begegnung mit der Marxistischen Ideologie"; Frank Dittmann, "Kybernetik in der DDR - Eine Einstimmung," in *Kybernetik steckt den Osten an: Aufstieg und Schwierigkeiten einer interdisziplinären Wissenschaft in der DDR*, ed. Frank Dittmann and Rudolf Seising (Berlin: trafo, 2007).
[42] See Ahrens, "Rationalisierungseuphorie Und Innovationsschwäche. Industrieroboter im Werkzeugmaschinenkombinat „Fritz Heckert" Um 1980"; Reinhold Bauer, "Ölpreiskrisen und Industrieroboter: Die siebziger Jahre als Umbruchphase für die Automobilindustrie in beiden deutschen Staaten" (Göttingen: Vandenhoeck & Ruprecht, 2008); Hachtmann and Neuheiser, "Rationalization, Automation, and Digitalization" in *A History Shared and Divided*.

levels of automation from the 1960s to the 1980s.[43] The findings of this study suggest that workers in the East exhibited relatively little concern about the destabilizing effects of a more automated economy and in fact embraced the possibility that machines could alleviate them of the more taxing and strenuous elements of their work.

The preponderance of historical literature on cybernetics has taken a decidedly nationalist frame, but the works of Paul Edwards and Antoine Bousquet have gone the furthest to situate cybernetics in a transnational setting. Unfortunately, the largely military focus of Edwards and Bousquet's works neglects a wider body of sources and fails to place cybernetic discourse in a broader socio-economic conversation.[44] Although Bousquet and others correctly identified the wartime origins of Norbert Wiener's cybernetics, their work does not engage sufficiently with cybernetics' relationship to technological unemployment, automation, and robotization. Paul Edwards' work on the role of computers in the Cold War helpfully elucidates the potential military applications of automated weapons, but the present study proposes that Cold War competition over cybernetics was more closely linked to questions of economic progress than weaponry. While it is true that American intelligence agencies took great interest in socialist cybernetics initiatives, they were primarily concerned with ensuring American superiority in computing power and economic competitiveness.

In the last decade, scholarship on past futurities has shed new light on how historical actors imagined what the future might look like. Long the realm of science fiction and prognosticating, futures research intersects nicely with the study of cybernetics as notions of automation were invariably tethered to new ideas about future economic organization. While the present study does

[43] Dorothee Wierling, "Work, Workers, and Politics in the German Democratic Republic," 44–50.
[44] Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge: MIT Press, 1996); Bousquet, "Cyberneticizing the American War Machine."

not position itself as a direct contribution to the field of futures studies, it will certainly draw on methodologies used by historians like Jenny Andersson and Thomas Rid. Andersson's 2018 work, *The Future of the World*, has traced how the idea of the future percolated through government agencies in the United States as well as select countries in the socialist East during the 1960s and 1970s. [45] Her argument that ideas about the future produced artifacts that informed later generations is well-reasoned, and this work hopes to show how futurist thinkers outside of government, such as Robert Theobald and Daniel Bell, also helped sculpt new future imaginaries in the 1960s. Thomas Rid, whose popular and well-researched history of cybernetics, *The Rise of the Machine: The Lost History of Cybernetics* has been particularly successful in relating cybernetic thought to cultural depictions of the future throughout the 1950s and 1960s.[46] The present study doesn't directly break from the works of Rid or Andersson but rather focuses more on practical cybernetic initiatives. In this way, the work takes a less theoretical approach than Andersson and prefers to view cybernetics as an field of technical, philosophical, and artistic inquiry which had the potential for proximate economic and social effects.

Rid's study represents the most thorough examination of cybernetics in the United States, but the study of cybernation - the distinctive American term from the 1960s – is largely overlooked.[47] Cybernation has received brief attention from historians of welfare reform, such as Gareth Davies, Desmond King, and Brian Steensland who have drawn attention to the connection between Great Society reforms under Lyndon Johnson and emergent interest in cybernation.[48]

[45] In particular, see chapters five and seven in Andersson, *The Future of the World*.
[46] Rid, *Rise of the Machines*, 156-194.
[47] While Rid does mention cybernation and provide a brief discussion of the Report on the Triple Revolution, he provides virtually no context on the intellectual backstory of cybernation theorists, like Theobald and Michael.
[48] Gareth Davies, "War on Dependency: Liberal Individualism and the Economic Opportunity Act of 1964," *Journal of American Studies* 26, no. 2 (1992): 205–31, https://doi.org/10.1017/S0021875800030760; Brian Steensland, *The Failed Welfare Revolution: America's Struggle over Guaranteed Income Policy* (Princeton: Princeton University Press, 2008); Desmond S. King, *Actively Seeking Work?: The Politics of Unemployment and Welfare Policy in the United States and Great Britain* (Chicago: University of Chicago Press, 1995).

Unfortunately, this coverage of cybernation theory has ignored important contributions from intellectuals like Daniel Bell and Robert Heilbroner who directly challenged the predictions of cybernation theorists during the 1960s. By examining how the works of the cybernation theorists like Robert Theobald were read by academics like Bell, as well as student organizers at the University of Chicago, this dissertation will demonstrate a greater sphere of influence for cybernation theory than has previously been recognized. The view of cybernation also expands Andersson's conception of futurity from the 1960s and hopefully enriches our understanding of cybernetics by tracing its intellectual offspring.

Cybernetics did not become a major field of academic research in the Federal Republic of Germany, due both to skepticism about cybernetics' totalizing claims and relatively little need for automated manufacturing in a period of enormous economic expansion and low unemployment. Philip Aumann's work on the technical history of West German cybernetics provides a detailed account of the discipline's scientific development and the FRG's contributions to biological cybernetics.[49] Alongside Aumann's work on scientific cybernetics, the works of Joachim Radkau and Frank Biess have illuminated interesting philosophical debates about automation among West German intellectuals like Friedrich Pollock, Helmut Schelsky, and Arnold Gehlen.[50] Biess and Radkau's respective works have covered this subject thoroughly and instead of rehearsing their explication of these debates, this study argues that West Germany's most important contribution to cybernetics emerged from the world of aesthetics and visual arts. As chapter two will highlight, an impressive body of philosophical and artistic work from the likes of Max Bense, Abraham

[49] Philipp Aumann, *Mode und Methode: Die Kybernetik in der Bundesrepublik Deutschland* (Göttingen: Wallstein, 2009).
[50] Joachim Radkau, *Geschichte der Zukunft: Prognosen, Visionen, Irrungen in Deutschland von 1945 bis heute* (Munich: Carl Hanser Verlag, 2017); Biess, "Modern Angst."

Moles, Frieder Nake, and Georg Nees made West Germany the center for cybernetic artistic output during the 1960s.[51]

Transnational and Comparative History: A Fruitful Analytical Tension

This study will build on both transnational and comparative frameworks to help understand the geopolitical, economic, and philosophical significance of cybernetics during the postwar. The historian Patricia Clavin has described transnational history as an analytical framework that focuses on transcending geopolitical divisions and emphasizes ideological exchanges uninhibited by national boundaries.[52] This approach is clearly well-suited to the study of cybernetics and automation, and this dissertation makes a conscious effort to examine how ideas about automation were transmitted across political boundaries. When approached from a transnational perspective, the boundary between socialist and capitalist thought about automation appears more porous than it otherwise would. What is more, the exchanges of idea about automation and cybernetics flowed in both directions as the chapters on the Soviet Union and the two Germanys will highlight.

The impulse in recent historical scholarship to shift analytical categories away from the monolithic nation-state has proven immensely profitable for the study of cybernetics, but there is also reason to proceed with caution. Although ideas and goods did cross borders, the nation state remained the dominant geopolitical unit during the Cold War, a period when political boundaries were defended with particular ferocity. The present study, therefore, will not shy away from drawing hard distinctions between national contexts and pointing to clear points of differentiation

[51] Christoph Klütsch, "Information Aesthetics and the Stuttgart School," in *Mainframe Experimentalism: Early Computing and the Foundation of the Digital Arts*, ed. Hannah Higgins and Douglas Kahn (Berkeley: University of California Press, 2012), 65–89; Georg Vrachliotis, "Zwischen Automation und Metatechnik," in *Geregelte Verhältnisse: Architektur und technisches Denken in der Epoche der Kybernetik* (Berlin: Birkhäuser, 2020), 66–83. Felicia Hönig, "Kunst und Kybernetik" (Master's thesis, Vienna, University of Vienna, 2008).
[52] Patricia Clavin, "Defining Transnationalism," *Contemporary European History* 14, no. 4 (2005): 429-431.

which mirrored political boundaries. The historian J.H. Elliot's insightful study of comparative history has traced the productive tension that has emerged from interrogating similarities and differences across national and chronological contexts. This author wholeheartedly agrees with Elliot's eloquent formulation that "to compare and connect are, and should be, treated as two sides of a single coin." [54]

The analytical framework of choice must be driven by the source base, so it is necessary to justify why a comparative lens is suited to the present inquiry. First, the availability of source material, such as international congresses on cybernetics, robotization, and automation make it straightforward to compare how actors with different geopolitical affiliations distinguished themselves in an international setting. Second, one can trace how the idea of cybernetics spread beyond the United States by examining the foundation of cybernetic institutes and schools in various nations both within the West and East. Finally, a wealth of sources about the economic, political, and philosophical implications of cybernetics and automation is available for the four states in question. This allows for fruitful and relatively direct comparisons between the writings of party ideologues in the East and think tank technocrats in the West.

The divergence between the socialist and capitalist receptions of cybernetics is particularly interesting because cybernetic theorists from both contexts were largely in agreement about the technical foundations of the discipline. A common understanding of the field's scientific specifications did not, however, overcome entrenched beliefs about economic and social organizing. Despite these differences, thinkers on both sides of the Iron Curtain demonstrated remarkable mental flexibility in adapting their respective ideologies to the promise of a cybernated future. In the West, many commentators were willing to rethink fundamental principles of

[54] J. H. Elliott, *History in the Making* (New Haven: Yale University Press, 2012), 182.

capitalist organization and many thinkers in the East also demonstrated ideological flexibility in adjusting Marxist-Leninist doctrine to fit within cybernetic frameworks.

Although this study mainly addresses itself to "macro" themes such as economic and technological policy, significant effort is made to understand how non-elites responded to developments in cybernetics. Interest in automation technology from labor unions shows that although developments in cybernation were driven by scientific and policy experts, workers were both interested in and worried about how new technologies could impact their daily lives. Wherever possible, this dissertation draws from published and unpublished accounts of workers in the West and East who directly experienced the effects of automation and robotics initiatives.

The Source Base

Like the discipline itself, the reception of cybernetic thought varied enormously across national contexts, a fact which necessitates a similarly wide source base. Because the goal of this project is to understand how ideas around cybernetics and automation were understood and debated in the public sphere, published primary sources form a significant part of the source group. Despite an emphasis on published primary sources, this study also draws from extensive archival work from the German Federal Archives and declassified intelligence reports from the United States. While some of these sources were not in public circulation, they still provide important insight into governmental perspectives on automation and cybernetics in a period where competition over these topics were important geopolitical and economic concerns.

The source base for the study of American cybernation draws on the published works of numerous cybernation theorists, including Robert Theobald, Donald Michael, and Robert Heilbroner. While not mainstream figures in the New Left, these thinkers published extensively

on themes of abundance, automation, and cybernation throughout the postwar and helped influence debates about welfare policy during the 1960s. The Report on the Triple Revolution, which was delivered to President Lyndon Johnson in 1964, became the most famous example of cybernation theory, and the analysis of works from Theobald, Michael, and others illustrates the intellectual backstory that gave rise to the report. Later in the decade, cybernation became the subject of a prominent public debate in the *New York Review*, which is analyzed extensively as an important turning point in which high-profile public intellectuals, such as Daniel Bell, engaged with proposed social reforms like the guaranteed annual income. By contextualizing the works of cybernation theorists within broader concerns around welfare reform, the first chapter elucidates a largely overlooked segment of 1960s radical reform, which emerged from concerns over a highly automated future. In addition to published debates, chapter one also examines the Guaranteed Annual Income Newsletter (GAIN), a student-run newsletter from the University of Chicago, which provides evidence for grassroots interest in a basic income. This fascinating source, which was only made available by one of its founding editors in 2019, provides a new perspective on how concerns about cybernation were understood and disseminated to a non-expert audience throughout the 1960s.

Over the past two decades, the Freedom of Information Act (FOIA) Reading Room has declassified a range of intelligence materials from the CIA, the RAND Corporation and other government bodies on the topics of cybernetics, automation, and economic planning. American intelligence studies offer insight into the geopolitical dimensions of cybernetic reception and reveal how American scientists and intelligence analysts tracked automation research in the socialist East. A particularly valuable and largely overlooked source is the classified *Soviet Cybernetics Review* (SCR), a publication from the RAND Corporation which translated and

analyzed thousands of Soviet documents relating to cybernetics. The volumes of the SCR, held at the British Library, afford detailed analysis of Soviet scientific and political documents about cybernetics accompanied by commentary from American intelligence officials and scientists. For a study of cybernetic reception during the Cold War, the SCR is a treasure trove and chapter three's analysis of these documents aims to uncover a rich space of cybernetic debate within the Soviet Union and the United States.

Once cybernetics became an ideologically acceptable field in the late 1950s, a large body of published works appeared in the Soviet Union and across the Socialist Bloc. The *Fundamentals of Marxism-Leninism*, which appeared as a replacement for Lenin's *Short History* in 1960, described for the first time a new communist futurity built on high levels of automation. *Fundamentals* was an important document not only for its discussion of automated communism, but also because it opened the door for many socialist thinkers, including the Czech Arnosht Kolman, the East German Georg Klaus, and the Hungarian Maxim Paloczi-Horvath to begin publishing about cybernetic communism. The works of Kolman, Paloczi-Horvath, in addition to the published works of Soviet scientists like Viktor Glushkov and Andrey Kolmogorov, expanded on the ideas from *Fundamentals* and advanced public debates about cybernetics in the Soviet Union.

In the German Democratic Republic, the works of Georg Klaus and his many students form the basis for the study of cybernetic ideas under Ulbricht. Klaus, a famous communist ideologue and professor of philosophy, championed cybernetics throughout the decade and his many published works were the primary instigators for East German cybernetic debates. In addition to the monographs from Klaus and his students, a variety of articles from party journals, including *Einheit* and the *Deutsche Zeitschrift für Philosophie*, highlight the many responses to cybernetic

socialism, which ranged from passionate opposition to optimistic embrace. As a complement to these public debates, materials from the *Stiftung Archiv der Parteien und Massenorganisation der Deutschen Demokratischen Republik* (SAPMO) housed in the German Bundesarchiv evidence interest in cybernetics from SED leaders, like Günter Mittag, Erich Apel, and Walter Ulbricht. SAPMO also contains numerous internal party documents relating to the industry robot and microelectronic initiatives from the late 1970s and 1980s, which reveal how party leaders like Erich Honecker reversed their opposition to technological investment in response to rising debt levels and high oil prices. SAPMO's collection of documents from the *Freier Deutscher Gewerkschaftsbund* (FDGB) also offers a view onto the ways East German labor responded to automation initiatives in individual factories. These accounts provide an interesting counterpoint to the ideological tracts commissioned by the *Parteihochschule "Karl Marx" beim ZK der SED*, which consisted largely of simplistic propagandistic tropes.

Across the wall in the Federal Republic of Germany, labor unions organized conferences about automation, and the proceedings from a series of meetings by the Industrial Union of Metalworkers or *Industriegewerkschaft Metall* (IG Metall) illustrate how West German and international labor leaders responded to automation in a capitalist context. These meetings, which took place in the early 1960s, followed a decade of sensationalistic coverage of so-called "thinking machines" in popular publications like *Der Spiegel* and monographs, such as Rolf Strehl's *Die Roboter sind unter uns* and Robert Jungk's *Tomorrow is Already Here*.[55] The early treatment of cybernetic ideas in these publications sheds light on skepticism towards American notions of progress in the early FRG. Despite West Germany's relatively small contribution to scientific cybernetics, new aesthetic and artistic schools emerged during the 1960s which applied ideas from

[55] Rolf Strehl, *Die Roboter sind unter uns. Ein Tatsachenbericht* (Oldenburg: Gerhard Stalling, 1952); Robert Jungk, *Tomorrow Is Already Here* (London: Hart-Davis, 1954).

cybernetics to the realm of artistic production. The pioneering works of Max Bense and Abraham Moles, and their contributions to the Ulm School of Design and the Stuttgart School of Computer Art form the basis for chapter two's investigation of Generative Aesthetics. The analysis of West German cybernetic art also explores the visual art produced from the likes of Frieder Nake and Georg Nees, two of the most important exponents of early computer art, who were both students of Bense and Moles. These early forms of computer art quickly spread beyond the FRG and exhibitions of cybernetic art were held in London and the United States throughout the 1960s and 1970s. Analysis of these exhibitions and the philosophical works of West German cybernetic philosophers supports the argument that the FRG's most important contribution to cybernetic came from the world of design aesthetics rather than science.

Whether it was American intelligence operatives, East German philosophers, Soviet scientists, or West German artists, the idea of self-regulating feedback and its implications across capitalist and communist society proved a remarkable inspiration. Even though cybernetics did not generate mass unemployment as predicted by some American commentators, forward-thinking individuals in both the West and East realized the potential for automation and computer-controlled processes to transform all facets of society. With the advent of new forms of cybernetic thought through machine learning and artificial intelligence, that potential for radical technological transformation is more real today than ever before. In this light, the thinkers and sources studied in this dissertation also offer perspective on the perennial challenge of linking scientific discovery with broader human advancement.

The Structure of the Argument

The body of this dissertation is divided into four chapters, each devoted to a national case study, and an epilogue on the cybernetic legacy. The four main chapters consider the United States, the Federal Republic of Germany, the Soviet Union, and the German Democratic Republic in turn and examine how each nation fit into the global debate about automation and its economic effects. The choice of these four countries allows for direct comparison of the two superpowers, and the inclusion of both Germanys sheds light on how mid-size powers in both East and West broke from and conformed to patterns set by the United States and the USSR.

The first chapter examines the American cybernation frenzy during the 1960s and examines the linkage between predicted automation technologies and calls for an income guarantee. After detailing the history of cybernetic thought in the United States from 1948 to 1962, the chapter explores the elaboration of cybernation theories in the works of Robert Theobald, Donald Michael, Robert Heilbroner, among others, and considers the legacy of the Report on the Triple Revolution. The reading of cybernation theorists calls attention to a unique form of social criticism that shared similarities with sixties-era counter-cultural writings but emphasized economic reorganization and technocratic solutions to poverty and inequality. American cybernation is also considered within broader welfare reform programs undertaken by the Johnson and Nixon Administrations. The chapter will demonstrate that cybernation played an important role in theorizing justifications for a basic income and helped catalyze new debates about poverty within an affluent society. The chapter ultimately posits that although the cybernation theorists' predictions were not realized, their work helped spur radical reconsiderations of the American way of life.

Chapter two pivots to West Germany and explores the varied reactions to automation within the Federal Republic's rapidly expanding economy. Initial reception of cybernetic thought in the 1950s was characterized by intense skepticism from West German journalists, and the chapter will begin by analyzing concerns about "thinking machines" and fears associated with cybernetic processes. During the 1960s and 1970s, however, labor unions in the Federal Republic took great interest in the prospect of increased automation in the workplace, and numerous reports on the topic provide insight into how workers and labor union leaders, responded to the potential for a more automated economic future. In an interesting divergence from the American example, discussion of automation in West Germany was characterized more by hope than fear of joblessness. Although technical experts in the FRG predicted that meaningful automation was unlikely for decades, workers repeatedly expressed their enthusiasm for robots and automation as tools to ease their workload and improve working conditions. The chapter will suggest that low levels of unemployment in the FRG likely accounted for the largely optimistic attitude toward increased automation. The second half of the chapter will trace the intellectual lineage of cybernetic art and study the philosophical and artistic contributions from Max Bense, Abraham Moles, Frieder Nake, and Georg Nees among others. In contrast to its relatively stagnant scientific research, artists in the FRG were at the center of a new movement of computer art which drew directly on ideas from cybernetics. Analysis of Generative Aesthetics, Information Aesthetics and early digital art will demonstrate how individuals outside of science and economic planning drew upon cybernetics to enhance their own aesthetic pursuits.

The third chapter crosses the Iron Curtain and probes how Soviet scientists and party ideologues tried to adapt cybernetic technologies to state socialism. The chapter briefly recounts the early history of cybernetic reception before offering a close-reading of revisions to the

Fundamentals of Marxism-Leninism from 1960. This text, which provided the ideological justification for Soviet socialism after the turn away from Stalinism, propounded a new theory of socialist utopia explicitly linked to automation technologies. The context to this development is explored by examining speeches from Soviet leaders, who accorded cybernetics increasing importance from the mid-1950s onward. Of particular note are the vehement pronouncements from Nikita Khrushchev which led to the establishment of a large cybernetic research infrastructure across the Soviet Bloc from 1955 onward. The explosion in Soviet cybernetic research unsurprisingly caught the attention of the American intelligence community, and the second half of the chapter explores American surveillance and reporting on Soviet cybernetics. Although short-lived, American reporting on Soviet cybernetics developed into something of a cottage industry with accompanying scholarly journals and publications that were circulated to a small but committed readership. Whereas the first chapter emphasizes how discussion of cybernation is best understood within the context of national concerns within the United States, the chapter on the Soviet Union exposes cybernetics as a rich field of transnational exchange.

The fourth chapter turns to the German Democratic Republic's two-pronged engagement with cybernetic thought: first in the 1960s and then again in the late 1970s and 1980s. Following the Soviet example, East German philosophers began a new project of cybernetic socialism throughout the 1960s. As the chapter will argue, these works were significantly more radical than their Soviet counterparts, and during Ulbricht's period of socialist modernization, East German thinkers had wide latitude to adapt traditional Marxist principles to new ideas from cybernetics. Although these revisions represent a fascinating chapter of socialist ideological development, they did not survive Ulbricht's replacement by Erich Honecker in 1971. Even though cybernetic language largely disappeared in the early 1970s, the ideas and ideological framing from the 1960s

reemerged in force during the push for industrial rationalization and robotization. The second half of the chapter recounts the drive for industrial rationalization and robotization during the global economic downturn of the 1970s to demonstrate how SED leadership attempted to offset trade deficits and a ballooning debt burden through technological innovation. The East German case also witnessed the production of new ideological tracts about the impact of robotization on the principles of Marxist-Leninist thought in the context of "real-existing socialism." Although official pronouncements from the likes of Erich Honecker, Günter Mittag, and others trumpeted industry robots and microelectronics as an economic panacea, more sober economic forecasts and technological reports identified a mismatch between industrial preparedness and the desire for widespread automation. Serious deficiencies in the deployment of industry robots doomed its ultimate efficacy, but the chapter concludes by suggesting that East German leadership exhibited impressive foresight in attempting to automate East German manufacturing.

A Future That Never Was?

Much of the postwar excitement about cybernetics emerged in response to predictions about near-term technological transformations. But these transformations never arrived, at least not in the more radical forms predicted. Why, then, does cybernetic reception warrant historical study? This dissertation's concluding epilogue will reflect on the legacy of cybernetic thought and argue that cybernetics represented a prescient step towards grappling with the unexpected ways that technology can shape human society, irrespective of borders, governments, and ideologies.

Hopes and fears around technological innovation are so commonplace at present that the scientific insights of Viktor Glushkov in the Soviet Union or the early computer drawings of Georg Nees in West Germany may strike the twenty-first century reader as unimpressive. But these

contributions formed the basis of today's technologically saturated world and reveal impressive foresight into the direction, if not the exact timing, of technological change. In an interview from 1967, the leading cybernation theorist, Robert Theobald, said: "I do not see the cybernetic era as a nice easy lotus land for us to live in. I see it requiring a much higher degree of responsibility."[56] The cybernetic era, or the era of information technology as it is known now, is hardly a lotus land and the responsibilities demanded by technological progress remain largely unfulfilled. This study chronicles the contributions of historical thinkers who made early attempts to understand the higher degree of responsibility required by a technological age. It is a question that remains unanswered, yet more relevant than ever.

[56] Robert Theobald, "Interview with Robert Theobald," *Perspecta* 11 (1967): 19.

Chapter I

Postwar America – Automation in an Age of Affluence

Cybernetics and the prospect of automated industrial production were sources of both hope and fear in the United States during the 1960s. In a period where competing views of progress were contested on the streets and the halls of power, the potential for radical technological change emerged as a polarizing theme that catalyzed new debates about the responsibilities an affluent society owed to its poorest citizens. In the words of one historian, the decade was an age of "age of contradiction."[2] As American society grappled with hippiedom, sexual liberation, the Vietnam War, and the civil rights movement, Norbert Wiener's theory of cybernetics was adapted to a new social and economic context that considered the practical impacts of widespread automation. As this chapter will demonstrate, the 1960s witnessed increased popular and non-scientific engagement with ideas from cybernetics, as Donald Michael's term, "cybernation," sparked new debates about social welfare and automation.[3]

Michael's concept of cybernation first received serious attention in 1964, when a report from the Ad Hoc Committee on the Triple Revolution was delivered to President Lyndon Johnson. The report established a new basis for economic critique by arguing that a qualitative leap in productive capacity would require the establishment of a government-funded income guarantee. This was a bold claim that rested on a vision of technological progress which, until the 1960s, was little more than fantasy. But the high-profile authors of the report, a collection of prominent

[2] Howard Brick, *Age of Contradiction: American Thought and Culture in the 1960s* (Ithaca: Cornell University Press, 2000).
[3] Donald Michael, "Cybernation: The Silent Conquest" (Santa Barbara: Center for the Study of Democratic Institutions, 1962), 5-7.

thinkers associated with the New Left, including Robert Theobald, Tom Hayden, and Wilbur Ferry, were able to generate widespread interest in the cybernation revolution, as seen in a front-page *New York Times* headline, which read "Guaranteed Income Asked for All, Employed or Not."[4] The Ad Hoc Committee's report was the most publicized document in a much wider field of research and policy advocacy which investigated the scientific background and social implications of forecasted technological change. Widespread inquiry into automation and its socio-economic impacts – derisively termed the "cybernation frenzy" by its critics – offers an important window onto 1960s frameworks for economic forecasting and helps explain the intellectual context in which guaranteed income proposals gained traction.

Unlike the other three states considered in this study – the Federal Republic of Germany, the Soviet Union, and the German Democratic Republic – cybernetics inspired a novel form of social critique in the United States which aimed to replace the normal mechanisms of income distribution and welfare provision. While socialist states, like the Soviet Union and the GDR, advanced radical revisions to traditional Marxist doctrine, cybernetics and automation came to be viewed as a means for achieving a communist society, rather than a cause to reject socialist doctrine. In the United States, however, cybernation advocates advanced a program of reform that reimagined the role of the state and challenged prevailing ideas about welfare and poverty alleviation within capitalism.

Writing some forty years after the height of the cybernation frenzy, the American sociologist Daniel Bell, himself a participant in automation debates from the 1960s, reflected with knowing hindsight on this fleeting moment of technological idealism: "They [authors of the Triple

[4] "Guaranteed Income Asked for All, Employed or Not," *The New York Times*, March 23, 1964 "Guaranteed Income Asked for All, Employed or Not," *The New York Times*, March 23, 1964, sec. Archives, https://www.nytimes.com/1964/03/23/archives/guaranteed-income-asked-for-all-employed-or-not.html.

Revolution report] saw in automation and cybernation 'a new era of production' sparked by gains in productivity so large that one could cope with the disruptive effects only by severing the link between employment and income maintained by the old industrial society of scarcity and distributing the usufruct to the populace at large. But this was not to be."[5] Even if these changes did not materialize, technology certainly changed the nature and conditions of work for millions of Americans, and later commentators like Harry Braverman were quick to identify how the drive for productivity had "deskilled" the workforce and divorced the laborer from his handiwork.[6] The philosopher Hannah Arendt also wrote critically about technological advancements during this period, as she feared that the depersonalization of work through automation could lead to widespread alienation among the working classes.[7] But widespread technological unemployment never did arrive, and the appetite for utopian visions of an affluent society, a society in which the problem of scarcity had been superseded by the moral responsibilities of abundance, appeared largely irrelevant a mere decade after the Triple Revolution Report first reached President Johnson's desk.

This chapter departs from the existing literature by arguing that debates about automation and their potential implications for labor had a demonstrable effect on the trajectory of welfare reform policies in the United States. Earlier work on welfare reform from the 1960s has largely dismissed the debates about automation because cybernation advocates overestimated the speed of innovation and its concomitant effects on unemployment. A central contention of this chapter

[5] Daniel Bell, *The Coming of Post-Industrial Society: A Venture in Social Forecasting*, Special anniversary ed. (New York: Basic Books, 1999), XXI.
[6] Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*, 25th anniversary ed. (New York: Monthly Review Press, 1998), 3.
[7] Hannah Arendt, *The Human Condition* (Chicago: University of Chicago Press, 2018). For a discussion of Arendt's beliefs about depersonalization, see, as well, Brian Steensland, *The Failed Welfare Revolution: America's Struggle over Guaranteed Income Policy* (Princeton: Princeton University Press, 2008), chapter one, and Jenny Andersson, *The Future of the World: Futurology, Futurists, and the Struggle for the Post Cold War Imagination* (Oxford: Oxford University Press, 2018), introduction.

is that the ultimate failure of their predictive models is irrelevant to understanding the impact of their policy proposals. Even if a productivity rupture never did occur, the publicity that such predictions generated changed public and academic perceptions of technology, economic growth, and equitable social outcomes. Through examining exchanges in the *New York Review* and highlighting grassroots engagement with cybernation debates at the University of Chicago, this chapter will track how concerns about automation were understood throughout civil society and how discussion of cybernation influenced perceptions of federal entitlement programs.

Recent work on the role of economic and political forecasting by sociologist Jenny Andersson has argued that postwar visions of the future had little immediate impact in their time but helped develop "artifacts and devices" for policy analysis which have reappeared in later decades.[8] The present study both challenges and extends Andersson's argument. On the one hand, the predictions of futurists like Robert Theobald did not initiate novel redistributive social programs, such as an income guarantee, in response to fears about an automated future. On this front, Andersson's thesis seems sound, but even if an income guarantee was never enacted, concerns about cybernation and the role of technology in public and private life took on a new meaning during the 1960s. Fear of the machine and its disruptive economic and social effects were not merely artifacts which only later attained political and cultural significance.

This chapter will also contend that the related concepts of cybernation, automation, and technological unemployment forced policy makers and the American public to reexamine the role of public assistance and welfare provision. From Lyndon Johnson's War on Poverty to Nixon's failed Family Assistance Plan, the 1960s witnessed unprecedented attempts to eliminate poverty in the United States. Prior literature on the topic has concluded that a persistent symbolic division

[8] Jenny Andersson, *The Future of the World: Futurology, Futurists, and the Struggle for the Post Cold War Imagination* (Oxford: Oxford University Press, 2018), 6.

between the "deserving" and the "undeserving" poor undermined welfare reforms and contributed to the resurgence of means-tested programs in the 1970s and 1980s. Historians, such as Brian Steensland and Gareth Davies, have persuasively argued that entrenched prejudices about the psychic and behavioral causes of poverty helped kill Nixon's welfare reform bill in 1970, which included a negative income tax.[9] But recognizing the persistence of earlier beliefs about poverty, as Steensland and Davies have done, does not mean that novel ideas about technology and guaranteed income did not also shape debates about the government's role in providing for its neediest citizens. Although beliefs about deservingness certainly hindered the acceptance of new reform programs, social policy premised on the idea of a highly automated future also informed academic and public debate on the topic. The very fact that the negative income tax, a form of basic income, was included in Nixon's reform package testifies to a new belief in unconditional forms of welfare, which the cybernation theorists championed.

This chapter will demonstrate that authors like Andersson, Steensland, and Davis have, to a degree, underestimated the extent to which the specter of cybernation prompted new debates about fairness, growth, and the legitimacy of the liberal cause in an age of perceived abundance. The longtime New York Senator and writer, Daniel Patrick Moynihan, wrote incisively about the legacy of guaranteed income debates in *The Politics of a Guaranteed Income* when he suggested: "Those who call for 'fundamental social change' could , if they so desired, point to the events leading up to the proposal and near enactment of the Family Assistance Plan as evidence that 'fundamental,' rather than merely 'incremental' social change *is* a realistic option for American

[9] Brian Steensland, *The Failed Welfare Revolution: America's Struggle over Guaranteed Income Policy* (Princeton: Princeton University Press, 2008), 42-44; and Gareth Davies, "War on Dependency: Liberal Individualism and the Economic Opportunity Act of 1964," *Journal of American Studies* 26, no. 2 (1992): 205-209.

society at this time."[10] Cybernation was hardly the sole instigator of social policy innovations, such as the negative income tax or more expansive basic income proposals, but it played a significant role in preparing a fertile ground for the consideration of novel redistributive programs. This chapter will first examine the intellectual heritage of cybernation by tracing the development of Norbert Wiener's cybernetics in the 1950s to the full-fledged theories of cybernation articulated by Donald Michael and the Ad Hoc Committee on the Triple Revolution during the 1960s. The latter half of the chapter will then analyze how cybernation theorist on the left introduced a new set of value considerations into sixties-era debates about economic and social freedom.

As one of the four countries considered in this study, the United States was in many ways exceptional. Like the Soviet Union and the German Democratic Republic, American policymakers endowed cybernetics with great importance for future economic competitiveness. But unlike its socialist counterparts or West Germany, persistently high unemployment cast a shadow over debates about cybernation. Among the four states, fear of the machine was most prominent in the United States where genuine concerns about mass unemployment prompted alarmist rhetoric from many cybernation advocates. As the birthplace of cybernetics in the 1940s, the United States had come to view cybernation and automation as something of a troubled child by the 1960s.

The Birth of Cybernetics

To appreciate the context in which the 1960s cybernation frenzy emerged, it is necessary to understand how wartime technological innovations were understood in the context of the postwar economic boom. The Second World War represented both the acme and nadir of technology's transformative potential when applied to production. The unprecedented manufacture of weapons,

[10] Daniel P. Moynihan, *The Politics of a Guaranteed Income: The Nixon Administration and the Family Assistance Plan* (New York: Vintage Books, 1973), 7.

the invention of the nuclear bomb, the development of networked communication systems, and the countless engineering problems solved for the war effort gave rise to a new skepticism towards humankind's relationship with technological achievement. Many scientists, including the founder of cybernetics, Norbert Wiener, experienced something of a moral crisis as they reflected on the applications of scientific advancement to industrial warfare.[11]

The term "cybernation" was only coined in 1962, but the concept of cybernetics was already in wide currency by the end of the 1950s. By all accounts, Norbert Wiener was a first-rate mind with tremendous intellectual ambition. He completed his undergraduate degree at fourteen and was awarded a doctorate from Harvard only four years later. After a stint studying with Bertrand Russell in Cambridge, Wiener returned to the United States where he would later begin a long affiliation with the Massachusetts Institute of Technology.[12] During his career, he made numerous contributions to mathematics, but he is best remembered for his work on the theory of self-regulating machines, an interest that grew out of his wartime research in anti-missile defense systems.[13] Wiener's avowed pacifism stood at odds with applied military research, however, and after the war, he established a new field for understanding the theoretical limits and practical implications of "thinking" machines. That field became cybernetics, a word which Wiener borrowed from the Greek, *kybernetes* or "helmsman."[14] Wiener first published on the topic in his legendary 1948 book *Cybernetics: Or Control and Communication in the Animal and the Machine*,

[11] Thomas Rid, *Rise of the Machines: The Lost History of Cybernetics* (Melbourne: Scribe, 2017), 43-52.
[12] For biographical background on Wiener, see Leone Montagnini, *Harmonies of Disorder: Norbert Wiener: A Mathematician-Philosopher of Our Time* (New York: Springer, 2017).
[13] Rid, *Rise of the Machines*, 29-31.
[14] Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (Boston: Houghton Mifflin, 1950), 15.

in which he analyzed the potential uses of self-regulating machines that could automatically respond to external stimuli without human intervention.[15]

The cybernetic capacity to engage in complex, adaptable feedback cycles led Wiener to draw parallels between self-regulating machines and self-regulating biological systems, such as the human body.[16] Cybernetics proposed that the laws governing feedback within biological substrata were fundamentally the same as those found in mechanically self-regulating systems. If these systems were governed by the same basic communication mechanisms, then a sufficiently general mathematical theory of feedback could be applied across virtually any material substrate.[17] In Wiener's own words: "It is my thesis that the physical functioning of the living individual and the operation of some of the newer communication machines are precisely parallel in their analogous attempts to control entropy through feedback."[18] Wiener's polymathic tendencies and his impulse to develop a multidisciplinary science gave rise to a field that built on and influenced subjects from physiology to economics; according to cybernetics, the only difference in studying physiological, economic, or mechanical systems was the granularity of the feedback cycles. Cybernetic theory also viewed information – a non-physical, abstract entity – as the primary encoder of order within a feedback loop. The primacy accorded information was elaborated by later thinkers, including the founder of Information Theory, Claude Shannon, but from the outset, Wiener understood cybernetic systems as information-processing pipelines. At the dawn of the

[15] Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine* (Cambridge: Massachusetts Institute of Technology, 1948), 1-13.
[16] Rid, *Rise of the Machines*, 53.
[17] For more detail on the technical background of the discipline, see W. Ross Ashby, *An Introduction to Cybernetics* (Eastford: Martino Fine Books, 2015); Stuart A Umpleby, "A History of the Cybernetics Movement in the United States," *Journal of the Washington Academy of Sciences* 91, no. 2 (2005): 54–66.
[18] Wiener, *The Human Use of Human Beings*, 26.

computer age, Wiener was one of the first thinkers to place information alongside matter and energy as a primary component of the universe.[19]

The ambition of Wiener's project captured the imaginations of scientists, policymakers, military strategits, and economists across the globe. One journalist reviewing Wiener's 1948 book famously proclaimed, "[it is] impossible for anyone seriously interested in our civilization to ignore this book."[20] The Macy Conferences during the 1950s, a series of scientific symposia, in which cybernetics was debated by the likes of Wiener, Claude Shannon, and other scientific luminaries, also helped increase the academic profile of the discipline.[21] As the field made waves in the academic world, new efforts at applying cybernetics to manufacturing emerged in the United States and abroad. From the outset, Wiener was keenly aware of the potential for cybernetic technologies to disrupt social and economic structures, and his 1950 book, *The Human Use of Human Beings: Cybernetics and Society*, marked an important first step in analyzing the social effects of his new discipline.[22] In *Human Use*, Wiener imagined an automated future and engaged in an extended thought experiment about what a fully-automated car manufacturing plant would look like. Even in 1950, Wiener had anticipated the more radical predictions that would emerge in subsequent decades, when he wrote: "we can expect an abrupt and final cessation of the demand for the type of factory labor performing purely repetitive tasks."[23] At the time of publication in 1950, predictions of fully-automated manufacturing were only beginning to generate wider

[19] The cybernetic view of information became a significant stumbling block for socialist thinkers, who attempted to unify cybernetics with dialectical materialism. See chapters three and four.
[20] John B. Thurston, *The Saturday Review of Literature*, as quoted in Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine*, 2nd edition (Cambridge: MIT Press, 1965).
[21] See Heinz; Margaret Mead; Hans Lukas Teuber von Foerster, *Cybernetics: Circular Causal and Feedback Mechanisms in Biological and Social Systems, Transactions of the Eighth Conference, March 15-16 1951* (New York: Josiah Macy Jr. Foundation, 1952); Steve Joshua Heims, *Constructing a Social Science for Postwar America: The Cybernetics Group, 1946–1953* (Cambridge: MIT Press, 1993).
[22] Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (London: Eyre and Spottiswoode, 1950), 150.
[23] Ibid., 161.

interest, but as the decade progressed, economists like Robert Solow, began developing new analytical frameworks to understand the social and economic impacts productivity improvements. In his landmark 1956 paper, "A Contribution to the Theory of Economic Growth," Solow posited a new view of economic growth which held that aggregate economic output was a function of capital investment, growth of the labor force, as well as technological development.[24] The technological contribution in Solow's system came to be known as the "Solow residual," and predictions about its effects on economic growth, employment, and productivity helped placed technology at the center of later debates about economic development and structural unemployment.[25]

The applications of cybernetics to industrial production share superficial similarities with Taylorist and Fordist rationalization practices that were developed during the interwar period. At base, cybernetic industrial applications and Fordism shared a similar goal, namely the improvement of industrial productivity through better utilization of manufacturing resources and more efficient production workflows. As noted in the introduction, however, these similarities are largely superficial. Unlike Fordism, which was developed in the automotive industry and focused primarily on the standardization of manufactured goods and rationalized manufacturing practices, cybernetics emerged from the academy and began life as a theoretical discipline, concerned with the theoretical limitations of feedback mechanisms.[26] In addition, cybernetic applications to industry emphasized automation rather than regularization of manufacturing practices. For this reason, cybernetics would engender greater fear from commentators who foresaw a future in which

[24] Robert Solow, "A Contribution to the Theory of Economic Growth," *The Quarterly Journal of Economics* 70 (1956): 65-94.
[25] Bell, *The Coming of Post-Industrial Society*, 12.
[26] G. Nigel Gilbert et al., *Fordism and Flexibility: Divisions and Change* (New York: St. Martin's Press, 1992), introduction and chapter 1.

machines had fully replaced humans. The distinction between interwar rationalization practices and postwar cybernetics was also perceived by contemporary actors who recognized cybernetic-based automation as an entirely new beast. In a 1955 article, the American industrialist John Diebold remarked,

> Although they are seldom, if ever, distinguished from one another in general discussions, they are really entirely different. On the one hand we have what I call "Detroit Automation," which is really advanced mechanization but to a very high degree. On the other hand we have the whole new system of automatic feedback control which is a new technology, wonderful in its possibilities.[27]

Diebold's distinction between "Detroit Automation", a euphemism for Fordist practices, highlights the distinction between improved "mechanization" and the possibility for true automation through automatic feedback control, a prospect the industrialist appeared to embrace wholeheartedly – "wonderful in its possibilities."

The possibilities of automated production also captured the imaginations of writers and filmmakers throughout the 1950s and 1960s who speculated about fictional futures in which humans were replaced or even eliminated by machines. Wiener, already something of an academic celebrity by the 1950s, would introduce productions of Karel Čapek's 1920 play, *R.U.R.*, in which the word robot was coined, with expert commentary.[28] Writers active in the 1950s, such as Kurt Vonnegut and Frank Riley, also engaged cybernetic themes as science fiction began to emerge as a new literary genre.[29] In subsequent decades, computer and cybernetic-inspired devices would become increasingly popular in literature and film, perhaps most famously in the form of Stanley Kubrick's anthropomorphic "Hal 2000" from his 1968 epic, *2001: A Space Odysse*y. While writers

[27] John Diebold, "Automation," *Textile Research Journal* 25, no. 7 (July 1, 1955): 635.
[28] Rid, *Rise of the Machines*; Karel Čapek, *R.U.R. and The Insect Play* (Oxford: University Press, 1996). See also J. D. Naughton, *Futurology and Robots: Karel Čapek's R.U.R.* (Nottingham: University of Nottingham, 1984).
[29] Rid notes Vonnegut's *Piano Player* as an example of a work inspired by cybernetic ideas and one of the few instances when Wiener was explicitly mentioned. Kurt Vonnegut, *Player Piano* (London: Macmillan & Co, 1953).

and filmmakers certainly responded to cybernetic developments with artistic renderings of powerful computers, their engagement with the technical specifics of cybernetics was relatively limited. In *2001: A Space Odyssey*, for instance, Hal is portrayed as a fully-functioning, human-like machine, but Hal is never described in explicitly cybernetic terms.[31] As Thomas Rid has also noted in his brief account of cybernetic-related science fiction, the "cybers" in Frank Riley's 1955 story, "The Cyber and Justice Holmes", were judgment devices that replaced human courts in the judicial system.[32] But in Riley's story, the term cyber represented only a surface-level relationship with the complex feedback loops that characterized academic cybernetics. The emergence of cybernetics and the excitement around radical technological change contributed to the cultural context in which great works of science fiction emerged, but direct parallels between academic cybernetics and artistic portrayals of cybernetics were largely elusive during the 1950s and 1960s.

The economic implications of self-regulating machines and the impact of productivity increases, which inspired speculative fiction, also formed the basis of Donald Michael's inquiry into cybernation in the early 1960s. Michael, a sociologist and physicist by training, held research positions in government during the decade where he studied the impact of scientific discoveries on social policy.[33] In his 1962 report, *Cybernation: The Silent Conquest*, Michael coined the term cybernation report as a portmanteau of "cybernetics" and "automation" to describe an automated system controlled by a self-regulating machine (a computer).[34] Rising productivity levels during the 1950s, Solow's new economic accounting of technological improvements, and the development of cybernetics set the stage for a wider reconsideration of the laborer's role in a

[31] Stanley Kubrick, *2001: A Space Odyssey* (Metro-Goldwyn-Mayer, 1968).
[32] Rid, *Rise of the Machines*, 87; Frank Riley and Paul Orban, *The Cyber and Justice Holmes*, 2019, https://www.gutenberg.org/ebooks/59148.
[33] James Crowfoot, "Donald N. Michael," *The University Record*, November 20, 2000.
[34] Michael, "Cybernation: The Silent Conquest," 6.

cybernated economy. In this context, the Marxist conception of the machine as a tool for enslavement took on a new and pernicious dimension. The machine not only subordinated the human; now it could replace the human laborer altogether. While Michael did not explicitly invoke the Marxist understanding of technological exploration, he wrote in no uncertain terms about the effects of fully-functioning cybernated systems: "It is no fantasy, then, to be concerned with the implications of the thinking machine. There is every reason to believe that within the next two decades machines will be available outside of the laboratory that will do a credible job of original thinking, certainly as good as thinking as that expected of most middle-level people who are supposed to 'use their minds' […] the capabilities and potentialities of these devices are unlimited. They contain extraordinary implications for the emancipation and enslavement of mankind."[35] Although Michael's predictions from 1962 were hardly mainstream, they became increasingly influential as academic inquiry into cybernetics, economics, and social policy began to migrate into a broader field of public debate in subsequent years.

The development of cybernetics and concerns about technological unemployment emerged during a decade which saw dramatic increases in productivity and aggregate output in the United States. The three percent annual growth in total factor productivity and persistent unemployment levels in the late 1950s suggested that a structural imbalance between labor demand and supply had emerged.[36] For the cybernation theorists from the subsequent decade, the 1950s provided ample evidence that market-based systems for labor allocation would be incapable of achieving equitable outcomes in a new era of productivity and material abundance. The context of rapid economic expansion and productivity growth in the United States helps explain why some writers

[35] Ibid., 8.
[36] Harold Bowen, et al., "Technology and The American Economy," Report of the National Commission on Technology, Automation, and Economic Progress (Washington, D.C.: National Commission on Technology, Automation, and Economic Progress, April 1966), 2.

in the capitalist West responded with such radical proposals in comparison to their socialist counterparts. In contrast to the United States, poor economic performance and relative technological backwardness in the Soviet Union and the GDR made cybernetics appear a panacea to economic ills, and after cybernetics had been rehabilitated under Khrushchev, Soviet thinkers championed the discipline as a means of overcoming technological and economic deficits. As chapters three and four will discuss, the attraction of socialist cybernetics as a means to overtake the West generated optimism from planners in the East, which differed markedly from their American counterparts who feared an impending rupture in labor markets. A newfound fear of destabilizing technological process gave rise to a range of radical policy ideas in the 1960s, which attempted to prepare American market capitalism for an automated future.

From Cybernation to a Guaranteed Annual Income

In the United States, the most significant policy proposal to emerge from the cybernation frenzy was the idea of a guaranteed annual income. The range of thinkers from across the political spectrum who came to support a form of income guarantee made the concept particularly attractive during a decade of social instability and divisive foreign entanglements. An idea that found some common ground between the libertarian economist Milton Friedman and liberal futurist Robert Theobald appeared worthy of serious consideration. The divide between Friedman and Theobald came to represent the widespread appeal of basic income proposals from this decade and has provided a framework for subsequent historical inquiry into the topic, which has taken the Friedman-Theobald spectrum as a tidy reference for examining divergent schools of basic income

advocacy.[37] From as early as 1943, Friedman and George Stigler had developed a form of income guarantee, the so-called negative income tax or NIT, which recommended that households with income below a legislated threshold receive a tax rebate. For Friedman, the negative income tax would ensure a basic level of subsistence while establishing a marginal tax regime that enhanced the work incentive. [38] Friedman expanded the idea in his 1962 book, *Capitalism and Freedom,* and a form of the negative income tax would later form the centerpiece of Nixon's 1970 Family Assistance Plan. Although significant attention has been devoted to Friedman's NIT as it related to Nixon's welfare reform bill, the evolution of views represented by Theobald and other thinkers on the left has received comparatively little attention.[39] This section will demonstrate that Theobald's competing vision of an income guarantee had its roots in a moment of cybernetic enthusiasm that viewed technological advancement as a spur to widespread welfare reform.[40]

Theobald grounded his advocacy for an income guarantee on the ideas of economic abundance and something I call a "technological eschatology" which predicted an imminent economic and social transformation through the adoption of cybernation technologies. A Harvard and Cambridge-educated economist, Theobald championed a unique form of capitalist critique throughout the 1950s and 1960s that drew heavily on the ideas of abundance, technological unemployment, and social equity. Often called a futurist by his supporters and critics alike, Theobald lacked an institutional affiliation throughout his career and often self-styled as a

[37] Steensland (*The Failed Welfare Revolution)*, Van Parijs (*Basic Income: A Radical Proposal*), and Standing (*Basic Income: How We Can Make It Happen*) all read basic income debates from the 1960s according to Friedman-Theobald divide.
[38] Milton Friedman, *Capitalism and Freedom* (Chicago: University of Chicago Press, 1982), 161-167.
[39] Philippe van Parijs, *Basic Income: A Radical Proposal for a Free Society and a Sane Economy* (Cambridge: Harvard University Press, 2017), 83.
[40] Other proposals for a negative income tax were developed by left-leaning economists, such as James Tobin. Unlike the guaranteed annual income, however, NIT proposals involve a means test and are therefore unconditional. See James Tobin, "The Guaranteed Income," in *Social Policy and Public Policy*, 2nd ed. (Routledge, 1974).

"consulting economist."[41] While Theobald's writings never were best-sellers, his work provided an important theoretical and economic foundation for leftist views on capitalism and social progress. Despite their popularity within quarters of the New Left, Theobald's views on abundance and technological transformation met increasing scrutiny throughout the 1960s because of relatively slower productivity growth and government reports which undermined the credibility of the cybernation theorists' predictions. Futurists like Theobald, Donald Michael, and others leveraged predictions about technological change to justify their support of an income guarantee, and this section will highlight both the potential power and ultimate limitations of policy proposals grounded in an imminent technological eschatology.

The cybernation camp of guaranteed income advocates first gained national prominence through the report on the Triple Revolution which was sent to President Lyndon Johnson and the Department of Labor in March 1964. The report anticipated three simultaneous "revolutions" - a cybernation revolution, a weaponry revolution, and a human rights revolution – that would fundamentally transform the American social and economic order. The document was authored by the Ad Hoc Committee for the Triple Revolution which had been organized by Wilbur H. Ferry, the founder of the *Center for the Study of Democratic Institutions*, and the committee's membership read like a laundry list of the most important thinkers in the New Left. Among the more prominent cosignatories of the report were Michael Harrington, author of *The Other America*, Tom Hayden, a central figure in *Students for Democratic Society*, as well as many notable economists such as Gunnar Myrdal, Herbert Simon, Robert Theobald, and Donald Michael. As noted by historian James Miller, the influence of the New Left - as represented by Harrington, Hayden and others - is clear in the text of the report, but the work of economist-futurist Robert

[41] Stephen Silha, "Robert Theobald: The Ultimate Model of Citizenship," *Christian Science Monitor*, March 13, 2000, https://www.csmonitor.com/2000/0313/p21s2.html.

Theobald left the most significant mark on the report's conclusions.[42] The report's opening section on cybernation, which would generate the most controversy and press coverage, was effectively a summary of Theobald's thought from his earlier works *Free Men and Free Markets* and the *Challenge of Abundance*. The predicted cybernation revolution articulated a clear technological eschatology:

> A new era of production has begun. Its principles of organization are as different from those of the industrial era as those of the industrial era were different from the agricultural. The cybernation revolution has been brought about by the combination of the computer and the automated self-regulating machine. This results in a system of almost unlimited productive capacity which requires progressively less human labor. Cybernation is already reorganizing the economic and social system to meet its own needs.[43]

The report's predictions received significant coverage in a variety of national publications, including a front-page article in the *New York Times* entitled, "Guaranteed Income Asked for All, Employed or Not."[44] It is important to note that the *New York Times* headline and the accompanying article focused almost exclusively on the cybernation prong of the triple revolution. While human rights and weaponry were hardly uncommon topics in sixties-era newsprint, cybernation and the income guarantee represented a new front in leftist revisionism. The emphasis on cybernation, and in particular, the call for an income guarantee in the *Times* article, helped set the terms for debates about guaranteed income by clearly linking the ideas cybernation and income supplementation in popular press coverage.

Although the possibility of enacting an income guarantee was remote in 1964, the attention generated by the report helped bring public attention to new forms of government support, just as

[42] Miller, *Democracy is in the Streets*, 190.
[43] The Ad Hoc Committee on the Triple Revolution, "The Triple Revolution" (Santa Barbara: Center for the Study of Democratic Institutions, 1964).
[44] "Guaranteed Income Asked for All, Employed or Not," *The New York Times*, March 23, 1964, https://www.nytimes.com/1964/03/23/archives/guaranteed-income-asked-for-all-employed-or-not.html.

the Johnson Administration was laying the foundation for the war on poverty. The recommendations of the Ad Hoc Committee appeared in a political moment when American citizens actively looked to government to shape their political and financial realities.[45] Although Johnson remained opposed to any form of state-sponsored cash transfer, his commitment to eradicating poverty through government intervention reflected a widespread belief that federal initiatives should play an active role in redressing social inequities like income inequality. At a time when government willingness to undertake wide-reaching policy initiatives was especially high, the report on the Triple Revolution marked a significant, albeit unrealized, step toward using federal policies to ensure fairer socio-economic outcomes.

The Triple Revolution report also brought attention to the role of cybernation by reframing the basic economic question in terms of abundance rather than scarcity: "An adequate distribution of the potential abundance of goods and services will be achieved only when it is understood that the major economic problem is not how to increase production but how to distribute the abundance that is the great potential of cybernation."[46] A basic tenet of neoclassical economic thought holds that resource scarcity requires the calculation of precise trade-offs to optimize production in a closed economic system. Market-based exchanges in which consenting parties leverage their comparative advantages were thought to maximize overall utility under conditions of scarcity. On the neoclassical view, mitigating scarcity was the primary aim of economic processes and market participants, acting out of self-interest, would acquire goods until a change in price decreased the marginal utility of any given product.

[45] Mike Alberti and Kevin Brown, "Guaranteed Income's Moment in the Sun" (New York: Remapping Debate, 2013), http://www.remappingdebate.org/node/1867.
[46] The Ad Hoc Committee on the Triple Revolution, "The Triple Revolution."

The Triple Revolution report, however, posited that cybernation would upend traditional economic thinking about scarcity because of massive improvements in total factor productivity. The concept of abundance, which appeared only fleetingly in the Triple Revolution report became a central pillar of later guaranteed income arguments advanced by many in the cybernation camp. The idea of abundance and the transition to a post-scarcity economy had its roots in the works of Simon Patten, one of the founders of the Wharton School of Business at the University of Pennsylvania.[47] In the nineteenth century, Patten had already anticipated many of the ideas behind abundance, such as the fear that relative overabundance would lead to gluttons and inequitable wealth distribution.[48] Patten recognized that humans had been conditioned to expect conditions of scarcity, and that a serious psychic shift would be required for humans to prosper, rather than suffer in an abundant future.[49] Although Patten's work was largely theoretical and did not make near-term predictions like those advanced by Theobald, his work represented an early current in American economic thought which foresaw social and economic challenges once abundance had replaced scarcity.

By the time Robert Theobald began publishing on the topic in the 1950s, the related notions of affluence and abundance had become concerns of the present rather than a distant future. While Theobald did not explicitly draw on the work of Patten, he extensively theorized the idea of abundance through extending John Kenneth Galbraith's conception of affluence articulated in his 1958 book, *The Affluent Society*.[50] Four years after Galbraith's work first appeared, Theobald authored *The Challenge of Abundance* in which he expanded on Galbraith by arguing that the goal

[47] See Daniel M. Fox, *The Discovery of Abundance: Simon N. Patten and the Transformation of Social Theory* (ACLS History E-Book Project, 2008).
[48] Benjamin Kline Hunnicutt, *Work without End: Abandoning Shorter Hours for the Right to Work*, Labor and Social Change (Philadelphia: Temple University Press, 1988), 34.
[49] Robert M. LaJeunesse, "Simon Patten's Contributions to the Institutionalist View of Abundance," *Journal of Economic Issues*, Journal of Economic Issues, 44, no. 4 (2010): 1031.
[50] John Kenneth Galbraith, *The Affluent Society.* (Boston: Houghton Mifflin, 1958).

of development should be on improving public conditions rather than satisfying private needs.[51] Unlike the more speculative theories of Patten from the nineteenth century, Theobald took a radical stance by positing that abundance did not describe a future state of affairs, but rather served as an apt characterization of American society in the early 1960s.[52] The presence of abundance in American society was the primary evidence invoked by Theobald in his critique of neo-classical economics by arguing that market forces were incapable of ensuring equitable outcomes in a high-growth economy. This view challenged the prevailing Keynesian orthodoxy, which was credited with the postwar economic boom, by proposing a new system of post-scarcity government intervention through a guaranteed income. In this sense, the abundance argument distinguished itself from a technological eschatology by focusing on the current state of American society and economic productivity rather than emphasizing the potential future effects of cybernetic change.

Theobald's radical view that the United States had achieved an economy of abundance struck many commentators as profoundly out-of-touch with the reality of a society in which millions lived in poverty.[53] Despite the fact that Theobald's views of abundance were rejected by some critics who viewed his conception of American society as fancifully unrealistic, the idea of an affluent society, in which abundant riches should be distributed more equitably retained its power throughout the decade.[54] A report of the President's Commission on Income Maintenance Programs from 1969, entitled, *Poverty Amid Plenty*, endorsed an income maintenance program and articulated its justification in language strikingly similar to that of Galbraith and Theobald: "By approaching this goal in a manner that reaffirms our society's respect for the worth and dignity

[51] Robert Theobald, *The Challenge of Abundance*, Mentor Book (New York: New American Library, 1962), 38.
[52] Ibid., 45.
[53] Michael Harrington, *The Other America: Poverty in the United States* (Harmondsworth: Penguin Books, 1963) and Dwight MacDonald, "Our Invisible Poor," *The New Yorker*, January 19, 1963, https://www.newyorker.com/magazine/1963/01/19/our-invisible-poor.
[54] Robert L. Heilbroner, "Where Do We Go From Here?" *The New York Review*, March 17, 1966, https://www.nybooks.com/articles/1966/03/17/where-do-we-go-from-here/.

of all its citizens, we shall have recognized the responsibilities of affluence and, in doing that, we shall have improved the quality of our national life."[55] While calls for a guaranteed income differed significantly from the conditional welfare reforms enacted under Johnson, they both sought to redress the "responsibilities of affluence."

Theobald's emphasis on abundance represented a strain of techno-optimism in the cybernation camp, which viewed productivity improvements as a way to enable new forms of unconditional income distribution. Others, however, expressed reservation, and even fear about the effects of untrammeled scientific advancement. Since the human capacity to annihilate itself was first discovered in the 1940s, scientists, social theorists, and the public had developed a reasonable skepticism toward the negative externalities of technological progress. Skepticism toward technological advancement also informed debates about cybernetics and basic income, and some commentators, such as the economist Meno Lovenstein, worried that a society without an income guarantee would continue to fracture along the lines of race and class:

> Even if high levels of unemployment from cybernation were not to occur, the experience of steady redeployment, reallocation, and retraining would constitute a kind of 'disguised' technological unemployment. If a growing economy and increased demand have offset the unemployment from cybernation, still the shock to security will have occurred, even at relatively full employment. Without risking a romantic explanation of history, one can argue tenderly that human beings may sense the threat to survival even when words fail them and statistics are elusive.[56]

For Lovenstein, dramatic changes in economic production not only represented a new cause for social strife but a serious "threat to survival," which would necessitate an income guarantee. Lovenstein's language certainly represented an extreme form of a technological eschatology, and

[55] President's Commission on Income Maintenance Programs, *Poverty amid Plenty: The American Paradox; The Report of the President's Commission on Income Maintenance Programs* (Washington, D.C.: USGPO, 1969), 9.
[56] Meno Lowenstein, "Guaranteed Income and Traditional Economics," in *The Guaranteed Income: Next Step in Economic Evolution?*, ed. Robert Theobald (Garden City, N.Y.: Doubleday, 1966), 110.

he admittedly grounded his calls on "elusive" statistics, even if most cybernation advocates sought to ground their recommendations in empirical evidence.

While hindsight has shown their predictions to be inaccurate, cybernation theorists did attempt to base their predictions on concrete evidence rather than pure speculation. The first section of a 1964 collection of essays edited by Robert Theobald was entitled "The Facts" and contained essays which bore titles like Robert Davis' "The Advance of Cybernation, 1965-1985." Even before Gordon Moore articulated his "law" that the number of transistors per computer chip would double every year, Davis had argued that a steep decrease in the price of computers would make computing power available to the masses.[57] This prediction proved prescient as the explosion of industrial and personal computers did, in fact, arrive in subsequent decades, but such an expansion did not precipitate widespread technological unemployment. From his vantage point in the early 1960s, Davis posited that the only significant checks to technological growth were social opposition and cultural norms which could slow the deployment of new cybernetic technologies. The conflict between technology and the fabric of human society helped explain both the potential dangers and possibilities of cybernation for Davis: "Unless new, stronger, and more responsible social control is exerted over those who make decisions of this kind, technology rather than human-considerations will set the goals of the society and determine its destiny."[58] For Davis and others who grounded their arguments for basic income in a technological eschatology, cybernation offered the opportunity to reconfigure society in a way that placed "human-considerations" at the center of social policy.

The emphasis on human considerations in a technological society, a theme which has reemerged forcefully in the first decades of the twenty-first century, represented a new way of

[57] Robert Davis, "The Advance of Cybernation: 1965-1985," in *The Guaranteed Income*, 42.
[58] Ibid., 36-38.

thinking about the relationship between technological advancement, social progress, and economic abundance. As Theodore Roszak suggested in 1969, countercultural dissent was only possible in an affluent society, but debates about guaranteed income underscore a different aspect of the abundance discourse.[59] For Roszak, the ability for young people to "tune in, turn on, and drop out" was only possible from a position of economic security. On this view, sixties-era radicalism was an expression of a diseased affluence which afforded youth an unprecedented and unwarranted degree of freedom. Concerns about automation and cybernetics reflected a different anxiety about affluence. For many cybernation theorists, affluence was not an enabler of antisocial behavior but the genesis of an era that would demand greater responsibility from its economic and political actors. Affluence, combined with a mix of fear and idealism, promoted a new form of debate around automation which viewed technology as a potential source of liberation, but also technological enslavement.

Interestingly, socialist theorists in the Soviet Union and the German Democratic Republic during the 1960s took great interest in devising human-oriented systems for technological deployment. Socialist writing about cybernetics, which will be studied in the latter half of this study, emphasized the human-first approach of Marxist-Leninist theory and propagandists frequently attacked the United States for devaluing human interests in the name of technological progress and attendant economic growth. Socialist attacks, however, entirely neglected the critiques of cybernation theorists, who advanced their own form of human-centric cybernation. In the context of Cold War discursive norms in both the West and East, Theobald and his counterparts in the Socialist Bloc did not actively engage the parallel ideas that emerged in their respective ideological and political regimes. While important American theorists, like Daniel Bell, would

[59] Roszak, *Making of a Counterculture*, XVII.

later elaborate theories of convergence, socialist ideologues explicitly disavowed the capacity for cybernetics to unify capitalism and socialism in a distant futurity. Nonetheless, the common focus on human agency and well-being in an automated future points to an early form of convergent thought in the midst of Cold War ideological tensions.

Frenzied Cybernation? Predictions versus Empirical Reality

As cybernation theorists probed the relationship between humanity and its technological potential, a growing chorus of opposition had come to view the cybernation camp as a misinformed fringe group of policy theoreticians, who stole attention from the real problems of poverty and welfare reform in the United States. Opponents cited a falling unemployment rate during the mid-1960s as evidence that cybernation had not initiated the predicted period of technological unemployment, and one critic of Robert Theobald acidly invoked the shortcomings of contemporary computers in his rebuke of the futurist: "Had he [Theobald] recognized the computer's weakness in adapting itself creatively to unprogrammed problems, he might have come to different conclusions about the obsolescence of man."[60]

In addition to academic critics, government studies from the 1960s also suggested that the cybernation camp had seriously overestimated the rate of technological change. A 1966 report of the National Commission on Technology, Automation and Economic Progress entitled *Technology and the American Economy* acknowledged the 1960s as a period of "conscious social change," but held that technology was not a primary driver for persistent levels of

[60] F. M. Scherer, review of *Review of Free Men and Free Markets*, by Robert Theobald, *Technology and Culture* 5, no. 3 (1964): 481–83, https://doi.org/10.2307/3101289.

unemployment.[61] The report also predicted no significant change in economic productivity in the coming decade which could result in serious unemployment beyond local effects in market sectors particularly well-suited to automated technologies.[62] In short, government findings seriously challenged the assertions of Theobald and others by suggesting a rate of technological progress that would have significantly smaller destabilization effects on employment and aggregate demand. The report, nonetheless, acknowledged a newfound reticence towards technological progress, which Theoabald and the cybernation theorists had articulated: "Technology is not a vessel into which people are poured and to which they must be molded. It is something to be adapted to the needs of man and to the furtherance of human ends, including the enrichment of personality and environment."[63] The report's empirical rejection of the cybernation frenzy, did not entail a full-scale rejection of the social and ethical dimensions of cybernation advocacy. As the quotation above demonstrates, concerns about cybernation had succeeded in drawing attention to the "furtherance of human ends" in a technological society.

Alongside the empirical work from government agencies, prominent social theorists and economists, like Daniel Bell and Robert Heilbroner published extensive critiques of cybernation theory in *The New York Review.* The reviews of Bell and Heilbroner, formed the basis of a printed debate in which Robert Theobald, Donald Michael, Herbert Simon, and other cybernation theorists responded to their critics and challenged new claims to scientific authority. These debates not only provide insight into the reception of cybernation theory, but also shed light on the role of expert

[61] Harold Bowen, et al., "Technology and the American Economy," Report of the National Commission on Technology, Automation, and Economic Progress (National Commission on Technology, Automation, and Economic Progress, April 1966), ii.
[62] See chapter 2 and appendix II in "Technology and the American Economy."
[63] Ibid., xiii.

authority during a period when claims to knowledge and expertise played an increasingly important role in shaping government policy.[64]

The work of the Ad Hoc Committee on the Triple Revolution and the writings of Robert Theobald were the subject of a pointed critique by the sociologist Daniel Bell in *The New York Review*. A professor at Columbia, a widely read public intellectual, and chair of the Commission for the Year 2000, Bell had already established himself as an intellectual authority in discussions of social and economic policy by the time he published "The Bogey of Automation" in August of 1965. Historian Howard Brick has noted that liberal intellectuals, like Bell, had begun the 1960s with a commitment to the social sciences and an attendant belief that modernization theory had the capacity to successfully integrate emergent social sectors into a more unified American society.[65] By the middle of the decade, however, violent protests challenged the optimism of liberal intellectuals and threw a menacing shadow over the predictions of social harmony which Bell and others had envisioned. Bell's essay on automation challenged the cybernation theorists on a variety of methodological grounds, but the context of emergent social unrest may help explain Bell's sneering dismissal of the "specters of automation" as a distraction from "the really difficult political and economic problems that lie ahead."[66]

For Bell, forecasts of an automated future like those advanced by the Ad Hoc Committee on the Triple Revolution were methodologically unsound and uselessly provocative in a period of rapid and destabilizing change. In the opening of his essay, Bell somewhat mockingly referred to the Ad Hoc Committee as a "new 'school'", and despite his sardonic characterization, he implicitly

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[64] See Nils Gilman, *Mandarins of the Future: Modernization Theory in Cold War America*, New Studies in American Intellectual and Cultural History (Baltimore: Johns Hopkins University Press, 2003) and Andersson, *The Future of the World*.

[65] Howard Brick, *Daniel Bell and the Decline of Intellectual Radicalism: Social Theory and Political Reconciliation in the 1940's* (Madison, Wis: The University of Wisconsin Press, 1986), 109.

[66] Daniel Bell, "The Bogey of Automation," *The New York Review*, August 26, 1965, https://www.nybooks.com/articles/1965/08/26/the-bogey-of-automation/, 7-8.

conceded that the Committee had achieved a measure of popular respectability. Bell began his attack on the cybernation school by briefly outlining the claims of the Ad Hoc Committee and Donald Michael about the predicted increase in productivity before dismissing their reasoning as something "based on speculation, not fact." As evidence, Bell cited a range of statistics from government agencies to undermine such "speculation" before turning to a broader question about the definition of "technology."

For Bell, the crux of the cybernation frenzy lay not in assessing the predictions of opposing camps in the automation debate, but rather in the methodological and scientific frameworks used to define and measure technological progress. Technology, in Bell's view, could only be understood through the language of economics which measured productivity as a "change that gives you more production for less work."[67] This metric could function as a proxy for technological progress and was measurable over time through statistics like national income, labor force participation, and unemployment rates. With this framework, Bell dismissed the idea that automation was to blame for persistently high rates of unemployment by arguing that population growth had outpaced the growth of national income. If the rate of population growth exceeded the growth of aggregate demand, steady levels of unemployment could be expected even under conditions of high growth. The ratio of population expansion versus aggregate demand offered a simpler and more measurable explanation of unemployment, which had little to do with secular trends in technological progress. Bell's invocation of economic theory and the assertion empirical economics as a source of unimpeachable authority offers an interesting example of what one historian has identified as "the idea of forecasting as a social and political technology for post-

[67] Ibid.

industrial mass society."[68] In this case, the assertions of fact and references to economic theory served to validate Bell's authority in refutation of the cybernation theorists' speculations.

The role of authority in debates about automated futures was taken up in Michael's response to Bell in which he appropriated the language of fact versus speculation. In the opening lines of his response, which appeared in the November 1965 edition of the *New York Review*, Michael pointedly rejected Bell's putative factual authority: "Any popular exploration of a topic as complex as cybernation is bound to be skimpy: to fuse fact and speculation. This includes Daniel Bell's contributions in the issue of August 26."[69] Michael proceeded to question Bell's facts by citing difficulties in measuring macroeconomic data and challenging head-on the reliability of statistical measures from the Department of Labor and other traditional sources of empirical data. Michael's critique did not highlight alternative measures of productivity or economic growth which were superior to those cited by Bell. Instead, his critiques comprised an effort to undermine the certainty of Bell's convictions. In this way, Michael charted a different course by accepting that all forecasts of technological progress entail some amount of speculation:

> At any rate, no report conscientiously estimating the future could assert categorically that computers could be *"only* in … offices" in certain industries, or that "*only* 14 of the 36 industries *could possibly use* computers to control production itself" during the coming decade. No available models can adequately, much less precisely, predict the rate at which an industry will cybernate […] These assertions are speculations, not facts – and incautious speculations at that.[70]

Michael's response did not precisely defend the cybernation theorists' claims, so much as undermine any effort to make definitive forecasts about the future. Michael's argumentative

[68] Andersson, *The Future of the World*, 101.
[69] Donald N. Michael, "Automation," *The New York Review*, November 25, 1965, https://www.nybooks.com/articles/1965/11/25/automation-1/.
[70] Ibid.

technique called explicit attention to deficiencies in normal predictive metrics, such as those cited by Bell, and in so doing, he positioned the more radical predictions about automation as equally speculative.

The Bell-Michael debate offers an instructive perspective on the role of rational forecasting versus normative moral judgements in the development of social policy from this period. Historian Irving Kristol has written that left wing championing of the "automation scare" prompted a neoconservative retrenchment, which sought to reassert reason and incrementalism as the foundations for social policy initiatives.[71] Bell's response to "speculative" claims about future predictions buttresses Kristol's argument that opponents of automation theorists used reason and facts to undermine the validity of more radical claims about a qualitative leap in productive capacity. But rejection of the so-called "automation scare" by the likes of Bell, Leon Keyserling, and others was hardly definitive.[72] In fact, the publications of Herbert Simon, Michael, and Theobald – some of the most ardent exponents of a technological eschatology – continued to be read and receive serious consideration throughout the decade. Although Kristol rightly identifies an important counterforce to the cybernation frenzy, the power of automation arguments continued to exert influence and attract both scholarly and popular attention throughout the decade.

Evidence for continued interest in the topic is found once again in the *New York Review* which proceeded to publish reviews of many significant texts on automation that appeared throughout the decade. In fact, Bell's August 1965 article was followed by a list of eight "Recent Books on Automation," which further attests to the widespread interest in this topic

[71] Irving Kristol, "American Conservatism 1945-1995," *National Affairs*, Fall 1995, 121, https://www.nationalaffairs.com/public_interest/detail/american-conservatism-1945-1995

[72] Leon Keyserling published a short response to "The Bogey of Automation" which accepted Bell's basic methodological framework but suggested slightly modified statistics about economic growth and productivity advances: Leon H. Keyserling, "Automation," *The New York Review*, November 25, 1965, https://www.nybooks.com/articles/1965/11/25/automation-2/.

notwithstanding serious criticism from some academic circles. In the year following Bell's review, the prominent economist, Robert Heilbroner, who was also a cosignatory of the report on the Triple Revolution, published a lengthy review of Herbert Simon's book *The Shape of Automation* and Theobald's edited text, *The Guaranteed Income*. Heilbroner cut an interesting figure in 1960s-era economic circles. He was a respected economist-philosopher and a student of Galbraith, who nonetheless remained a committed socialist throughout the 1960s and offered pointed philosophical and economic critiques of the capitalist system.[73]

In Heilbroner's assessment of Simon and Theobald's writings, he accepted from the outset that technological unemployment would remain a prominent if, at times, unseen force in the capitalist future: "I believe that a persistent cloud of technological displacement will nonetheless hover over the future of capitalism."[74] But Heilbroner's acceptance of technological unemployment did not translate into full-throated support for Simon or Theobald's arguments. Heilbroner initially took aim at Simon's self-styled moniker, "technological radical and economic conservative," by suggesting that no form of economic conservatism could be compatible with the radical technological innovations anticipated by Simon's own work. This critique of Simon's view provides the background for Heilbroner's own argument that market mechanisms would be unable to ensure a smooth transition away from an economy based on wage-labor:

> It is the question whether the market process will be able to supervise the inevitable transition to a society in which less labor will be used. I do not believe it will, nor do I think that the market will serve, at the terminal point of that transition, as an adequate mechanism for the distribution of income to the population in general, or of jobs to those who will work.[75]

[73] See, for example, Robert L. Heilbroner, *The Limits of American Capitalism* (New York: Harper Torchbooks, 1967).
[74] Heilbroner, "Where Do We Go From Here?"
[75] Ibid.

Unlike Bell, Heilbroner was not primarily interested in the validity of short-term predictions about changes in productive capacity. Rather, he was centrally concerned about the role of market allocation mechanisms in the long-term, and for this reason, he accepted guaranteed income proposals as a "very useful remedy" to questions of economic distribution in a world of highly automated labor.[76] But Heilbroner's theoretical acceptance of an income guarantee was qualified in a way that Theobald's was not. Whereas Theobald proposed the prompt enactment of a program of basic economic security, Heilbroner's timescale did not recommend an income guarantee in the near term: "the long run is still a long way off, and in the meantime we have to operate within the confines of a market economy where technology is only gradually and incrementally making its effects know."[77]

The idea of an income guarantee, however, did make Friedman's negative income tax appear a more practicable alternative to Heilbroner, and his essay concluded with explicit support for a form of NIT. Heilbroner's critique of the automation theorists illustrates how apparently unrealistic claims about technological change were understood and adapted in the mainstream. As noted, Heilbroner accepted an income guarantee on a theoretical level, and he came to view the negative income tax as a pragmatic intermediate step on the road to a new form of economic allocation. Even if the cybernation theorists' predictions or recommendations were not accepted *in toto*, their claims offered different justifications for more incremental social reforms like the NIT.

Several important themes emerge from the responses to the works of cybernation theorists from the mid-1960s. First, and quite simply, technology and its potential for social change appears as an important space for methodological, futurological, and ideological exchange during the

[76] Ibid.
[77] Ibid.

decade. In addition to the reviews and listed texts which appeared in the *New York Review* from 1965/66, an essay from later in the decade entitled, "Technology: The Opiate of the Intellectuals" unequivocally stated: "No other single subject [technology] is so universally invested with high hopes for the improvement of mankind generally and of American in particular."[78] Technology captured the attention of writers for a variety of reasons, but the unknowable character of technological progress allowed theorists of different ideological persuasions to inscribe debates about technology with their own normative visions of the future. Some expressed reserved optimism whereas others were more fearful, but in all cases, a technological future represented a form of rupture that would challenge traditional economic and social principles.

A second important theme to emerge is the role of scientific authority and expertise. As Theodore Roszak famously argued in *The Making of a Counterculture*, an ascendant technocracy of expert elites was remaking American society through a silent managerial conquest during the 1960s.[79] On first reading, the writings of academics in the *New York Review* appear to conform to Roszak's conception of a malign technocracy, but this ostensible similarity is not borne out upon closer examination. Although Theobald, Heilbroner, Simon, and others were, in some sense, members of the sphere of experts, they were deeply involved with the New Left and student organizers through their work on the Triple Revolution and the Guaranteed Annual Income Newsletter (discussed below). Further, their critiques of labor markets and their rejection of traditional economic metrics mirrored calls for reform found within the counterculture. The report on the Triple Revolution, for instance, was signed by leading figures from SDS, and James Miller has noted that calls for renewed democracy in the report evidence the influence of ideas from

[78] John McDermott, "Technology: The Opiate of the Intellectuals," *The New York Review*, July 31, 1969, https://www.nybooks.com/articles/1969/07/31/a-special-supplement-technology-the-opiate-of-the-/.
[79] Roszak, *The Making of a Counterculture,* 19.

student organizing.[80] Although the figures participating in the automation debates were members of the "technocratic elite," many of them were highly critical of social and economic structures in a way that amplified calls for reform from student organizers and radical Leftists.

A final theme to note from the automation debates is the exclusively American-centric focus of the exchange. Virtually no reference was made to foreign powers or the global implications of technological progress in the many pages devoted to automation. Rapid and destabilizing technological change appeared in the many accounts, as a uniquely American phenomenon. The almost total absence of reference to the socialist East or even other nations in the capitalist West reveals a deep current of American exceptionalism. The power of postwar growth and the advent of what Lizabeth Cohen has called the "Consumer Republic" lent American discussions about economic progress a unique character.[81] Heilbroner and Theobald were both deeply critical of capitalist norms, and they questioned the ultimate efficacy of market-based systems, but they never appealed to contemporary examples of socialism in their arguments. Certainly their reticence to invoke geopolitical foes like the Soviet Union can be understood within the context of Cold War ideological polarization, but the absence of non-American examples went further. As John McDermott noted in his 1969 essay, the potential and burden of technological progress was predicted to impact "Americans in particular."[82]

The lack of non-American references throughout the automation debates ignored important currents in the socialist East, in which communist ideologues and economic planners similarly probed the relationship between technology and social progress. Although public writings in the United States on automation initiatives was largely silent about socialist cybernetics, American

[80] Miller, *Democracy is in the Streets*, 192.
[81] Lizabeth Cohen, *A Consumer's Republic: The Politics of Mass Consumption in Postwar America*, 1st Vintage Books edition (New York: Vintage Books, 2004), 30.
[82] McDermott, "Technology: Opiate of the Intellectuals," 6.

intelligence agencies eagerly studied the potential impact of cybernetics on both economic planning and socialist ideology across the Soviet Bloc. As subsequent chapters will demonstrate, socialist cybernetics prompted revisions to Marxist doctrine and played an important role in economic planning in both the Soviet Union and the German Democratic Republic. Due to endemic inefficiencies in labor allocation, however, socialist theorists never feared the economic disruptions which the American cybernation theorists forecasted. Cybernetics prompted significant revisions to socialist thinking about economic planning, but Soviet and East German ideologues sought to harmonize cybernetics with socialism rather than overthrow the entire system.

Grassroots Initiatives and the Guaranteed Annual Income Newsletter

As members of the cybernation camp were expounding their technological eschatology in publications and newsprint, grassroots engagement around the basic income guarantee also began to emerge on American college campuses. This form of engagement with cybernation demonstrates that interest in guaranteed income and rapid technological change extended into American universities alongside more mainstream leftist critiques from the decade. Existing historical literature on guaranteed income proposals from the 1960s, particularly research on the negative income tax, has taken a decidedly institutionalist approach. Brian Steensland and Daniel Patrick Moynihan's work on Nixon's Family Assistance Plan has emphasized the role of policy experts from the Office of Economic Opportunity, the Department of Labor, and other government institutions in developing the slate of policy initiatives, including the NIT, which became the basis

of Nixon's failed welfare reform bill.[83] This understanding certainly illuminates the important influence of government bureaucracy in developing the negative income tax proposal, but it largely discounts a wider engagement with welfare reform, which considered income guarantees and child allowances. A primary example of student engagement is seen in the Ad Hoc Committee for A Guaranteed Income (AHCGI), which was formed by a group of social work students from the University of Chicago's School of Social Service Administration in the summer of 1966.[84] From 1966 to 1968, the AHCGI published a monthly newsletter called the Guaranteed Annual Income Newsletter or GAIN, which according to its statement of purpose was "primarily intended for the interested citizen who wishes to learn about a pressing social issue rather than for the specialist."[85]

GAIN's focus on a non-specialist audience represented an effort, albeit a limited one, to communicate concerns about cybernetics and welfare reform to the public. Not only did the topics discussed in GAIN address a different audience, but the publication also analyzed a wider range of justifications for an income guarantee than those found in government agencies. The pages of GAIN comprised an impressive collection of social theorists who approached income guarantees from a range of perspectives and methodological backgrounds. Some of the most notable contributors included Edward Schwartz, Frances Fox Piven, and Richard Cloward who, despite differing approaches and social concerns, argued for an income guarantee in the pages of GAIN. According to Irwin Garfinkel, a founding member of the AHCGI and former social work student

[83] See Brian Steensland, *The Failed Welfare Revolution: America's Struggle over Guaranteed Income Policy* (Princeton: Princeton University Press, 2008) and Daniel P. Moynihan, *The Politics of a Guaranteed Income: The Nixon Administration and the Family Assistance Plan* (New York: Vintage Books, 1973).
[84] AHCGI as an abbreviation was never used by the committee itself, but I use this acronym to distinguish it from the Ad Hoc Committee on the Triple Revolution.
[85] "The Ad Hoc Committee for a Guaranteed Income," *Guaranteed Annual Income Newsletter*, June 1966, 1.

in Chicago, both a desire for welfare reform and concerns about technological disruptions prompted consideration of the income guarantee.[86]

The first issue of GAIN, which appeared in June of 1966, took an ambivalent stance towards the relationship between cybernetics and an income guarantee: "They [economists] envision a day in the not-too-distant future when machines, particularly the computer, will do most of man's work for him. Assuming for a moment the validity of this argument, it is only too obvious that some means will be needed to assure citizens an adequate standard of living unrelated to work." While the young Chicago publishers of GAIN recognized the role of cybernation in sparking discussion about an income guarantee, they were reticent to premise the justification of basic income on a future economic state. Despite their ambivalence towards the cybernation argument, the publication was indebted both intellectually and practically to Theobald, who was instrumental in establishing the publication and whose presence at a retreat in April 1966 first instigated interest in developing a newsletter.[87]

Theobald's own writing appeared in the May-June 1967 edition of the newsletter under the title "Guaranteed Income: Short and Long- Run Issues." In his article, Theobald remained committed to an income guarantee and he frequently referred to the long-run necessity of such a program given forecasted economic developments. But unlike earlier works, Theobald approached the predicted chronology of technological change in a different light. In the conclusion of his article, he shifted the debate from the immediate focus on statistics and policy specifics to a more general reflection on the moral state of American society:

> The basic debate must not therefore be permitted to drift into concerns about the details of how we set up measure to provide incomes to the poor: this is largely a

[86] Chris Hughes, "Historical Q&A: Irv Garfinkel on the Guaranteed Income," Medium, November 29, 2017, https://medium.com/economicsecproj/historical-q-a-irv-garfinkel-on-the-guaranteed-income-47260c585c20.
[87] "The Need for a New Approach," *Guaranteed Annual Income Newsletter*, August 1966, 2.

> technical question capable of largely technical solutions. The profound question is whether we will, or will not, concede the right of each man to participate in the decisions which determine his destiny.

It is interesting to contrast Theobald's moral theorizing from the 1967 issue of GAIN to the more technical forecasts which appeared in earlier works such as *Free Men and Free Markets* and the *Rich and the Poor*. The National Commission on Technology had published its report in the year prior to Theobald's article which seriously undermined the credibility of the more radical predictions about automation.[88] As is clear from the GAIN article and Theobald's 1968 book, *Committed Spending*, automation did not disappear from his policy calculus, but his arguments now depended on an updated chronology.[89] Although Theobald never explicitly disavowed his earlier predictions, he couched his policy recommendations in a more philosophical idiom as the 1960s progressed. Automation still appeared as a serious threat which required meaningful economic and social redress, but his later theories employed cybernetic predictions as justifications for new social policies rather than motivators for immediate action.

Other writers in GAIN took a stronger stance against automation, as it became increasingly clear that the most dire predictions around technological unemployment had not been realized. Writing in the final issue of GAIN from 1968, a graduate of the Columbia University School of Social Work, Ed Spannaus argued:

> What about the "problem" of automation? Automation does not necessarily mean fewer jobs. It can mean fewer hours of labor, hence more leisure time, cheaper commodities, and a higher standard of living. This, of course, depends on how those who own the means of production *use* automation – to enrich themselves or to benefit society as a whole.[90]

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[88] Harold Bowen and et al., "Technology and The American Economy," 21-27.
[89]Robert Theobald, *Committed Spending: A Route to Economic Security*, 1st ed. (Garden City, N.Y: Doubleday, 1968).
[90] Ed Spannaus, "The Welfare Rights Movement and the Guaranteed Annual Income," *Guaranteed Annual Income Newsletter*, January 1968, 2.

Spannaus' reflection on the relationship between automation and equitable economic outcomes reflects a softening of the technological eschatology that had dominated earlier in the decade. For Spannaus, automation held promise as a way to reorganize society and achieve social goods, like increased leisure time and a higher standard of living. By the end of the decade, the liberating potential of technology had taken on greater importance and had begun to serve as inspiration for social reorganization. Spannaus was hardly an orthodox techno-optimist, and he clearly linked the capacity of technology to improve lives with the economic and political structures in which automation was deployed. The pages of GAIN evidence a clear development toward more measured predictions about technological change later in the decade. The welfare concerns that had previously been coupled with calls for an income guarantee became the primary argument for a guaranteed income as the prospect of unprecedented productivity leaps receded.

As Theobald's own writings and those of fellow GAIN contributors suggest, imminent technological rupture had ceded its primary position to more nuanced concerns about the equitable implementation of automation technologies. While writers in GAIN never referenced counterparts in the socialist world, planners and socialist philosophers in the Soviet Union and the German Democratic Republic, were deeply concerned about similar issues and sought, as well, to adapt their economic system to accommodate productivity-enhancing technology. In this way, the parallel worlds of socialist and economic debates about technology and social equity began to approximate each other, as American theorists advanced less radical revisions to their economic system in the late 1960s. By this time, technology held enormous promise, but policymakers and public intellectuals had begun to emphasize more incremental solutions rather than the systemic changes that dominated earlier in the decade.

The Guaranteed Annual Income Newsletter represented an important, but seemingly forgotten chapter of the debate surrounding income guarantees and automation in the 1960s. The newsletter and its young publishers from the University of Chicago underscore a different form of engagement with social policy that bridged the divide between government bureaucrats and the public. As a publication devoted to advancing the guaranteed income agenda, GAIN functioned as a form of grassroots advocacy not otherwise referenced in the literature on the guaranteed income efforts from this period. In addition, the articles published in GAIN took seriously the question of automation while revealing that debates about cybernation clearly evolved as the 1960s progressed. The imminent threat of economic rupture appears to have waned by the end of the 1960s, but the topics raised by the cybernation frenzy remained salient to discussions of guaranteed income. Robert Theobald's own writings also demarcate an evolution on the part of cybernation rhetoric which moved away from direct forecasting to more general considerations about the moral requirements of a technological society. Even if the cybernation theorists modified their arguments, the initial consideration of an automated society helped spur new considerations of welfare revision.

Conclusion

The cybernation frenzy of the 1960s was a volatile space of debate which drew contributions from academics, government policy makers, and student activists. The rhetoric in debate was often sensationalistic – nothing less than the legitimacy of the capitalist system hung in the balance – and an imminent technological eschatology succeeded in prompting vigorous responses from both supporters and detractors of the cybernation forecasts. This chapter has argued that discussion of automation is central to an understanding of sixties-era welfare reform programs, and that the

threat of technological unemployment gave space to a new form of social critique which questioned the very foundations of the liberal capitalist state. The wide-reaching ramifications of a displaced labor force prompted novel reconsideration of the responsibilities of an affluent American state. Although writers in the United States focused almost exclusively on the technological disruptions in their own society, non-capitalist states in the Soviet Bloc experienced a similar reckoning with the economic and social implications of a cybernated future.

While the cybernation frenzy was based on an inaccurate chronology of technological advancement, the question of human-considerations in a highly technological society have reemerged forcefully in the second decade of the twenty-first century. A new raft of basic income proposals, championed most prominently by the American entrepreneur Andrew Yang, have emerged in recent years in response to new dislocations brought about by the gig economy, high levels of economic inequality, and digital misinformation.[91] Current debates about technology have largely ignored earlier contributions from sixties-era thinkers who accurately foresaw the direction, if not the timing, of technological advancement in the United States. The economic challenges of 1970s and the emergence of Reaganism in the 1980s refocused attention away from cybernation to questions of economic deregulation in the wake of stagflation.[92] Nonetheless, secular trends in technological advancement and faster-than-predicted improvements in computing power meant that the concerns of cybernation theorists only grew in importance, even if their work received relatively little attention in subsequent decades. With several decades of hindsight, the cybernation theorists appear more prescient than ever. Their rhetoric may have been melodramatic

[91] Eric Lach, "Andrew Yang's Ideas on Universal Basic Income Earned Him Fans. But Can He Win Votes?," *The New Yorker*, January 23, 2021, https://www.newyorker.com/news/our-local-correspondents/andrew-yangs-ideas-on-universal-basic-income-earned-him-fans-but-can-he-win-votes.
[92] See the Epilogue for a discussion of cybernetic afterlives and the emergence of second-order cybernetics.

and their timeline inaccurate, but the deeper insights into the relationship between technological change and social stability appear to have been realized.

The powerful ideas from Wiener's new discipline and attendant interest in industrial automation crossed borders rapidly during the Cold War. In the West, the Federal Republic of Germany was undergoing an unprecedented economic reinvigoration after its founding by the occupying forces in 1949. Unlike the United States, where cybernetics was studied both as an academic discipline and a social-scientific phenomenon, West Germans primarily embarked on a deep philosophical and aesthetic engagement with cybernetic ideas and practices. The tight labor market and explosive growth rendered the industrial applications of cybernetics less relevant to West German economists and industrial planners, but by the late 1950s, a group of artists, physicists, and designers had seized upon cybernetics as a new, modern form of artistic expression that promised to transcend artistic subjectivity. This chapter has emphasized the impact of cybernetics on technological thought and social policy from the 1960s in the United States, but in West Germany, cybernetics helped generate early computer art and contributed to new schools of aesthetics built on the insights of feedback, control, and communication.

Chapter II

From Fear to Free Time – From the Keyboard to the Canvas in West Germany

> The artist will find freedom during the invasion of machines in society: he will be able to use the machine to his advantage and in so doing increase his own powers. But it is incumbent upon him to learn to speak the machine's language.[1]

The 1950s was an auspicious decade for the fledgling Federal Republic of Germany. After wartime destruction and subsequent occupation by Western Allied Forces, the postwar experiment with liberal democracy had begun with massive economic expansion. Production levels in 1960 had improved by 125% percent from a decade prior and a tight labor market kept unemployment low, while an ever-improving capital stock permitted impressive increases in productivity.[2] As the *Wirtschaftswunder* got underway in the Federal Republic, advances in computing technologies and industrial automation began to cross the Atlantic and capture the attention of West German writers, artists, industrialists, and workers.

Unlike the rampant academic interest found in the United States, the Soviet Union, and to a lesser extent, the German Democratic Republic, cybernetics did not become a major focus of West German academic research. As the historian Philip Aumann has noted, cybernetic departments were few and far between in the Federal Republic's scientific research centers, and Norbert Wiener's founding text on the subject, *Cybernetics: Or Control and Communication in*

[1] Abraham Moles, "Kybernetik und Kunstwerk (1965)," in *Ästhetik*, ed. Wolfhart Henckmann, vol. xxxi, Wege er Forschung (Darmstadt: Wissenschaftliche Buchgesellschaft, 1979), 331.
[2] Peter Alt and Max Schneider, "West Germany's 'Economic Miracle,'" *Science & Society* 26, no. 1 (1962): 46–57.

the Animal and the Machine, was not translated into German until 1963 - fifteen years after its original publication.[3] American influence through the Marshall Plan and strategic investment in productivity enhancing capital continued to increase living standards and aggregate output, but the Adenauer government did not ascribe particular importance to automation in West German industrial policy. As Charles Maier has argued, the impact of American foreign policy and its commitment to economic growth and productivity prescribed a particular vision of progress for the West German economy: "the stress on productivity growth arose out of the very terms in which Americans resolved their own organization of economic powers. Americans asked foreigners to subordinate their domestic and international conflicts for the sake of higher steel tonnage or kilowatt hours."[4] The "stress on productivity" brought myriad benefits to the German economy, but it also engendered criticism from a range of German writers, who took exception with economic and scientific policy oriented toward output over equitable growth. This criticism frequently manifested itself as a rejection of American notions of progress, including the adoption of cybernetic technologies.

As the 1950s progressed, the twinned ideas of cybernetics and automation took on an increasingly important role for West German intellectuals and writers, who looked to the United States both as a model and cautionary tale. In the past decade, historical scholarship on automation, rationalization, and cybernetics has cast new light on the reception of postwar technological innovations within West Germany. Frank Biess' recent work, *German Angst,* is a particularly valuable contribution, which draws on intellectual debates from the 1950s to describe

[3] Philipp Aumann, "The Distinctiveness of a Unifying Science: Cybernetics' Way to West Germany," *IEEE Annals of the History of Computing* 33, no. 4 (April 2011): 19.
[4] Charles S. Maier, "The Politics of Productivity: Foundations of American International Economic Policy after World War II," *International Organization* 31, no. 4 (1977): 609.

"ambivalences" toward the advance of automation technologies.[5] Joachim Radkau's work on the history of the future in the early Federal Republic has called similar attention to a strain of cultural pessimism, which bore the scars of Nazi totalitarianism and expressed concerns about the psychological manipulability of the German public.[6] The works of Radkau and Biess represent a departure from earlier scholarship on technological reception in the early FRG, which viewed the West German public as eager adopters of new, predominantly American technologies.[7] Taken together with Aumann, recent scholarship suggests that cybernetics was a marginal academic discipline that attracted a mixed response from an economically ascendent but psychologically traumatized West German public.

This chapter largely accords with this understanding of cybernetics and automation from the 1950s but rejects Biess' idea of modern angst as an overly simplistic characterization. By framing his work around the idea of fear rather than the more nuanced, yet accurate concept of ambivalence – a term he uses in his own work – Biess' conceptual framework does not adequately capture the historical reality he has painstakingly reconstructed. The first half of this chapter is therefore devoted to nuancing Biess and Radkau's arguments around German technological pessimism while highlighting its relationship to American influence. Writers, such as Robert Jungk, Rolf Strehl, and numerous articles in the West German periodical, *Der Spiegel*, provide an important perspective on how a booming but fragile postwar state conceptualized the role of American economic influence, the importance of labor, and the potential benefits of highly automated industrial production. By focusing on depictions of cybernetics and automation that

[5] Frank Biess, "Modern Angst," in *German Angst: Fear and Democracy in the Federal Republic of Germany*, (Oxford: University Press, 2020), 131–57.
[6] Joachim Radkau, *Geschichte der Zukunft: Prognosen, Visionen, Irrungen in Deutschland von 1945 bis heute* (Munich: Carl Hanser Verlag, 2017), 113.
[7] Biess, "Modern Angst," in *German Angst,* 134.

were widely circulated within the West German public instead of the philosophical debates discussed by Radkau and Biess, my work emphasizes the non-specialist and non-elite circulation of ideas around automation during the 1950s.[8] This focus reveals that although many popular accounts viewed cybernetics as an expression of the American obsession with economic growth, labor organizations and others came to reflect optimistically about shorter working hours and a higher standard of living.

Radkau and Biess draw on a similar source base in their respective works and consequently overlook important cybernetic developments in the fields of aesthetics and visual art. Beyond merely revising Radkau and Biess' arguments, the larger goal of this chapter is to illuminate a more vibrant field of cybernetic reception found in West German visual art and aesthetics, which was championed by Max Bense and Abraham Moles. Through their work in Ulm during the 1950s and the emergence of the Stuttgart School in the 1960s, Bense, Moles and their students developed the twinned ideas of Information Aesthetics and Generative Aesthetics, which were heavily influenced by Wiener's work on cybernetics.[9] The flourishing of artistic output and aesthetic thought around cybernetics during the 1960s reveals a surprising paradox in West German cybernetic reception, which is unique among the four states considered in this study. While West German academic circles, the popular press, and philosophical writings from the 1950s expressed varied opinions about the economic and social impacts of cybernetics, the avant-garde artistic scene during the 1960s forged a lively and internationally recognized new school of cybernetic aesthetics. By reconstructing this history of cybernetic aesthetics, this chapter seeks to place

[8] Both Radkau and Biess offer extensive discussion of philosophical debates between Friedrich Pollock, Helmut Schelsky, and Arnold Gehlen. Both authors, however, arrive at similar conclusions and their approaches are only trivially different.

[9] See Christoph Klütsch, "Information Aesthetics and the Stuttgart School," in *Mainframe Experimentalism: Early Computing and the Foundations of the Digital Arts*, ed. Hannah Higgins and Douglas Kahn (Berkeley: University of California Press, 2012), 65–89 and Eliza Pertigkiozoglou, "1960s," Medium, April 7, 2017, https://medium.com/designscience/1960s-d611bd76d056.

Information and Generative Aesthetics at the core of our understanding of West German cybernetic reception

American Science in Post-Fascist Germany

In West Germany, the first significant public treatment of cybernetics appeared in a 1950 *Spiegel* article, entitled "Alarmingly Human."[10] The 1950 article, which was authored by an unnamed journalist, struck an interesting balance between assessing the military and philosophical dimensions of cybernetic innovations. The shadow of the Second World War and nascent Cold War tensions were apparent throughout the piece: "Alongside the United States, England, France, and the Soviet Union are working feverishly to construct more capable and ever faster 'thinking' mechanical brains. Therefore, the technical details of the electronic brains are kept strictly secret, 'for reasons of military importance."[11] Even in 1950, the international dimension, particularly in the military realm, was a focal point for West German coverage. After German disarmament in the aftermath of the Second World War and before the formation of the *Bundeswehr* in 1955, West Germany had virtually no military apparatus in 1950.[12] The initial conjunction between cybernetics and military technology may help explain why West German coverage of the subject focused almost exclusively on foreign developments in cybernetics, rather than domestic initiatives. This view squares with Philip Aumann's understanding that while German scientists followed the developments of American cybernetics in the 1950s, they did not view their American counterparts

[10] Aumann, "The Distinctiveness of a Unifying Science," 17.
[11] "Maschinengehirn/Technik: Beängstigend Menschlich," *Der Spiegel*, December 7, 1950.
[12] David Clay Large, *Germans to the Front: West German Rearmament in the Adenauer Era* (Chapel Hill: University of North Carolina Press, 1996).

as role models.[13] In the scientific sphere, skepticism toward American science and its military dimensions virtually eliminated cybernetics from all major research initiatives during the 1950s.[14]

The 1950 *Spiegel* article set the stage for a larger inquiry into the military and even imperial dimensions of new computing technologies. The most prominent text on this subject, Robert Jungk's *Tomorrow is Already Here,* appeared two years later and became a bestseller in the Federal Republic before being published in the United States in 1954.[15] In preparing the book, the Austrian journalist Robert Jungk had traveled the United States to document how technology, the drive for productivity improvements, and the quest for military superiority were reshaping postwar American society. Jungk was a writer with a deep mistrust of technological progress, and in many ways, *Tomorrow is Already Here,* anticipated the darker themes that emerged in his famous 1958 book on nuclear weapons development, *Brighter than a Thousand Suns.*[16] The sensationalist, yet trenchant rhetoric which Jungk deployed in *Tomorrow is Already Here* became something of a cautionary tale to a young German state navigating a polarized geopolitical world. Jungk took a dim view of the American postwar grasp for power, by linking the drive for technological improvement with imperialistic motivations: "To occupy God's place, to repeat his deeds, to re-create and organize a man-made cosmos according to man-made laws of reason, foresight and efficiency: that is America's ultimate objective."[17] Jungk's impressions were informed by the remarkable access he gained to major centers of American research, such as the National Bureau of Standards Eastern Automatic Computer (SEAC). SEAC was a marvel for its time, and its ability

[13] Aumann, "The Distinctiveness of a Unifying Science," 23-24.
[14] Despite its slow reception within the West German scientific community, biological cybernetics later emerged as an important field and the journal *Kybernetik* was ultimately renamed *Biological Cybernetics* and is still in publication.
[15] Jungk, *Tomorrow Is Already Here*.
[16] Robert Jungk, *Brighter than a Thousand Suns: The Moral and Political History of the Atomic Scientists* (London: Hart-Davis, 1958).
[17] Jungk, *Tomorrow Is Already Here*, 7.

to store executable programs alongside data represented a paradigm shift in computing technology that made possible rapid improvements in computational performance in subsequent decades. [18] But for Jungk, the experience with SEAC and a subsequent visit to the RAND Corporation did not inspire optimism about future progress: "It is a melancholy symptom of the times that these branches of science, when they work together for the first time on the theory and practice of administrative problems, should do so under the aegis of destruction."[19]

In the early 1950s, there was widespread disagreement among the scientific community over the extent to which early computers could think, feel, or learn; on this point, the 1950 *Spiegel* article introduced Norbert Wiener, who argued that "cybernetic devices (robots) are really nothing new: A thermostat regulates the temperature, auto-pilot keeps a plane on course at the right altitude […]" Wiener's argument did not assuage the author from *Der Spiegel*, however, who proceeded to conjure images of humans serving their robot overlords in a cybernetic dystopian future. The human characteristics of robots were not welcome, but rather something to be feared. Jungk pursued a similar line of inquiry in *Tomorrow is Already Here* by considering the nearer-term effects of highly automated manufacturing on the nature of work. Jungk's visit to the headquarters of IBM, where he was guided by company founder Thomas Watson, further stoked his concerns. In one exchange, Watson described the liberating potential of robots, to 'relieve [the human spirit] of routine labor." Jungk, however, was unimpressed by Watson's rhetoric and remarked: "The

[18] See Russell A. Kirsch, "Computer Development at the National Bureau of Standards," September 1, 2000, https://www.nist.gov/publications/computer-development-national-bureau-standards.

[19] Jungk, *Tomorrow Is Already Here*, 234. Given the German experience during the Second World War, it is, perhaps, unsurprising that early West German reviews of cybernetic technologies bore the imprint of grievous wartime destruction and viewed early computers and their military applications so skeptically. In addition to Jungk's work, Rolf Strehl's 1952 book entitled, *The Robots are Among Us: A Factual Report,* took a similar approach to Jungk and documented the potential for death and destruction that machines were capable of inflicting. Although Strehl's book did not become a popular success, his interest in the human characteristics of thinking machines prefigured broader debates about the nature of human existence in an increasingly technological age: Strehl, *Die Roboter sind unter uns. Ein Tatsachenbericht*.

working man today has less need to exert his muscles, but in dealing with the mechanical slaves, his nerves and spirit are put to new and severe tests."[21]

Jungk's criticism of the American project, however, did not stop it from being published in the United States with a nuanced introduction by the journalist and historian Herbert Agar. Agar summarized Jungk's perspective as follows:

> The author attacks a deformity of the whole Western world - the materialism which, if continued, must dehumanize us. The effort to explain life in terms of the inanimate, the rage to bend every time-honored institution into the service of the new metallic demons, the eagerness to turn even the humanities into an imitation of natural science […] this is the great modern heresy. And like most heresies, it is in fact a wild exaggeration of an otherwise sensible point of view.[22]

The "deformity of the whole Western world" and the attendant concerns around the deployment of cybernetic technologies provide evidence for the argument advanced by Raymond Stokes that the postwar economic recovery in Germany was characterized by a "drive for technical excellence tempered by gradual implementation of new technologies."[23] In the Federal Republic, the earliest reactions to cybernetics cast the United States as a troubled poster child for the wanton pursuit of technological advancement. The focus on foreign developments in cybernetics supports Stokes' idea of "gradual implementation," by demonstrating how debates about computers preceded any meaningful scientific or industrial engagement with the subject. Ultimately, West German scientific research into cybernetics chose to focus on its biological rather than its industrial applications. The only meaningful scientific journal on the topic, *Kybernetik*, was founded in 1961 and its emphasis on biological cybernetics was so great that the journal was renamed *Biological*

[21] Jungk, *Tomorrow Is Already Here*, 180.
[22] Jungk, *Tomorrow Is Already Here*, viii.
[23] Raymond G. Stokes, "Technology and the West German Wirtschaftswunder," *Technology and Culture* 32, no. 1 (1991): 3.

Cybernetics in the 1970s.[24] Serious scientific engagement with cybernetics only came after a decade of public debate about the subject, and when West German scientists began to study the topic, they focused on a branch of cybernetics that was largely divorced from the more controversial themes of dehumanization and destruction.

By the middle of the 1950s, coverage of cybernetic technologies in the West German press showed signs of increasing sophistication as journalists began to contemplate the economic consequences of new manufacturing technologies. While the first accounts from Jungk, Strehl, and *Der Spiegel* focused on questions around artificial intelligence and automated weapons development, popular accounts and government-sponsored conferences began to emphasize the economic implications of cybernetics and automation from the middle of the decade. In a lengthy 1955 essay from *Der Spiegel*, entitled "The Revolution of Robots," the term automation and the idea of fully-automated industrial production were introduced to West German audience: "In America, the code word 'automation' had already been coined years earlier for this most modern form of a manufacturing economy."[25] The article went on to remark that the "modern manufacturing economy' both within the United States and the Soviet Union had already produced 'empty-of-humans [*menschenleere*] and fully automatic [*vollautomatisch*] factories."[26] Like earlier coverage in the same publication, the accomplishments of Thomas Watson were documented incredulously, but "The Revolution of Robots" was important in linking the American drive for productivity-enhancing technology to the work of Henry Ford II, who had implemented labor-saving technologies in his father's automobile empire. The discussion of Ford is particularly

[24]Aumann, "The Distinctiveness of a Unifying Science," 21.
[25] "Die Revolution der Roboter."
[26] Ibid.

interesting because it related postwar automation efforts to earlier manufacturing practices, that later became known as Fordism.[27]

While the article recognized the Fordist production regime as the most technologically advanced fabrication system in the world, it noted that the risks taken by the founder Henry Ford paled in comparison to those taken by his son, who had begun to automate car manufacturing: "Before the First World War, Henry Ford had already adopted the assembly line system from Chicago slaughterhouses. His grandson, Henry Ford II, risked much more. In the last seven years, he [Henry Ford II] built new automatically driven production lines and assembly stations for 1.7 billion dollars." This observation highlights the extent to which the new era of production marked a significant break from earlier productivity enhancing technologies. The postwar period was one characterized by greater risks as the impacts of productivity-enhancing technologies grew ever larger. Further, postwar automation differed from its Fordist predecessors in the focus on computer-controlled assembly lines versus more efficient manufacturing processes. Although the terms rationalization, cybernetics, and automation were frequently used interchangeably during the postwar, the rationalization practices from prewar Ford factories emphasized improved deployment of human labor and optimized manufacturing workflows. As noted above, Ford's insight lay in appropriating principles from an adjacent industry, but the prewar pattern of productivity enhancement was markedly different from the deployment of cybernetics in which entirely new technologies were built to replace workers, rather than streamline existent manufacturing processes.

[27] Stefan J. Link, *Forging Global Fordism: Nazi Germany, Soviet Russia, and the Contest over the Industrial Order*, *America in the World* (Princeton: Princeton University Press, 2020); and G. Nigel Gilbert et al., *Fordism and Flexibility: Divisions and Change* (New York: St Martin's Press, 1992).

The "Revolution of Robots" generated some controversy within the West German reading public, and a series of letters published in *Der Spiegel* suggest some readers were left unconvinced that a robotic takeover was imminent. In one response, the psychologist Dr. Paul Feldkeller argued that robotics and automation represented a promising new development, but not a serious threat to the fundamental economic and social order: "To speak of a 'dictatorship of robots' is as an inaccurate as speaking of a 'dictatorship of mathematics' which has not and does not exist […] if the focus on thinking machines hinders conflict and spares humankind unspeakable suffering, we can be content."[28] Feldkeller's response highlights an uncommon thread of techno-optimism in the midst of broader currents of techno-pessimism. For Feldkeller, robots represented an extension of the natural sciences, which was as ideologically neutral as mathematics. Interestingly, he also highlighted the potential for thinking machines or cybernetic technologies to curb violence, in contrast to the more sensational accounts of the period which feared cybernetics as a high-powered weapon in the nuclear age. While Feldkeller's response certainly ran contrary to the prevailing techno-skepticism in West German writing from the early 1950s, his letter suggests that, at least some West German readers, viewed cybernetics not as a harbinger of dictatorship and destruction, but rather as a tool for improved economic and social stability.

A second letter in *Der Spiegel* from the Press Office of the Work Ministry offers an early window into unionist thinking about automation in the Federal Republic. As the chapter will later discuss, West German labor leaders came to view automation as a boon for workers, and they registered little concern about job loss in the midst of a booming postwar economy. In his letter, Herr Heinrich noted that Wiener had acted as an important advisor to organized labor and helped workers in preparing for the introduction of automation technologies in their respective

[28] Dr. Paul Feldkeller, "Automation," *Der Spiegel*, October 16, 1956.

industries.[29] While Heinrich did not cite specific instances when Wiener had assisted labor unions, his remarks provide early evidence that West German labor leaders were carefully monitoring developments in the United States to understand and prepare for deployment of cybernetic technologies.

The United States dominated early discussion of cybernetics and automation in West Germany, but by the middle of the decade, the focus began to shift towards homegrown technologies. On 12 October in Frankfurt, Postal Minister Dr. Siegfried Balke oversaw the ceremonial inauguration of a 7-million mark "electronic brain." According to an article on the topic, the occasion marked a Europe-wide first: "The period of robots has now begun in Europe."[30] While coverage in 1956 granted that such "reasoning robots [*Geistesroboter*]" were already prevalent in the United States, the inauguration of the electronic brain prompted increased interest in automation from sectors of the West German government and labor unions. A 1957 study from the "Rationalization Board for the German Economy" (RKW) marked one of the earliest and most sophisticated studies of automation in West Germany, and its measured, empirical outlook presented a far more nuanced, and less pessimistic view of an automated German future.

Founded in 1921 as the *Reichskuratorium für Wirtschaftlichkeit in Industrie und Handwerk*, the RKW was chartered to coordinate industrial initiatives and jumpstart the economy in the wake of the First World War.[31] After its re-founding in 1950 as the Rationalization Board for the German Economy, the organization set out to promote productivity enhancing technologies across the young FRG, and by 1957, interest in automation had grown sufficiently that the RKW published its first study on the topic, *Automation: The Current State and Effects in the German*

[29] H. Heinrichs, "Automation," *Der Spiegel*, October 16, 1956.
[30]"Die Magie der Roboter," *Der Spiegel*, February 10, 1956, https://www.spiegel.de/spiegel/print/d-43064251.html.
[31] J. Ronald Shearer, "The Reichskuratorium für Wirtschaftlichkeit: Fordism and Organized Capitalism in Germany, 1918-1945," *The Business History Review* 71, no. 4 (1997): 569.

Federal Republic or *Automatisierung: Stand und Auswirkungen in der Bundesrepublik Deutschland*. It is clear from the opening pages of the text, that the RKW viewed automation as a potentially transformative technology, but one that posed little threat of destabilization in the near term. Instead, improved production technologies were seen as a continuation of a foreseeable economic tendency to increase output at ever lower costs:

> Automation is, at base, nothing new, but something that organically emerges from the mechanization and rationalization of industry. From a technical perspective, automation appears as a linear extension of efforts already in motion; in this way, it is an evolution. But it must not be overlooked that its widespread application might constitute a 'revolution' from an economic and social perspective, namely a rethinking of well-known assumptions. Nonetheless, automatic production will not overturn our economy overnight.[32]

This sober reflection on both the evolutionary and revolutionary nature of automation differs markedly from the journalistic accounts discussed above. Here, the dramatic predictions of cybernetic pioneers and the alarmist rhetoric of Jungk, Strehl, and others appeared as premature exaggerations.

But why did the RKW's study arrive at a more measured conclusion about the likely effects of cybernetic technologies for the West German economy? A possible answer is found in the study's methodology and its sector-wise analysis of automation technologies. Rather than detailing the potential applications of "electronic brains" to the entire economy, the RKW study devoted specific sections to the effects of automation on a range of vital industries in the FRG: metal, coal and steel, wood, textiles, and others. In addition, the study offered a detailed consideration of the "scientific and technical basis of automation," which provided concrete analysis of applied automation technologies and their attendant limitations in different sectors. Abstract terms, such as cybernetics, computing machines, and electric brains, which were used extensively in

[32] Rationalisierungs-Kuratorium der deutschen Wirtschaft, *Automatisierung: Stand und Auswirkungen in Der Bundesrepublik Deutschland* (Munich: Carl Hanser, 1957), 1.

journalistic coverage from this period, elided the many distinct subfields of early computing and robotization technologies. The RKW study, however, considered, in turn, numerous sub-technologies that were frequently lumped under the umbrella term 'automation.' By disaggregating the idea of automation across different industries, the authors of the RKW study made clear that the likelihood of a cybernetic rupture in the West German economy was remote. While it was true that the seeds of a computerized and widely automated economy were germinating in the 1950s, the RKW study argued forcefully that they had yet to bloom.

Although near-term economic disruptions were viewed as unlikely, the study anticipated the wide-ranging social effects of automation in a chapter entitled "Effects of Automation on Jobs and Society." By examining the state of the FRG's economy specifically rather than looking to the United States, the RKW study registered little concern about the employment effects of increasing automation. By 1957, the so-called "economic miracle" was well underway in the Federal Republic and the large-scale retooling of industry had resulted in a significant labor shortage. The RKW's assessment of the West German economy did not ignore the effects of robotization on manufacturing workers, and it granted that displaced workers would be inconvenienced if forced to change jobs, but from a macro perspective, the study concluded that the labor market was sufficiently robust to offset near-term technological unemployment.[33] West Germany was not alone in its enthusiasm for robotics as a solution to a serious labor shortages. As chapter four will demonstrate, endemic labor shortages in socialist states, like the German Democratic Republic, functioned as a guard against the threat of technological disruptions. While the causes of the East German labor shortage derived from inefficient mechanisms for human capital allocation in a command economy rather than massively growing

[33] Rationalisierungs-Kuratorium der deutschen Wirtschaft, *Automatisierung*, 247-248.

aggregate demand, the existence of a labor shortage proved a compelling argument against any concerns about automation's negative externalities on employment levels.

Beyond details of an oversupplied West German labor market in the late 1950s, the RKW report also highlighted important obstacles to the adoption of automated technologies that were largely absent from earlier discussion of the topic. A central challenge in updating manufacturing technologies derives from the upfront capital outlay and attendant risk associated with constructing or retrofitting a new manufacturing system. While the promised gains of advanced robots were attractive to business owners, questions around reliability and concerns over implementation costs were seen as a significant barrier to widespread adoption.[34] In the cases where robotization was introduced, however, the RKW report sounded an optimistic note by remarking that strenuous physical labor would likely be diminished with the aid of computer-controlled robots.[35] The potential benefits to workers - particularly those who worked under difficult or dangerous conditions - was an important theme that began to emerge in the late 1950s and early 1960s. Here again, an interesting parallel can be drawn with the German Democratic Republic in the 1970s, where socialist planners presented automation as a tool for improving working conditions and strengthening the *Arbeiterklasse*.[36]

Significantly, the RKW report was one of the first published accounts to record the thoughts of West German workers toward automation technologies. Labor's stance toward automation is portrayed as "skeptical" in the report, but much of the reticence is attributed to the absence of high-quality information about the actual applications of automation in different industries:

[34] Ibid., 15.
[35] Ibid., 20.
[36] See chapter on the German Democratic Republic and Fischer and Hartmann, *Industrieroboter im Sozialismus*.

> One of the most important tasks for ensuring the workers maintain a positive attitude toward automation is early instruction about planned technological initiatives and thorough planning for the necessary reallocation and retraining of workers […] It is understandable that the entire workforce will react with fear and uneasiness to any uncertainty arising from the effects of technological innovations.[37]

Although "fear and uneasiness" were present among the working population, the report also underlined the many positive aspects of automation, which both industrialists and workers could expect from more extensive automation, including higher wages and the elimination of physically strenuous work. Early reactions from the Economic Science Institute of the German Trade Union Confederation (WWI) also testify to labor's ambivalence toward automation from this period. According to the RKW: "the unions see in automation the opportunity for a further increase in social product [GDP] and a concomitant improvement in living standard across different social levels; on the other hand, [they] believe it necessary that national economic policy pursues goal-oriented measures to ensure the feared disturbances associated with advancing mechanization and automation do not come to pass."[38]

The RKW study marks a turning point in the West German reception of automation and highlights an important divergence between journalistic and academic writing on the subject that emerged in the middle part of the decade. While journalistic writing tended to exaggerate the diabolical effects of automation, academic studies and conferences held by labor unions in the ensuing decade were frequently more optimistic in their handling of the subject. As discussed later in the chapter, a similar gulf between journalistic coverage of cybernetics and its applications to visual art characterized the reception of ideas around Information Aesthetics and Generative Aesthetics in the 1960s. The discrepancy between academic and popular writing on the topic

[37] Rationalisierungs-Kuratorium der deutschen Wirtschaft, *Automatisierung*, 255.
[38] Ibid., 256.

reveals a more differentiated reception of cybernetics than other scholars have permitted. While Frank Biess' work characterized interest in automation as a form of modern angst, a wider perspective reveals more varied views on the topic, that ranged from fear to genuine optimism. [39]

Although the effects of automation came to be viewed as an evolutionary process, the RKW study did not discount the potentially destabilizing effects of automated technologies. By focusing on the unique position of the West German economy in the mid-1950s and exploring the varied effects of automation across different industries, the report jettisoned earlier approaches that viewed American conceptions of technological progress as a dire threat to economic stability and social order. Despite its relative optimism, the report specifically acknowledged the role of state intervention in ensuring that technological innovation would result in the desired improvements in output and living standard promised by cybernetic technology. From the RKW's standpoint, economic forces and technological advances were insufficient to achieve broader social gains: "The above discussed problems [social and economic destabilization] are absolutely not unresolvable. They will require, however, from the outset thorough analysis and well-directed objectives. In-house industrial initiatives will often be insufficient and will therefore require support through cross-industry and national measures to overcome emerging challenges."[41]

In this way, the RKW study paralleled the arguments advanced in socialist texts from the 1960s, where state planning was seen as key to ensuring equitable social outcomes in an automated future. While the rhetoric in socialist texts differed from the RKW's apolitical perspective, both West Germany, and its socialist counterparts acknowledged the state's role as a necessary regulator of increasingly automated economies. Critiques from leftist futurists in the United States also

[39] Biess' examination of the philosophical debates between Pollock, Schelsky, Gehlen, is also treated extensively in Radkau, *Die Geschichte der Zukunft*.
[41] Rationalisierungs-Kuratorium der deutschen Wirtschaft, *Automatisierung,* 247..

called upon the state to intervene in advanced technological upheaval. Despite enormous differences in government, ideology, and economic outlook, all four states considered in this study turned toward government control as a guard against the excesses of an automated economy. Within West Germany, the themes addressed in the RKW report received increased attention from German labor unions in the late 1950s and 1960s, as West German workers became more attuned to the potentials and pitfalls of automated industry.

Automation and Organized Labor in the FRG

As the second decade of postwar expansion began in West Germany, labor unions became increasingly interested in understanding how new technologies would impact the lives and wages of workers. In 1963 and 1965, the Industrial Union of Metalworkers or *Industriegewerkschaft Metall* (IG Metall) held two conferences on the effects of automation for the German workforce. The conferences, which were organized in collaboration with the RKW and the Organization for Economic Cooperation and Development (OECD), produced accompanying monographs that shed light onto West German unionist thinking about automation, progress, and economic fairness from the perspective of labor leaders and economists alike. Like earlier works, the United States cast a long shadow on the proceedings, but by the 1960s, persistent levels of unemployment in the United States were beginning to raise serious alarm from some West German observers. Although the United States was viewed as a test-case for West German planners in the 1960s, it was increasingly clear that a more automated and technologically advanced economy in the FRG had already begun. In the words of one commentator: “Automation and technical progress are no longer questions of

the future, but rather the present. We must seriously address ourselves to this if we hope to maintain control over these developments."[42]

The first workers' conference hosted by IG Metall, entitled "Automation and Technical Progress in Germany and the USA," took place over the course of three days in August of 1963, and featured a range of thinkers, labor leaders, and economists from both nations. 250 experts from within Germany and abroad were in attendance, including many representatives from international labor organizations, such as the International Metal Workers Federation in Geneva, the AFL-CIO, and the Japanese Steel Workers Union.[43] IG Metall convened the conference to better understand how new technologies could change the economic lives of its members, and although relevant concerns about the potential effects of increased automation were voiced, the labor representatives explicitly disavowed Luddism: "IG Metall has for a long time concerned itself with the positive and negative effects of technical progress. And alongside the German Labor Federation and the International Workers' Movement, IG Metall has never spoken out against technological progress. In fact, the organization has always maintained that all peaceful forms of modern technology can and must be instruments for an increase in living standards and the improvement of working conditions."[44] The central concern, therefore, lay not in the deployment of new technologies *per se*, but the potential that benefits of automation would redound to the owners of capital rather than the workers. As a result, conference speakers repeatedly emphasized the importance of government intervention to preserve the delicate balance between technological development and equitable economic distribution.

[42] Günter Friedrichs, ed., *Automation und technischer Fortschritt in Deutschland und den USA* (Frankfurt am Main: Europaische Verlagsanstalt, 1963), 5.
[43] Ibid., 2.
[44] Ibid., 7.

In his address to the conference, the AFL-CIO representative to Europe, Bert Seidman, proposed a range of policy initiatives that the American experiment with automation could recommend to the FRG. Although Seidman never referenced the calls for radical reform articulated in the Report on the Triple Revolution which also appeared in 1963, his speech during the conference acknowledged recent skepticism towards the forward march of technological progress: "In the United States of America, widespread opinion previously held that technological progress would automatically improve the lots of all […] In the last few years, however, a clear reorientation of American thought has taken place."[45] Seidman's acknowledgment of a changed American psyche seemed to validate the West German reticence towards rapid deployment of new manufacturing technologies which was manifest in the comparatively slow uptake of cybernetics throughout the 1950s.

By 1963, Seidman worried that continued full employment in West Germany threatened to obscure the subtle, but significant effects of an under-skilled workforce under conditions of rapid technological advancement. On this point, the United States demonstrated that unsustainably high growth rates would be required to maintain full employment under conditions of high automation. Even more concerning was the potential that full employment in the Federal Republic would mask the pernicious and harmful effects of increased automation for workers. To mitigate the overt and hidden effects associated with an automated economy, Seidman argued that governments on both sides of the Atlantic should pursue a two-pronged strategy. First, national economic policy should be committed to economic interventions that promote high growth and full employment. Second, governments should develop programs targeted at mitigating the effects of automation for workers. While Seidman gave few specifics to substantiate his first proposal, he cited the Area-

[45] Ibid., 29.

Redevelopment Act under the Kennedy Administration as an example of a federal policy that supported workers by providing opportunities for further education and retraining.[46] Although Seidman viewed the Area-Redevelopment Act as a positive step forward, his broader concern for both the United States and West Germany was that neither nation would pursue coordinated program across the entire economy: "While these measures [Area-Redevelopment Act] are certainly welcome, they are in no way sufficient. What is necessary is a coordinated program for ensuring the positive deployment of new technologies." [47] Seidman's commitment to government intervention emerged from a deep concern that the promises of scientists and cybernetic experts would benefit the few, rather than the many. As a representative of American labor, Seidman remained committed to the beneficial uses of technology, but he maintained strong opposition to the idea that technological progress would necessarily entail social progress.

Other speakers at the conference, such as Dr. Günter Friedrichs, Leader of the Department of Automation and Nuclear Energy on the IG Metall Board, echoed Seidman's concerns, but were careful to distinguish between automation and other forms of technical progress. For Friedrichs, the emphasis on automation threatened to conceal broader trends that did not involve robotization *per se*, but still had important implications for the nature of work and employment levels. The differentiated effects of technical progress prompted Friedrichs to propose a new five-part taxonomy for classifying new technological interventions in the economy: 1) improved organization methods; 2) mechanization; 3) high mechanization, which involved computer-controlled devices; 4) full automation; 5) use of artificial materials e.g. aluminum, graphite, etc.[49]

[46] Friedrichs, *Automation und technischer Fortschritt in Deutschland und den USA*, 35.
[47] Ibid., 35.
[49] Ibid., 81.

Friedrichs' differentiated approach permitted him to make "macro-level" observations about the West German economy, rather than generalizing from anecdotal industry-specific evidence:

> Whether effective joblessness arises from direct or indirect release of workers [*Freisetzungen*] is not only dependent on the rate of technical progress. It is decidedly more dependent on the volume of simultaneous production increases […] Even weak technical progress can lead to widespread labor dislocations during periods of low growth. *The real labor effect of technical progress is determined alone through the interaction between technical progress, growth rates, and work-hours.*[50]

Friedrichs' argument that technical progress cannot be viewed in a vacuum but must be understood relative to macroeconomic factors like aggregate demand and average working hours led him to arrive at a more nuanced conclusion about the future of the West German economy. Interestingly, the American sociologist, Daniel Bell, cited precisely the same argument in his response to American cybernation theorists, whom he believed had overplayed the economic threat of automation.[51] In his response to the cybernation frenzy in the United States, Bell analyzed changes in aggregate demand and the working-age population to argue that secular demographic and economic trends were to blame for persistent levels of unemployment, rather than changes in productivity.[52] The examples from Friedrichs and Bell suggest that by the 1960s more measured assessments of cybernetics and its effects on labor had begun to temper the more highly sensationalized accounts from the decade prior.

Friedrich's contribution is also significant as one of the first accounts from West Germany to invoke working hours as an important variable in a highly automated economy. Although Friedrichs did not describe in detail his proposals for "securing social well-being," he listed four proposals that would attract increased attention in West Germany and the United States for the

[50] Ibid., 98
[51] Bell, "The Bogey of Automation."
[52] See chapter one.

remainder of the decade: "consent of workers during a redeployment, wage guarantees for intra-factory reassignment, special protections for elderly workers, and compensation payments for job loss."[53] These proposals signaled an important turn toward practical solutions for addressing an automated West German economy. By 1963, technical advances had begun to cross the Atlantic, as both the United States and the Federal Republic began to consider new systems of economic distribution. While the reckoning with automation technologies did not produce a full-blown movement for widespread economic reform as it did in the United States, West German labor leaders were clearly committed to reinventing the relationship between wage earners and the owners of capital under conditions of increasing industrial mechanization.

After a successful first conference in 1963, IG Metall hosted a second international gathering under the title, "Automation: Risks and Opportunities" in March 1965. Much of the 1965 conference expanded upon the major themes from the earlier meeting, but the proposal for shorter working hours as compensation for increased automation took on increased importance. In his address to the conference, Jef Rens, First Representative of the Director of the International Workers' Organization in Geneva, devoted an entire section to the topic of "lengthened free-time." For Rens, increased free time was central to a holistic view of an improved living standard: "The benefits that arise from higher productivity can and should be devoted to a lengthening of free time. Lengthened free time, which increases in importance with age, certainly belongs to any true definition of a 'higher living standard'".[54] The International Workers' Organization played an important role in advocating for the 40-hour work week during the 1930s, and by the 1965, it

[53] Ibid.,131.
[54] Jef Rens, "Technischer Fortschritt und die Tätigkeit der Internationalen Arbeitsorganisation (IAO)," in *Automation Risiko und Chance: Beiträge zur Zweiten Internationalen Arbeitstagung der Industriegewerkschaft Metall für die Bundesrepublik Deutschland über Rationalisierung, Automatisierung und Technischen Fortschritt, 16. bis 19. März 1965 in Oberhausen*, ed. Günter Friedrichs (Frankfurt am Main: Europäische Verlagsanstalt, 1965), 49.

appeared likely that new legislation would result in a further decrease of working hours in light of technological advances.[55]

At the time of his speech, Rens saw the labor movement as an important force for advocating legislative change, but he also viewed unions as a mechanism for ensuring the well-being of its members once shorter working hours had arrived: "The labor movement can best determine, which free time activities are of interest to its members and arrange corresponding programs. On this front, the labor movement of today certainly has an important task ahead."[56] Labor leaders in subsequent decades would oppose calls for shorter working hours or a universal basic income out of fear that such a program would undermine support for the labor movement, but Rens not only welcomed the idea but proposed a new role for the unions in a future with fewer working hours. The movement would become responsible not only for protections on the job, but also for ensuring the well-being of its members while away from work.

Rens' commitment to shorter-working hours was not, however, universally accepted. Whereas Rens approached the quest for shorter working hours from an international perspective, Wilhelm Claussen took up the topic with a particular focus on West Germany. In his address, entitled "Technical Progress and Actions of the Government in the FRG", Claussen cautioned against overly simplistic comparisons between the United States and the Federal Republic. Claussen acknowledged that the American case could be instructive for West German policy, but he drew attention to the differences in the labor market, which were characterized by oversupply in the United States and undersupply in the FRG. These differences alongside a lower living standard in West Germany, prompted Claussen to reject calls for shortening working hours:

[55] Hunnicutt, *Work without End*, chapters three and five.
[56] Rens, "Technischer Fortschritt und die Tätigkeit der Internationalen Arbeitsorganisation (IAO)," 50.

> The current living standard in the Federal Republic is still distant from that in the United States. To achieve a comparable level, a long period of strong growth – particularly in industrial production – will be needed. We hardly require shorter working hours in the Federal Republic to avoid negative effects on employment levels, but rather widespread technical progress to make possible shorter working hours, which are desirable from a social standpoint.[57]

Claussen's opposition to shorter working hours in the Federal Republic highlights a crucial difference in American and German rhetoric surrounding systemic social change during this period. Unlike American cybernation theorists who justified their calls for shorter working hours and a guaranteed annual income by invoking the concept of economic abundance, Claussen warned that economic conditions in West Germany would not permit similarly ambitious goals. Although the West German economy had achieved significant gains since 1950, Claussen did not believe that the FRG's aggregate output during the 1960s could support the kind of radical proposals which were entertained in the United States.

The idea of a guaranteed income or a drastically shortened work week were not economically viable in the FRG, but Claussen still portrayed automation as an important tool for achieving improved social and economic stability in the log run. Claussen's analysis of the divergence between technological conditions in the United States and West Germany reflected a larger trend in West German thinking about automation and its effects on workers. The two conferences held by IG Metall during the 1960s evidenced a more analytical approach to comparisons with the United States that accounted for structural differences in growth rate, unemployment rate, and technological progress. From the labor perspective, fears about automation had been replaced by practical, and even optimistic, visions of what a more efficient and equitable economy might look like. But these optimistic visions were tempered by more concrete analyses that assessed the United States as a vastly different, and far more advanced

[57] Claussen, "Technischer Fortschritt und die Tätigkeit der Regierung der BRDClaussen," 145.

economy. The promise of automation was real, but its near-term realization seemed remote. While the industrial and scientific applications of cybernetics remained small relative to its public attention, avant-garde thinkers from the world of visual art were charting a new course that would firmly plant the Federal Republic at the center of a new form of cybernetic reception.

Cybernetic Humanities and The Dawn of Information Aesthetics

In parallel to the social scientific and popular press of coverage of cybernetics, the Federal Republic witnessed a serious attempt to integrate cybernetic principles into the burgeoning fields of design, computer art, and aesthetics. In West Germany, the short-lived but influential *Hochschule für Gestaltung in Ulm* (HFG) and the *Technische Hochschule Stuttgart* (THS) emerged as the central loci where the applications of cybernetics to the humanities and aesthetics received the most sustained attention. But more important than the institutions were the contributions from the polymathic physicist-philosopher, Max Bense, and his French colleague, Abraham A. Moles, who together laid the theoretical foundations for two new fields of cybernetic aesthetics – Information Aesthetics and later Generative Aesthetics. Even Norbert Wiener himself was sufficiently interested in this new development that he spoke not at the German Academy of Sciences during his visit to the Federal Republic, but at the HfG and the THS at the invitation of Max Bense and Max Bill, the Ulm school's founding director.[58]

Information Aesthetics and its spinoff discipline, Generative Aesthetics, were built on a broad intellectual foundation, which drew variously on David Birkhoff's work on semiotics, Claude Shannon's ground-breaking insights into information theory, and Norbert Wiener's

[58] Elisabeth Walther, "Max Bense und die Kybernetik," in *Computer Art Faszination*, ed. Gerhard Dotzler (Frankfurt am Main: Medien-Institut), 360, reproduced at https://www.netzliteratur.net/bensekybernetik.htm.

cybernetics.[59] Empowered by the cutting-edge insights into information density and feedback loops, Information Aesthetics sought to develop an objective aesthetic methodology, which, in Bense's words would overcome the "the provincial aesthetic irrationality of our academies."[60] By the 1960s, theoretical work on Information Aesthetics had motivated a new generation of young artists, such as Georg Nees and Frieder Nake, to create computer art in accordance the precepts of Information Aesthetics. These works and the development of Generative Aesthetics gave rise to a series of exhibitions within West Germany at the *Studiengalerie des Studium Generale* in Stuttgart and the famous 1968 exhibition in London, *Cybernetic Serendipity*, for which Max Bense was credited as the primary inspiration.[61] The extensive output from the likes of Bense, Moles, and their students during this period has received modest academic treatment in the past, but these studies have largely addressed the effects of computing on the emerging field of digital art.[62] This section will take a different approach and try to locate cybernetic aesthetics within broader intellectual trends within West Germany and abroad during the 1950s and 1960s.

When viewed from a wider perspective, it becomes clear that Bense and his colleagues stimulated international dialogue about the limits of cybernetics. Information Aesthetics, with its firm commitment to rationality and the integration of objective scientific principles into the world of art, had lofty ambitions which mirrored the rhetoric of cybernetic advocates in the United States. Just as Donald Michael had written in his book, *Cybernation*, about the capacity of cybernetics to "emancipate or enslave" humankind, Bense, Moles, and their students were similarly interested in

[59] Pertigkiozoglou, "1960s."
[60] Max Bense, "Ist Kunst berechenbar?," *Frankfurter Allgemeine Zeitung*, March 13, 1968, pg. 22.
[61] Christoph Klütsch, "Information Aesthetics and the Stuttgart School," 65; Jasia Reichardt, *Cybernetic Serendipity: The Computer and the Arts*, 2nd ed. (London: Studio International, 1968), 5.
[62] See Felicia Hönig, *Kunst und Kybernetik* (Master's thesis, University of Vienna, 2008); Herbert Lindinger, ed., *Ulm Design: The Morality of Objects* (Cambridge, Mass.: MIT Press, 1990), Paul Betts, "Science, Semiotics and Society: The Ulm Hochschule für Gestaltung in Retrospect," *Design Issues* 14, no. 2 (1998): 67–82.

evaluating the role of the artist in an increasing technological age.[63] For both American cybernation theorists and avant-garde West German aestheticists, cybernetics demanded a fundamental reconsideration of the relationship between humans and their technological creations.

The West German fascination with cybernetic aesthetics represented a highpoint in optimism around the manifold applications of cybernetics. In stark contrast to the more measured responses from the labor leaders in the 1960s and the harsh critiques of cybernetics seen in popular literature from the 1950s, the West German art world was deeply influenced by a provocative strain of optimism about objective methods for the creation and evaluation of art. Just as automation threatened to upend the world of manufacturing, Information Aesthetics would challenge the role of the artist in an age of digital art. Thinkers from the Ulm School and later the Stuttgart School of Computer Art, embraced cybernetics as an empowering tool for artistic endeavor, or as Abraham Moles argued, "the artist will find freedom during the invasion of machines in society: he will be able to use the machine to his advantage and in so doing increase his own powers. But it is incumbent upon him to learn to speak the machine's language."[64] West Germany may have had a lackluster scientific record on cybernetics, but it stood at the vanguard of humanistic cybernetics by the 1960s.

Widespread popular interest in Information Aesthetics only emerged in the 1960s, but Max Bense and Abraham Moles had already laid much of the theoretical groundwork for the new discipline during the 1950s. Bense's education and scientific career prior to joining the faculty in Stuttgart reveal an intellect with a deep interest in the intersection of art and science. Bense had received a doctorate from Bonn with the title, "Quantum mechanics and the Relativity of Being"

[63] Donald Michael, "Cybernation: The Silent Conquest" (Santa Barbara: Center for the Study of Democratic Institutions, 1962), 8.
[64] Abraham Moles, "Kybernetik und Kunstwerk (1965)," in *Ästhetik*, ed. Wolfhart Henckmann, vol. XXXI, Wege er Forschung (Darmstadt: Wissenschaftliche Buchgesellschaft, 1979), 331.

before beginning as a career as a physicist in the 1940s.[65] In 1950, Bense arrived at the *Technische Hochschule* Stuttgart and shortly thereafter began to revolutionize the field of aesthetics through the application of contemporary scientific advances to artistic objects. According to his collaborator and wife, Elisabeth Walther, Bense had received a copy of Wiener's foundational text, *Cybernetics: Or Control and Communication in the Animal and the Machine*, from an American colleague in 1949, only a year after its original publication.[66] The receipt of Wiener's text in 1949 places Bense at the cutting edge of cybernetic reception within postwar Germany, well before any serious academic or popular press coverage of the topic had appeared.

Bense's arrival in Stuttgart and his knowledge of Wiener's emergent academic discipline prompted the publisher of *Merkur*, the self-styled "magazine for European thought", to request an article on the topic in 1951.[67] The article, entitled, "Cybernetics or the Metatechnology of a Machine [Kybernetik oder die Metatechnik einer Maschine]" appeared in March 1951, and would become one of the foundational works in cybernetic humanities and a significant milestone in the broader reception of cybernetic thought in the Federal Republic. In his characteristic discursive style, Bense proposed that technology had advanced so far that it required a methodological apparatus to theorize the relationship between technological developments and philosophical questions around being and consciousness. The primary development responsible for the philosophical elevation of technology was what Bense termed the "cybernetic expansion":

> Technology was until now at base a superficial phenomenon concerned with the inhabited and habitable spheres; what is now developing before our eyes is "deep technology;" we are experiencing its penetration into the fine structures of the world, into the immaterial elements, where accordingly its pathological elements

[65] Klütsch, "Information Aesthetics and the Stuttgart School", 66.
[66] Walther, "Max Bense und die Kybernetik."
[67] Walther, "Max Bense und die Kybernetik."

> are more dangerous and more hidden. The cybernetic expansion of current technology therefore entails an "expansion under the skin."[68]

While Bense's language certainly highlighted the potentially insidious effects of cybernetic advancement, he was anything but a luddite. In contrast to the popular coverage from Robert Jungk, and others discussed earlier, Bense sought to harness the power of cybernetics through appropriate an philosophical framing. From this perspective, Bense's approach to cybernetics shared more similarities with American cybernation theorists, like Theobald and Michael, who articulated concerns about technological advancement, but ultimately viewed technological progress as a necessary tool for long term social progress. In language strikingly similar to that of Theobald, Bense concluded "Metatechnik" with a provocation for further study: "Man as a technological being: this strikes me as one of the greatest tasks for the philosophical anthropology of tomorrow".[69]

While Bense's *Merkur* article considered cybernetics from a philosophical perspective, cybernetics quickly began to draw special attention from the fields of design and aesthetics in the early Federal Republic. The *Hochschule für Gestaltung in Ulm*, where Bense and Abraham Moles served as founding members of the Information Department, became the first and most important institution in the 1950s to incorporate cybernetic insights into their curriculum. The HfG was founded in 1953 by Inge Aicher-Scholl, Otl Aicher, and Max Bill with the aim of providing young designers a "universal" and practical education.[70] Max Bill, who served as the institute's founding leader until 1957, explicitly placed the Ulm School in the tradition of the Bauhaus and was

[68]Max Bense, "Kybernetik oder die Metatechnik einer Maschine," in *Max Bense: Ausgewählte Schrifte, Band II: Philosophie der Mathematik, Naturwissenschaft und Technik*, ed. Elisabeth Walther (Stuttgart: J.B. Metzler, 1998), 4.
[69] Ibid., 10.
[70] Eva von Seckendorff, *Die HochschulefFür Gestaltung in Ulm* (Marburg: Jonas Verlag, 1989), 11. Inge Aicher-Scholl was also the elder sister of Hans and Sophie Scholl, two of most prominent members of the anti-Nazi resistance group, The White Rose.

responsible for recruiting Max Bense after he first lectured at the Ulm *Volkshochschule* in 1952.[71] As Paul Betts has noted, the school was imbued from its founding with a particular moral vision, which sought to educate its students in *Allseitigkeit* as an intellectual guard against the temptations of fascism.[72] In this intellectual milieu, Bense's hyper-rational approach to design and his commitment to applying scientific methods to aesthetics and design sat somewhat uneasily within the Ulm School's larger vision.

Despite its controversial position vis-à-vis the school's larger vision, cybernetics played an important role in the education of designers in the school's early years. Through his position on the faculty from 1953 to 1958, Bense developed the curriculum for the Information Department, which reflected his interests in information theory, cybernetics, and his own work in Information Aesthetics. The department's mission was to train students for careers in television, radio, and motion pictures, but Bense's influence ensured that the theoretical portion of the curriculum viewed texts "in terms of the quantity of information they contain […] and the novelty lies not only in the close collaboration with the department of Visual Communication but also in the fact that general semantics and information theory are the disciplines that underlie the work of both disciplines."[73] Bense's published contributions to cybernetics lay in the realm of theoretical philosophy, but he believed that developments in information theory and cybernetics had an important role to play in preparing young people for an increasingly technological society.

The Ulm School's commitment to integrating technological theory into its curriculum led Bense to invite Wiener to speak at the TH Stuttgart and at the Ulm School during Wiener's visit

[71] Cornelie Leopold, "Precise Experiments: Relations between Mathematics, Philosophy and Design at Ulm School of Design" (Relationships Between Architecture and Mathematics, Milan, 2012), 376.
[72] Paul Betts, *The Authority of Everyday Objects: A Cultural History of West German Industrial Design* (Berkeley: University of California Press, 2004), 172-173.
[73] Max Bense quoted in Lindinger, *Ulm Design*, 170.

to West Germany in July 1955.[74] The official invitation from Max Bill to Norbert Wiener provides further evidence for the importance of cybernetic thought during Bense's time in Ulm:

> It is the goal of the HfG to achieve a unity of creative work, and it therefore pursues with great interest the developments of cybernetics and teaches its basics in courses within "cultural integration;" cybernetics, as a science of information and communication is also a foundation for the "Information" department at the school.[75]

According to Elisabeth Walther, who taught alongside Bense and later collected his works, Wiener's talks were treated as major events in the academic calendar and in Stuttgart, the large auditorium where Wiener spoke "overflowed" with attendees.[76]

Wiener's visit to Stuttgart and the Ulm School reflects the fact that early cybernetic reception in the Federal Republic was dominated by sectors outside of the major academic and research institutions. Whereas West German scientists were slow to adopt Wiener's new methods, philosophers and science-adjacent fields like industrial design eagerly consumed Wiener's work and sought novel applications of cybernetic feedback to their respective disciplines. Wiener's 1955 visit to the Federal Republic also coincided with an important development in the way cybernetics was theorized among West German intellectuals. Bense's work on cybernetics prior to 1955 was primarily concerned with the philosophical implications of the new science, but in the latter half of the decade, Bense and Moles would began to focus on the implications of cybernetic thought for aesthetics.

In 1956, Bense published the second volume of *Aesthetica* entitled *Aesthetische Information* and in the subsequent year, the French philosopher-theorist, Abraham A. Moles

[74] Walther, "Max Bense und die Kybernetik."
[75] Georg Vrachliotis, "Zwischen Automation und Metatechnik," in *Geregelte Verhältnisse* (Berlin: Birkhäuser, 2020), 71.
[76] Elisabeth Walther, "Max Bense und die Kybernetik."

published *Theory of Information and Aesthetic Perception.*[77] These two texts formed the basis of Information Aesthetics, an influential and controversial strand of aesthetic thought which served as the intellectual foundation for Stuttgart School of computer art, which emerged in the mid-1960s. A full explanation of Information Aesthetics is beyond the scope of this study, and the topic is well-covered in Christoph Klütsch's work on the topic, but a brief overview of its intellectual underpinnings serves to illustrate how Moles and Bense conceptualized cybernetics within their new aesthetic framework. Information Aesthetics built primarily on George David Birkhoff's work on aesthetic measurement from the 1920s and Claude Shannon's foundational work on information theory from the 1940s.[78] In the late 1920s, Birkhoff had attempted to devise a formula to calculate the aesthetic measure of a work of art, by taking the ratio of order and complexity: $M = O / C$.[79] If a critic could accurately measure the relative order and complexity of a work of art, its aesthetic measure could be calculated by dividing the two terms. At the time of Bense and Moles' writing in mid-1950s, Shannon's work on the information density and Wiener's insights into feedback loops provided the theoretical insights necessary to develop a more systematic theory of aesthetic measurement. The aim of this new aesthetics was to transcend the subjective assessment of art and establish a rational basis for the judgment of artistic output. While Information Aesthetics remained a relatively fringe discipline, largely confined to the corridors of the Ulm School and the TH Stuttgart during the 1950s, the effort to evaluate art through cybernetic means laid the groundwork for the more influential fields of Generative Aesthetics and computer art, which emerged in the subsequent decade.

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[77] Max Bense, *Aesthetica II, Aesthetische Information* (Baden-Baden: Agis, 1956) and Abraham A. Moles, "Théorie de l'Information Et Perception Esthétique," *Revue Philosophique de La France Et de l'Etranger* 147, no. 1 (1957): 233–42.
[78] Klütsch, "Information Aesthetics and the Stuttgart School," 67.
[79] George David Birkhoff, *Aesthetic Measure*, Reprint 2013 ed. edition (London: Harvard University Press, 1933)., chapter one.

Despite its relatively low-profile, Information Aesthetics attracted a range of detractors who objected to the rationalization of art, and only two years after Wiener's visit to the Ulm School, Max Bill was replaced as the school's director and Bense departed the following year. The end of Bill's tenure was precipitated in part by a highly critical editorial in *Der Spiegel* and a larger intellectual shift away from cybernetics that was driven by Bill's successor, Tomas Maldonado.[80] As Georg Vrachliotis has observed in a recent work on the topic, Maldonado refocused the school's curriculum away from cybernetics, systems theory, and semiotics which dominated the school's earlier years when Bense and Bill were active.[81] Although Vrachliotis' observation about a "discursive caesura" around cybernetics clearly reflects an important shift within the Ulm School, wider interest in the cybernetic humanities only increased from the late 1950s onwards.[82] By 1960, interest in the topic had grown sufficiently to justify the establishment of the academic journal entitled, *Grundlagenstudien aus Kybernetik und Geisteswissenschaft – Internationale Zeitschrift für Modellierung und Mathematisierung in den Humanwissenschaft* or "Fundamental Studies of Cybernetics and Humanities – International Review for Modelling and Application of Mathematics in the Humanities," which offered international contributions on "the recent convergence of natural sciences and the humanities through the methodological insights known as cybernetics".[83] Throughout the 1950s, the application of cybernetics to humanistic fields of study was largely confined to the Federal Republic where Bense and Moles were active, but from 1960, the international reception of the field increased precipitously as West German thinking around cybernetic aesthetics and computer art spread across Europe and the Atlantic. Indeed, the journal's

[80] Betts, *The Authority of Everyday Objects*, 173.
[81] Vrachliotis, "Zwischen Automation und Metatechnik," 72-73.
[82] Ibid., 72.
[83] *Grundlagenstudien aus Kybernetik und Geisteswissenschaft* 1, no. 1 (January 1960), 1.

subtitle, which included the word "international," hinted at the international ambitions of this growing academic discipline.

Despite its explicit international orientation and the publication of numerous articles by non-German authors, the editorship evidenced a marked interest in the German pre-history of cybernetics. In December 1961, the journal's editors presented an extensive appendix which reproduced Hermann Schmidt's unpublished work on *Regelungstechnik* or "control engineering" from the 1940s. Schmidt, a trained physicist and philosopher, had proposed the establishment of an Institute for Control Engineering to the National Socialist Federation of German Technologists in 1941. The editors' introduction to Schmidt's work sought to place Schmidt as an intellectual forefather to cybernetics and even argued that he had received insufficient credit relative to Norbert Wiener: "The history of what is today called cybernetics (even if there is only half agreement about what this term describes) did not first begin with the publication of Norbert Wiener's sensational book, *Cybernetics* […] Hermann Schmidt's "Memorandum for an Institute of Control Engineering" from 1941 has been long forgotten."[84] For the editors of *Grundlagenstudien*, the publication of Schmidt's work was both an effort to elucidate Germany's own cybernetic history and to call attention to the relevance of Schmidt's insights for the contemporary relationship between cybernetics and the humanities. The introduction went on to claim that the "[memorandum] had already demonstrated the socio- and cultural political effects of control engineering. Professor Schmidt's concept of general control engineering has been fully hidden behind the later developed term cybernetics […]."[85]

[84] "Vorwort der Schriftleitung," *Grundlagenstudien Aus Kybernetik Und Geisteswissenschaft* 2, Beiheft (December 1961).
[85] Ibid.

The editorial board's interest in Germany's cybernetic prehistory did not end in 1961, but continued in 1965 with a second special edition devoted to Schmidt's work. By 1965, the editors of *Grundlagenstudien* noted increased interest in the "anthropological meaning" of cybernetics, which their earlier publication of Schmidt's work had ignited.[86] Of particular interest was the question of whether cybernetics prescribed a deterministic path for technological development. According to the editorial board, Schmidt's work from the 1950s, which was reproduced in the 1965 edition, had prompted fundamental questions about the extent to which cybernetic control could undermine human free will by completely describing feedback patterns. A thoroughly described feedback loop would, in the words of the editorial board, "transform man's technological world into his biological environment"[87]. The continued fascination with Hermann Schmidt's work reveals not only an effort to resurrect the German cybernetic heritage which preceded Wiener, but also to extend the boundaries of cybernetics into anthropological and philosophical questions. The engagement with Schmidt stands in contrast to the wider societal reckoning with the crimes of Nazism or the so-called *Vergangenheitsbewältigung* during the 1960s.[88] While the 1960s witnessed a serious effort to "come to terms" with Germany's National Socialist past, the internationally oriented, but distinctively German journal of cybernetic humanities lauded the early contributions of a German scientist whose foundational work was done during the Nazi period. There is no evidence to suggest that Bense or his fellow editors were making an explicit political gesture by reproducing Schmidt's texts in the 1960s, but it is nonetheless remarkable how the

[86] Helmar Frank, "Vorwort Der Schriftleitung," *Grundlagenstudien Aus Kybernetik Und Geisteswissenschaft* 6, Beiheft (December 1965).
[87] Ibid.
[88] See Norbert Frei, *Vergangenheitspolitik: die Anfänge der Bundesrepublik und die NS-Vergangenheit* (Munich: Beck, 1996) and Matthias Frese et al., *Demokratisierung und gesellschaftlicher Aufbruch: die sechziger Jahre als Wendezeit der Bundesrepublik* (Paderborn: Ferdinand Schöningh, 2005).

editorial board of *Grundlagenstudien* celebrated Nazi-era scientific achievements during a wider social reckoning with the German past.

Throughout the 1960s, *Grundlagenstudien* represented an important continuation of West German cybernetic thought after it receded from importance in the Ulm School. It is also evident from reviews published in the *Operational Research Quarterly* and the reputable American journal *Nature*, that *Grundlagenstudien* attracted serious academic attention from a range of disciplines across different geographies. These reviews, although brief, highlighted the fact the West German thinkers had succeeded in assembling international contributions on the topic. Interestingly, the *Nature* review pointedly remarked that a similar Russian journal could not boast the same level of international collaboration seen in the West German publication.[90] The success of *Grundlagenstudien* and the extension of cybernetic thought through Bense's work in the 1960s highlights the resilience of cybernetics in response to its de-institutionalization at the Ulm School. Although the work of Bense, Moles, and their colleagues at Ulm were never mainstream, they were able to survive a turn away from the cybernetics within the design community and reemerge in the 1960s. While the theoretical underpinnings were largely established by Bense and Moles during the 1950s, it was only in the subsequent decade that cybernetic aesthetics gained sustained public attention through controversial art installations in the Federal Republic and abroad, which firmly placed West Germany at the forefront of cybernetic humanities.

The Moment of Cybernetic Art: Generative Aesthetics and Computer Art in the 1960s

By the mid-1960s, Bense and Moles' work at the intersection of aesthetics, cybernetics, and philosophy had shifted focus from the evaluation of art to the theoretical limits of artistic

[90] P. G. Lucas, review of *Kybernetik: A Journal Dealing with the Transmission and Processing of Information as Well as with Control Processes in both Organisms and Automata*, by H. B. Barlow et al., *OR* 12, no. 2 (1961): 127–29, https://doi.org/10.2307/3007424 and "Kybernetik," *Nature* 189, no. 4768 (March 18, 1961).

production. In many ways, the project of Generative Aesthetics, which Bense coined in a 1965 essay, borrowed more heavily from cybernetic theory than his earlier work on Information Aesthetics by placing explicit emphasis on the role of feedback in the creation of art. Through his position at TH Stuttgart, Bense trained several pioneers in computer art, such as Georg Nees and Frieder Nake, who used basic computer programs to generate new forms of visual art. In contrast to the 1950s, where cybernetic influences on design and art were largely confined to educational curricula and theoretical texts, the 1960s witnessed concrete production of cybernetic art, which was displayed in both West Germany and abroad.

Bense's work on Information Aesthetics helped make the TH Stuttgart a destination for aspiring digital artists during the 1960s, and another physicist, Georg Nees, would help found what became known as the "Stuttgart School" while under Bense's tutelage. In 1964, Nees published an article in *Grundlagenstudien*, entitled "Statistical Graphics" or *Statistische Graphik* and in the following year, Bense published, "Projects of Generative Aesthetics."[91] Together these texts formed the basis for a new school of digital art, which hosted more than ninety exhibitions of digital art until its closing in 1978.[92] In "Projects of Generative Aesthetics", which was subsequently expanded in an English edition from 1971, Bense sought to extend the theory of Information Aesthetics into the realm of artistic production:

> Aesthetic structures contain aesthetic information only in so far as they manifest innovations, or rather innovations of probable reality. The aim of generative aesthetics is the artificial production of probability, differing from the norm using theorems and programs. Hence, generative aesthetics is an "aesthetics of production," which makes possible the methodical production of aesthetic states,

[91] Max Bense, "Projekte Generativer Ästhetik," in *Computer-Grafik*, vol. 19 (Stuttgart: Elisabeth Walther Eigenverlag, 1965). and Georg Nees, "Statistische Graphik," *Grundlagenstudien aus Kybernetik und Geisteswissenschaft* 5, no. 3 (December 1964).
[92] Klütsch, "Information Aesthetics and the Stuttgart School," 2012., 65.

> by dividing this process into a finite number of distinct and separate steps which are capable of formulation.[93]

Bense's interest in the expression of innovation through aesthetic structures was echoed in both the written work of Georg Nees, who completed a dissertation on the topic in 1969, and the artworks of several Stuttgart students who were eager to apply Bense's theoretical insights to the generation of real artwork.[94]

On 5 February 1965, the opening of the "Computer-Grafik" exhibition in the *Studiengalerie des Studium Generale* in Stuttgart marked an important turning point in the reception of Generative Aesthetics and gave rise to the Stuttgart School of Computer Art.[95] By all accounts, the exhibition was a modest affair, displaying only several dozen works by Georg Nees and his colleague, Frieder Nake. Despite its size, Bense's stature within the art community ensured good attendance from a range of artists and academics, who brought a heavy dose of skepticism to the exhibition. According to Nake's recollection of the event, Bense's brief speech was followed by a question-and-answer period, in which a professor of painting asked Georg Nees if he could program his computer to "paint in the style I do [in meinem Duktus]".[96] For Nake, Nees' response encapsulated the new philosophy of programmable computer art, which required precise mathematical descriptions of artistic intent; Nees responded by remarking, "Oh yes, I can – if you tell me how *you* [my emphasis] do it."[97]

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[93] Jasia Reichardt, *Cybernetics, Art and Ideas.* (London: Studio Vista, 1971), 58.
[94] Georg Nees, *Generative Computergraphik* (Berlin: Siemens, 1969).
[95] Frieder Nake, "Information Aesthetics: An Heroic Experiment," *Journal of Mathematics and the Arts* 6, no. 2–3 (June 2012): 65–75, https://doi.org/10.1080/17513472.2012.679458.
[96] Ibid., 72.
[97] Ibid.

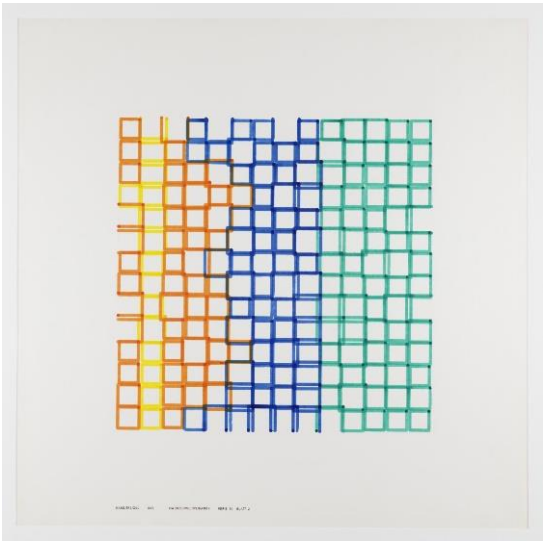


Figure 1. A series of untitled works by Frieder Nake from the portfolio *matrix multiplications.* (Tate Modern London). Bottom left is the computer code, included in the portfolio, which contains the instructions used to generate the designs.

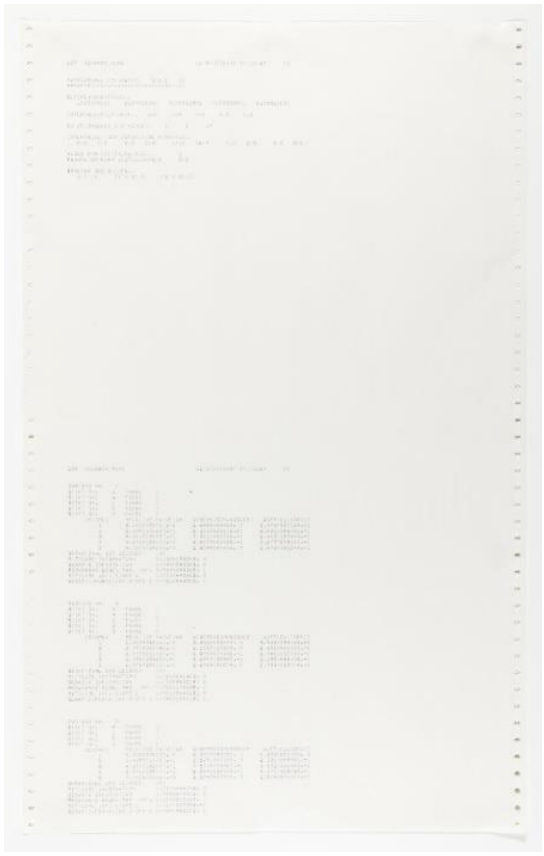
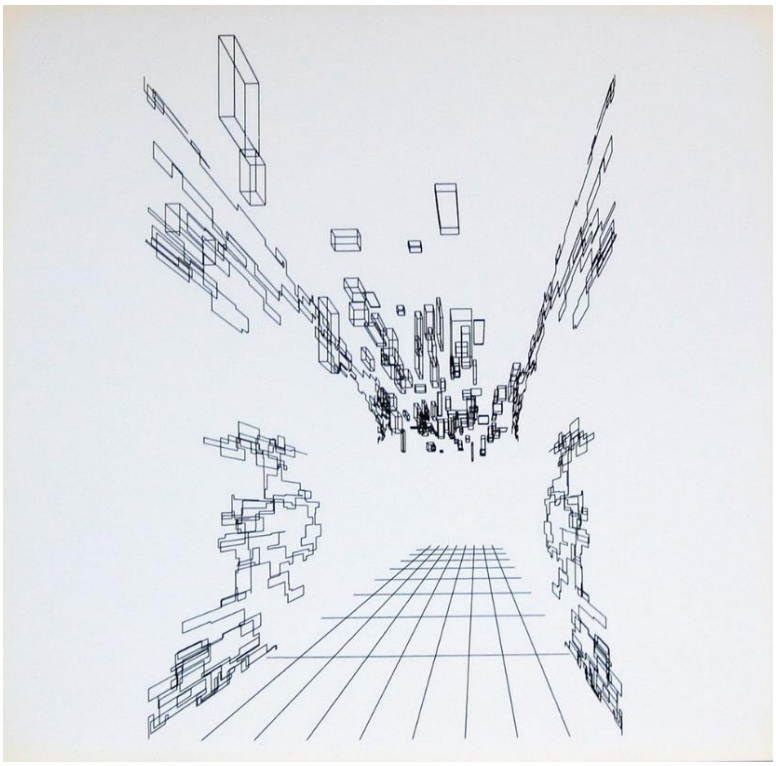
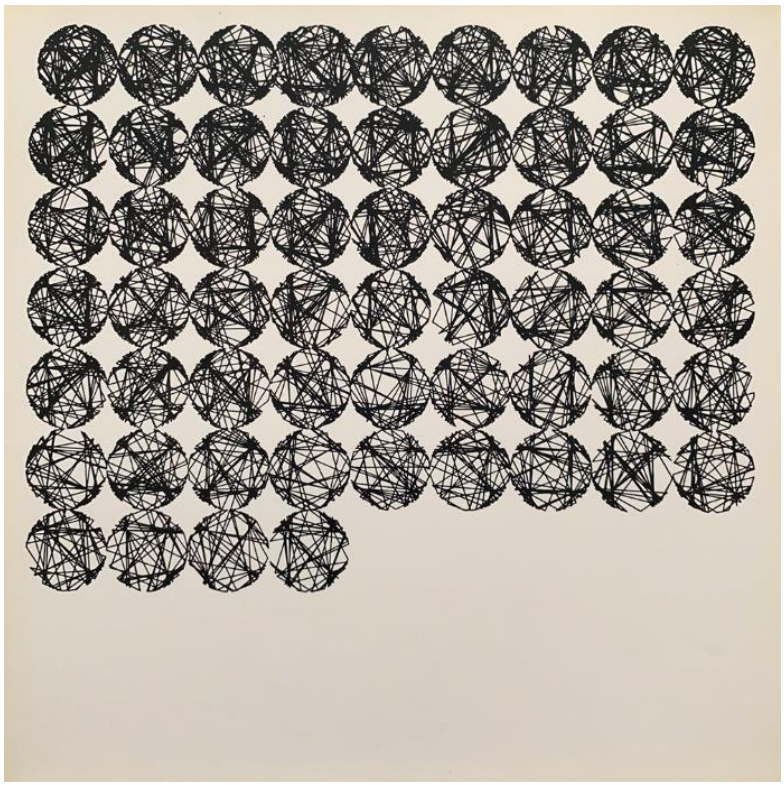


Figure 2. A selection of works from Georg Nees highlight the interplay between order and randomness, a fundamental principle in generative aesthetics. Nees' work *Hall* (right) adds a third dimension, calling attention to the possibility for ordered disorder in higher-dimensional space. In the two works below, randomized scribbles have been etched into a highly regular grid pattern. The deterministic computer can still generate pseudo-random forms, but the regular grid imposes a macro-level structure over the random scribbles.





The works of Nake and Nees from this period (selections reproduced in Figures 1 and 2 evidence a clear interest in the interplay between structure and disorder, which emerged from the theoretical contributions from Bense and Moles. Nees' untitled work reproduced at bottom right in Figure 2 presents a highly ordered meta-structure of repeating circles of equal diameter. Within each circle, however, random lines call attention to the stochastic processes which are possible even when generated by deterministic machines, like computers.[98] Nees' work seen at bottom left in Figure 2 explores the same theme but introduces even greater disorder by abandoning a fixed structure for the individual elements. Each computer-drawn scribble follows an independent geometric pattern, and yet each design is limited to a fixed area. Within each bloc, randomness is dominant, but when viewed as a totality, an ordered pattern of fixed-width designs emerges in the form of a grid. In this visual idiom, Nees expresses the dissonance between order and disorder, which his teacher Max Bense had elaborated in the projects of information and generative aesthetics.

Nake's 1967 collection of twelve untitled works, entitled *matrix multiplications*, makes explicit reference to linear algebraic operations performed on matrices.[99] The calculation of determinants in linear algebra requires calculating products across a matrix's diagonal, and Nake's diagonalized grids seen in Figure 1, echo the diagrams seen on blackboards in elementary linear algebra courses. In contrast to the selection of Nees' works in Figure 2, Nake adds color to his renderings, perhaps suggesting the multidimensionality of matrices, which permit the representation of mathematical objects that are not visualizable in three-dimensional space. Even

[98] Georg Nees, *Untitled*, 1970, Lithograph, 1970, Anne and Michael Spalter Digital Art Collection, https://www.artnews.com/wp-content/uploads/2020/01/NEES-IMG_0313-1970.jpg; Georg Nees, *Hall*, 1970, Lithograph, 1970, Anne and Michael Spalter Digital Art Collection, https://www.artnews.com/wp-content/uploads/2020/01/nees_corridor.jpg.
[99] Frieder Nake, *matrix multiplications*, 1967, Computer plotter print on paper, 480 × 480 mm, 1967, Tate, https://www.tate.org.uk/art/artworks/nake-no-title-p80806.

within the algorithmic process of matrix multiplication, Nake still introduces disorder in the imperfectly rendered squares which form the elements within each matrix. As Nake himself later noted:

> […] every individual piece of algorithmic art is no more than only one instance of the potentially infinitely many from the class of works defined by the algorithm. The tragedy is that the algorithm itself does not show visual qualities. Its qualities are the potential to generate visual works. But each of its visual products is a shadow only of the algorithm.[100]

In his reflection on algorithmic art, Nake acknowledges a paradox in computer art: the progenitor of the artwork – the computer instructions – have no visual form but are only seen when instantiated. The instantiation, as Nake notes, can take infinitely many forms, but none can express the algorithm in its totality. In the same way no one work of Leonardo or Michelangelo can encompass the artist's entire imagination, no single piece of stochastic computer art can fully express the algorithm which lay at the work's core.

Alongside the colorful designs discussed above, Nake also included a "programme sheet" in *matrix multiplications* which contained the computer instructions used to generate each individual piece of art.[101] The inclusion of computer code alongside the actual art raises interesting questions about the fundamental nature of artistic production in a computerized age. One is led to ask: to what extent are the computer instructions art in-and-for-themselves, on a par with the colorful and visually appealing squares? Nake's quotation from suggests that he viewed program code as fundamentally distinct from instantiated works of art. But as a viewer, the inclusion of the "programme sheet" certainly problematizes our conception of what constitutes art in a digitized age. The works of Georg Nees and Frieder Nake are themselves instantiations of the theoretical

[100] Frieder Nake, "Paragraphs on Computer Art, Past and Present", https://doi.org/10.14236/ewic/CAT2010.7 reproduced in David Hodge, "Summary for 'Programme Sheet', Frieder Nake, 1967," Tate, March 2016, https://www.tate.org.uk/art/artworks/nake-programme-sheet-p80818.
[101] "Programme Sheet," *matrix multiplications.*

work of their teachers, Max Bense and Abraham Moles. The questions of order and disorder, determinism and randomness are all reflected in the artistic productions of Nees and Nake, who, by the mid-1960s, had generated significant, if not entirely positive, positive public attention for their works.

Perhaps unsurprisingly, much of the public reaction to the 1965 exhibition and the larger project of Generative Aesthetics was highly critical. One observer who attended the opening of "Computer-Grafik" recalled an "enraged" segment of the audience, "who left the colloquium in protest".[102] Apart from the immediate reactions of attendees, a review in *Der Spiegel* from April 1965 objected to the arrogance with which Generative Aesthetics approached the evaluation of art. In the review, Bense is quoted as saying "The artists were angry because they felt their creative abilities to be under threat."[103] The unnamed reviewer from *Der Spiegel* responded acidly to Bense's explanation by remarking, "The machine could not, however, provoke the scorn of one particular artist because he was already dead for three hundred years: with the computer's help, Bense had determined that Rembrandt was a worse painter than Rubens".[104] The highly critical response to the project of Generative Aesthetics and "Computer-Grafik" in many ways marks a continuity with earlier criticisms around "Maschinengehirn" and robots from the 1950s. It is worth remarking, however, that the *Spiegel* reviewer had completely misread the aims of Generative Aesthetics, by focusing on the evaluation of artwork rather than its production. "Computer-Grafik" and the entire movement around computer art during the 1960s had begun to focus on production rather than critique. In this way, public reception of Generative Aesthetics clearly lagged the theoretical advances in cybernetic humanities during the 1960s.

[102] "Reinhard Döhl: Die Sechziger Jahre in Stuttgart," http://www.stuttgarter-schule.de/stutt60.htm.
[103] "Bald Krumme Linien," *Der Spiegel*, April 27, 1965, https://www.spiegel.de/kultur/bald-krumme-linien-a-4a4b2a37-0002-0001-0000-000046272435.
[104] Ibid., 1965

As the decade progressed, Bense's colleague Abraham Moles, who was highly active in West German artistic and philosophical circles, was responsible for making explicit the connection between Generative Aesthetics and cybernetics. Like Bense, Moles had extensive training in the natural sciences and his work at the intersection of science, communication, and design made him one of the most important cybernetic thinkers of the period. Moles had begun writing about cybernetics during the 1950s when he published *Information Theory and Aesthetic Consciousness*, which first appeared in 1958.[105] *Aesthetic Consciousness* introduced Moles' interest in subjective aesthetic experience during a period in which technology had come to influence the production and conception of artistic objects. By the time he published his pathbreaking essay, "Cybernetics and the Work of Art" later in the decade, Moles had not only transposed cybernetic methods into the aesthetic realm, but fundamentally reconsidered the role of the artist in a technological society. It is clear from the public reaction to "Computer-Grafik" and Moles' writing that philosophers and critics alike were grappling to understand the relationship between artists and cybernetics in an age of computers. Moles' investigation in "Cybernetics and the Work of Art" is premised on the ideas that machines' capacity to create art represents a fundamental shift in aesthetics. Through programmatically generating art and responding to external stimuli in a cybernetic manner, Moles became interested in exploring what might be called the "solution space" of artistic objects. For Moles, increased computing power would permit rigorous analysis of all possible forms of art that could be produced: "Only the machine is capable of systematically researching the totality of this field of possibility and according to some criteria selecting the best of the million realized works to create. This is the 'permutational art.'"[106] Within permutational art, each individual artwork would represent a unique reification from the infinite set of possible artworks. No human could

[105] Abraham A. Moles, *Information Theory and Esthetic Perception* (Urbana: University of Illinois Press, 1966).
[106] Moles, "Kybernetik und Kunstwerk," 320.

ever conceptualize the infinite set of possible artistic forms, but Moles' approach sought to develop a precise mathematical definition for the artistic solutions space.

Moles' own interest in communication theory led him to investigate further the subjective role of the artist and the art-consumer in a cybernetic age.[107] Empowered by the ideas of permutational art and cybernetic feedback, Moles argued that the computer age would enable rather than replace human artists. In the same way that cybernetic machines adapted their behavior to exterior influences, Moles proposed that artist-programmers would develop computer programs to mediate the interaction between artistic will, socio-cultural context, and technological output. Art was no longer a personal reaction to socio-cultural context, but a technologically mediated response that could be enriched through programmatic feedback cycles. Rather than bemoan the displacement of the human artist, Moles placed the burden on the artist to "speak the machine's language" and thereby enhance his own artistic powers.[108] Moles' vocabulary of the "machine's language" evidences his personal interest in communication theory, and his work on cybernetic aesthetics emphasized the communicative aspects of the feedback cycle between artist and machine. The wide-ranging applicability of cybernetic ideas and its apparent compatibility with fields as disparate as physics, communication theory, and aesthetics highlights why the discipline held so much promise for many postwar intellectuals. At the same time, cybernetics' broadness also made it susceptible to attacks from critics who viewed the discipline as overly ambitious and lacking a sufficient technical foundation to justify its application across such varied fields. Cybernetics' all-encompassing nature challenged thinkers, like Bense and Moles, to reconsider the role of human agency in the era of early thinking machines.

[107] "Abraham André Moles | Database of Digital Art," compart: center of excellence digital art, accessed August 31, 2021, http://dada.compart-bremen.de/item/agent/352.
[108] Ibid., 331

The Stuttgart School, the artistic works of Nees and Nake, and the writings of Bense and Moles delineate a particular reaction to cybernetic technologies, which accepted the power of machines but sought to restore human artistic agency in an increasingly technological era. The focus on human agency paralleled American cybernation theorists from the period, who sought to harness the power of cybernetics and automation to ensure more equitable growth and improved welfare outcomes in the United States. In the Federal Republic, the exponents of computer art and cybernetic humanities viewed cybernetics as a novel disruption to accepted artistic practice, but like their American counterparts, they chose to emphasize the emancipatory effects of cybernetic technologies. While their unique strand of techno-aesthetic optimism received fierce criticism from many quarters in West German society, computer art had already begun an inexorable march across borders.

In 1968, an enterprising curator at the Institute for Contemporary Art in London named Jasia Reichardt hosted an exhibition, entitled *Cybernetic Serendipity*, which rapidly became an international phenomenon. In her introduction to the book, which accompanied the exhibition, Reichardt directly credited Bense with inspiring the exhibition, and the many works by Nees and Nake testify to the influence of the Stuttgart School on this exhibit. Nake and Nees' revolutions new works may have received a cool reception in Stuttgart, but by 1968, the public profile of digital art had grown to the extent that Princess Margaret patronized the exhibition as an honored guest when *Cybernetic Serendipity* opened in London.[109] While the exhibition did not receive unanimous praise from critics, *Cybernetic Serendipity* significantly increased public awareness about computer art, but also the philosophical dilemmas around human agency and artistic creation that Bense and Moles had theorized in their academic work. One critic from the American

[109] C. Evans-Pughe, "Cybernetic Serendipity - Did '60s Art Shape Technology's Future?," *Engineering & Technology* 13, no. 4 (2018): 66.

magazine *Time* commended some of the designs as "elegant", but concluded that computer art had demonstrated, if anything, the continued necessity of humans as the primary artistic agent:

> Can computers create? Maybe not, but many of their programmers have a lot of fun trying to make them behave as if they could […] Even at its best, the show proves that computers can make art, but that humans are more essential than ever. For each of the drawings, a detailed program, painstakingly prepared by a human, was needed; the computer did no more than fill in the requested dots and lines.[110]

While Bense and Moles' own work supported the idea argument that humans were elemental to the artistic process, the reviewer from *Time* clearly misunderstood the stochastic element of computer art, which was central to the order-disorder dichotomy. As noted in the discussion of Nake and Nees' art above, the computer was permitted a degree of artistic "freedom" by allowing periods of random drawing, which were not deterministically programmed. The human would lay down the overall structure, as seen in the spheres from Figure 2, but within those restrictions, the computer could create its own designs. This subtlety appears to have eluded the contemporary reviewer, but the argument for human primacy in the artistic primacy clearly drove wider interest in the entire project of computer art. After its seven-week display in London during which some 40,000 visitors perused the earliest forms of digital art, the exhibition traveled travel across the Atlantic to Washington D.C. and San Francisco.[111]

International reception of the exhibition prompted Reichardt to publish several collections of cybernetic artwork and related philosophical writings in English from 1968 to 1971. One reviewer of Reichardt's 1971 book, *Cybernetics, Art, and Ideas*, even suggested that Bense's work was so well-known that Reichardt should have included works from lesser-known theorists. Writing in English for the MIT journal, *Leonardo,* Michael Thompson wrote, "Of course there is

[110] "Exhibitions: Cybernetic Serendipity," *Time*, October 4, 1968, http://content.time.com/time/subscriber/article/0,33009,838821,00.html.
[111] Ibid.

the expected offering from Max Bense 'The Projects of Generative Aesthetics' and I agree with almost everything he writes. But for stimulation I suggest reading Stefan Themerson."[112] In addition to reviews in the English-speaking world, the works of Bense were published in Spain, Brazil and even Czechoslovakia and Yugoslavia, although reception outside of the Anglophone and German world was comparatively quiet.[113]

While *Cybernetic Serendipity* increased the international profile of Bense's contributions to cybernetic humanities, criticism of Generative Aesthetics hardly abated. The noted German daily, *Frankfurter Allgemeine Zeitung*, played host to a brief debate between the opinion writer, Günter Pfeiffer and Max Bense on the question of whether art is calculable. In February of 1968, Pfeiffer authored an editorial entitled, "Is Art Calculable [Ist Kunst berechenbar]?", which argued that Bense's overly complex theory was an intellectual solution in want of a problem. Pfeiffer engaged with some of the more arcane elements of Generative Aesthetics, such as the calculation of order and complexity according to the laws of thermodynamics, but he firmly rejected Bense's approach to aesthetics. In rather vivid language, Pfeiffer concluded his critique by stating: "One should not pass everything through the meat grinder of "information", not least because the computer has no aesthetic consciousness. Here precisely is the border of information aesthetics, but also its chance, if it were critically thought through anew."[114] Pfeiffer was deeply critical of information aesthetics, but his concluding remark suggests that his objection lay with Bense's approach rather than the entire project of computer art. Like earlier reviews, Pfeiffer conflated the idea of Generative Aesthetics and Information Aesthetics, but the FAZ's willingness to publish

[112] Michael Thompson, *Review of The Computer in Art; Cybernetics, Art and Ideas, Jasia Reichardt*, by Jasia Reichardt, *Leonardo* 6, no. 1 (1973): 82.
[113] Klütsch, "Information Aesthetics and the Stuttgart School," 83.
[114] Günter Pfeiffer, "Ist Kunst berechenbar: Max Bense und der Computer," *Frankfurter Allgemeine Zeitung*, February 17, 1968.

Bense's response highlights a growing interest in an otherwise obscure field of aesthetics. In an editor's note which accompanied Bense's response to Pfeiffer, the FAZ editorial board offered a thumbnail sketch of the second law of thermodynamics as background to Bense's article. Bense's response did not contain any novel theoretical insights into Generative Aesthetics, but it did provide an important platform within the Federal Republic to defend his new branch of artistic and philosophical thought.

Despite its radical departure from any earlier strand of aesthetic thought, Generative Aesthetics emerged as one of West Germany's most important contributions to cybernetic reception during the postwar period. Within the Federal Republic, the appeal of a rational aesthetics grounded in Norbert Wiener's cybernetics and Claude Shannon's information theory, proved to be a resilient, albeit polarizing, strand of aesthetic reasoning. According to Klütsch's study of the Stuttgart School, Generative Aesthetics did not end abruptly, but rather slowly faded from attention as Bense and Moles turned toward new philosophical endeavors during the 1970s.[115] Despite its quiet end, the application of cybernetic through to aesthetics remains one of the most enduring intellectual legacies from West German cybernetics. As recently as 2019, the American National Academy of Science held a colloquium entitled, "Creativity and Collaboration: Revisiting Cybernetic Serendipity," which explored the impact of cybernetic thought on ideas of industrial design. In a review of the colloquium, Ben Schneiderman remarked that "the emergence of design is not due to Steve Jobs or Jony Ive, but they were part of a larger movement"[116]. That "larger movement" emerged from the pioneering works of West German thinkers and artists, who, despite criticism at home, succeeded in theorizing a new relationship between art and cybernetics

[115] Klütsch, "Information Aesthetics and the Stuttgart School,", 84.
[116] Ben Shneiderman, "Creativity and Collaboration: Revisiting Cybernetic Serendipity," *Proceedings of the National Academy of Sciences of the United States* 116, no. 6 (2019): 1838.

Conclusion

Interest in cybernetics and automation in the Federal Republic of Germany grew slowly during the 1950s and did not exhibit the meteoric rise in scientific attention that occurred in the United States, the Soviet Union, and even the German Democratic Republic. Nonetheless, journalistic coverage throughout the 1950s, which frequently exaggerated American cybernetic advances brought the idea of automation into the West German public sphere, even if the West German scientific community remained reticent to invest heavily in cybernetic research. Although West German writers were quick to underscore the potential downsides of a highly automated economy, they correctly identified cybernetics and automation as important international trends which engendered global competition between nations on both sides of the Iron Curtain. By the 1960s, technological advancement and public interest warranted deeper inquiry into the subject by West German labor organizations, which proceeded to commission studies and hold conferences on the topic. Sources from these conferences reveal a higher level of analytical sophistication than that found in earlier journalistic accounts and an increased focus on policy proposals to ameliorate the effects of automation. In fact, a guarded optimism, which evidenced faith in the role of central government and economic planning, emerged as a central theme.

The relatively weak uptake of cybernetic technologies in industry and scientific research did not slow its development in the fields of visual art and aesthetics. As this chapter has demonstrated, West German thinkers in Ulm and Stuttgart laid the foundations of an important and internationally resonant form of aesthetics, which built on Wiener's cybernetic insights. The works of Bense, Moles, Nees, Nake, and Walther established the Federal Republic as a testing ground for early digital artwork, and their works played an important role in the dissemination of

cybernetic ideas to fields outside of the laboratory or the manufacturing hall. In sum, the West German reception of cybernetics and automation comprised a varied field of discourse that is not easily categorized. On the one hand, a reticent scientific community left little mark on the field of cybernetics and a tight labor market diminished the demand for rapid deployment of automation technologies. And unlike its communist counterpart, the GDR, which would hang its economic future on the successful deployment of industry robots in the 1970s, West German thinkers never wedded their future economic success to improved productivity. On the other hand, enterprising artists and philosopher-scientists who worked across the disciplines of cybernetics, information, early computer programming, and aesthetics embraced the potential for a new era of cybernetic art. As noted, their work received harsh criticism from within the FRG, but journalistic critiques of Generative Aesthetics could not halt an enthusiastic international reception of radical new ideas that reconceptualized the role of the artist in a digital age. In the end, West Germany's most important contribution to cybernetics came from the canvas rather than the keyboard.

In parallel to the cybernetic developments in the United States and the Federal Republic of Germany, socialist thinkers in the Soviet Union and the German Democratic Republic were establishing the theoretical and practical foundations for cybernetic socialism. Just as the discipline polarized segments of society in the capitalist West, factions of socialist planners and ideologues approached cybernetics variously as an existential threat to Marxism, while others came to view the discipline as key to achieving true communism. Despite heavy censorship, the Soviet Union and the GDR engaged in extensive debates about the role of cybernetics and automation within postwar socialist states. These debates challenged accepted beliefs about Marxist-Leninism and proposed novel visions for a highly automated communist future. The remaining two chapters will examine these debates in the Soviet Union and the German Democratic Republic respectively.

Chapter III

Soviet Cybernetics and the Quest for an Automated Socialist Future

> One of the most important developments in the second part of the twentieth century is the fact that in the Western Communist world Marxism-Leninism is giving way to a new science, cybernetics, as the theoretical guide and general method in governing, economic planning and industrial production.[1]

Despite its origins in American military research, the ideas behind cybernetics rapidly spread across the divided geopolitical landscape of the Cold War. On the east side of the Iron Curtain, the applications of cybernetics to industrial rationalization, automation, and economic planning figured prominently in Soviet technological policy from the late 1950s onward. Cybernetics encompassed a range of disciplines, including computer science, biology, physics, and engineering, but the focus on building adaptive control-communication systems offered Soviet planners a powerful tool for engineering their centrally planned economy. For some commentators, cybernetics offered the Soviet government an instrument for social control without violence.[2] For others, the promise of cybernetics lay in rationalizing economic production to improve competitiveness and harmonize different branches of the economy.[3] The present and the following chapter will explore cybernetics within the Soviet Union and the German Democratic Republic respectively to understand the promise and peril of cybernetics within state socialism. Through viewing cybernetics as a field of cross-curtain rivalry during the Cold War, this chapter will argue

[1] George Paloczi-Horvath, *The Facts Rebel: The Future of Russia and the West* (London: Secker & Warburg, 1964), 10.
[2] Peters, "Normalizing Soviet Cybernetics," 147.
[3] Viktor Glushkov, "Address to Supreme Soviet," ed. Wade Holland, *Soviet Cybernetics Review* 2, no. 5 (September 1972): 23–27.

that cybernetics became an important, albeit elusive, tool for legitimizing the socialist project in the Soviet Bloc. This chapter, which addresses the Soviet Union, will focus on practical cybernetic initiatives undertaken by Soviet researchers and planners, and the subsequent chapter on the GDR will emphasize the philosophical dimensions of socialist cybernetics, in a state where applied cybernetics did not emerge until the 1970s and 1980s.

The history of cybernetics in the Soviet Union has been well-documented in recent years. The MIT historian Slava Gerovitch has written extensively on cybernetics as an ideological language in the Soviet Union, which evolved over the course of several decades and reflected the changing priorities of party leadership.[4] For historians of science like Gerovitch, the Soviet reception of cybernetics offers an illuminating example of the interplay between scientific research and political dictates from the Politburo. Gerovitch's argument that anti-cybernetic rhetoric in the early 1950s emerged from an ever-amplifying echo chamber of critics rather than from a central directive has helped undermine overly simplistic views of totalitarian state control.[5] The works of Gerovitch and others like Benjamin Peters, and Egle Rindzeviciute have helped reconstruct the early years of Soviet cybernetic reception when it was widely derided as bourgeois materialism, before the discipline was resuscitated in the late 1950s.[6] Other historians, such as Paul Edwards and Antoine Bousquet, have written about the application of cybernetics to military planning, such

[4] Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge: MIT Press, 2002), 12.
[5] Slava Gerovitch, "'Russian Scandals': Soviet Readings of American Cybernetics in the Early Years of the Cold War," *The Russian Review* 60, no. 4 (2001): 549.
[6] Benjamin Peters, "From Cybernetics to Cyber Networks: Norbert Wiener, the Soviet Internet, and the Cold War Dawn of Information Universalism" (Columbia University, 2010). Egle Rindzeviciute, "Purification and Hybridisation of Soviet Cybernetics: The Politics of Scientific Governance in an Authoritarian Regime," *Archiv für Sozialgeschichte* 50 (January 1, 2010): 289-309; Egle Rindzeviciute, "Constructing Soviet Cultural Policy: Cybernetics and Governance in Lithuania after World War II," Linköping Studies in Arts and Sciences (Linköping: University Electronic Press, 2008).

as battlefield modeling and even fighting robots.[7] During the early 1950s, secret military libraries were the only place in the Soviet Union where Wiener's works could be read, and military interest in cybernetics helped keep the discipline alive within certain scientific circles before it was widely accepted later in the decade. But the literature from military history has overemphasized the wartime origins of cybernetics and consequently missed the more significant cybernetic applications during the Cold War, namely its economic and industrial uses. While it is certainly true that American and Soviet military researchers investigated the potential uses of cybernetics on the battlefield, the more urgent question for both countries was how to assimilate cybernetic advancement into their respective economic and political systems.

Because of its American roots, cybernetics was a perennially problematic field in the Soviet Union. The field's origins in American missile defense research required computer scientists, engineers, and economic planners in the Soviet Union to balance party dictates with promising new forms of scientific inquiry related to cybernetics. Across the Soviet Bloc, a large body of philosophical research would investigate and challenge the compatibility of cybernetics with dialectical and historical materialism. As the following chapter will explore, cybernetic debates in the German Democratic Republic during the 1960s were largely limited to philosophical discussions, but in the Soviet Union, the practical applications of cybernetics and computer technology were very much a practical concern. Large institutes headed by some of the Soviet Union's leading mathematicians and scientists studied how best to utilize cybernetic methods within the system of centralized economic planning. Research at the nexus of planning and cybernetics gave rise to ambitious proposals, such as the All-State Automated System, which was

[7] Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge: MIT Press, 1996); Antoine Bousquet, "Cyberneticizing the American War Machine: Science and Computers in the Cold War," *Cold War History* 8, no. 1 (February 1, 2008): 77–102.

championed by the renowned Soviet cybernetician, Viktor Glushkov. While the All-State System was never realized, it represented a highpoint of cybernetic ambition and optimism during the 1960s when many Soviet scientists came to view cybernetics as key to successful economic rationalization.

Through adapting Marxist-Leninist thought to accommodate cybernetics, Soviet thinkers in the post-Stalin era used the economic applications of cybernetics to emphasize the superiority of the command-control economy. For Soviet planners, the application of cybernetics to centrally planned industries offered a pathway for improved productivity, an economic indicator that consistently lagged the United States.[8] Industrial automation, and more sophisticated forms of automated industrial management challenged the primacy of labor in a socialist economy and forced party leaders to adapt the principles of Marxist-Leninism to an unknown future of work. As scientists across the Soviet Union developed new plans for industrial automation and argued over the details of a statewide computer network, communist ideologues seized upon cybernetics as a new weapon to combat Western capitalist ideology. Soviet thinkers turned cybernetics on its head and argued that although its origins lay in the West, cybernetics could only be deployed productively within a socialist economy. In official party documents, socialist theoreticians furthered a new line of argumentation which held communism was the only system which could accommodate cybernetics without initiating mass unemployment or destructive rent-seeking behavior.[9] Unlike the Space Race, the cybernetic rivalry was never a question of which nation could first achieve an arbitrary technological feat. Rather, competition around cybernetics was

[8] Irving H. Siegel, "Labor Productivity in the Soviet Union," *Journal of the American Statistical Association* 48, no. 261 (1953): 65–68.
[9] O. W. Kuusinen and C. P. Dutt, *Fundamentals of Marxism-Leninism* (London: Lawrence & Wishart, 1961), 611.

rooted in a deeper ideological conflict over which system of governance and economic organization could better accommodate technological innovation.

This chapter will briefly rehearse the early history of cybernetics in the Soviet Union before examining how Soviet thinkers understood cybernetics and automation from the late 1950s onward. Automation and cybernetics lived intertwined lives both in the United States and the USSR, and Marxist theorists were careful to delineate how advances in cybernetics could promote automation while never undermining the principles of socialist economic organization. The chapter will then examine how American intelligence officials from the RAND Corporation tracked cybernetic developments in both classified reports and the internally published journal, *Soviet Cybernetics Review*. Studies from the RAND Corporation will be contrasted with contemporaneous reports from the CIA, and the chapter will examine divergences between both organizations' assessments of Soviet capabilities. The comparison of studies from RAND and the CIA will evidence shortcomings in the CIA's capacity to assess objectively the state of Soviet automation and cybernetics. Through drawing on this source base, the chapter will uncover how American and Soviet thinkers understood the potential implications of a highly automated future of work within their respective ideological systems.

Cybernetics in the Soviet Union: A Troubled Birth

The potential for cybernetics to revolutionize scientific understanding as well as economic development sparked enormous interest in the United States, and numerous academic and industrial organizations devoted to the topic sprouted across the United States during the 1950s.[14] In the Soviet Union, however, the future of cybernetics was anything but certain. The historian

[14] Rid, *Rise of the Machines*, *115.*

Benjamin Peters has noted that many elements of cybernetic theory, such as its frequent references to Pavlovian conditioned reflex – a much-lauded theory in Soviet scientific circles – made it partially acceptable to Soviet researchers.[15] But the American origins of Wiener's new science and his own remarks about the effects of a cyberneticized economy did not conform to Soviet ideology in the final years of Stalin's rule. The emphasis on "thinking" machines in cybernetics and the discipline's ambitions to explain all phenomena through the language of feedback presented serious philosophical challenges to dialectical and historical materialism, the socialist frameworks for scientific and historical understanding.

Journalists in both the socialist and capitalist world were captivated by the idea of thinking machines, but the capacity for machines to reason threatened to undermine the primacy of the human within socialism. As such, Soviet ideologues initially rejected any theory of science which would displace the human as the central actor in historical development. A full discussion of historical and dialectical materialism is outside the scope of this study, but brief background can help clarify these two important terms. At base, historical materialism offered the sociological explanation for the resolution of class conflicts which culminated in the proletariat ascendency. Dialectical materialism, on the other hand, offered the theoretical and scientific explanation for the resolution of physical dialectics. According to orthodox dialectical materialism, the resolution of physical dialectics over centuries ultimately gave rise to rational humans, so the cybernetic belief in rational machines posed an ideological threat primarily to dialectical, rather than historical materialism. [16]

[15] Peters, "Normalizing Soviet Cybernetics," 160.
[16] See Joseph Stalin, *Dialectical and Historical Materialism* (London: Lawrence & Wishart, 1941). The differences between historical and dialectical materialism were never fixed, but rather an ongoing topic of debate with socialist philosophical circles. Although Stalin's text was the foundational document, interpreting the text remained a popular academic exercise for socialist ideologues throughout the postwar.

As an American science with a problematic philosophical relationship to socialism, it was unsurprising that official organs and the popular press in the Soviet Union pilloried the philosophical underpinnings of cybernetics and attacked Wiener as a bourgeois philosopher. In the early years, popular press coverage was unequivocal in its denunciation of the new American science. Titles of anti-cybernetic articles included, "The Science of Modern Slaveholders," and "Cybernetics - An American Pseudoscience."[17] Despite cybernetics' uniformly negative reception in the Soviet Union, Gerovitch's studies have suggested that anti-cybernetic writing was not a manifestation of a carefully orchestrated propaganda campaign. Instead, Gerovitch has argued that anti-cybernetic sentiment was amplified through increasingly sensationalistic writing as Soviet journalists sought to establish their own ideological bona fides.[18] It is important to recognize that almost no journalists in the Soviet Union had access to Wiener's foundational work, as the only Russian translations were held in the classified sections of state libraries, such as the Lenin Library and the Library of Foreign Literature.[19] The lack of access to the original text required Soviet journalists to draw exclusively from other secondary accounts of Wiener's work, which according to Gerovitch, accelerated the trend toward vehement denunciation.

Although Wiener's texts were confined to classified military libraries, some enterprising scholars still managed to gain access and read firsthand about the discipline which had come to symbolize the excesses of postwar bourgeois science. The Czech philosopher, Arnosht Kolman, was one such scholar and his access to Wiener's text prompted him to reconsider cybernetics, and he ultimately became one of the discipline's earliest public advocates in the Soviet Union. In later

[17] Gerovitch, "Russian Scandal," 547.
[18] Ibid., 549.
[19] Valery Shilov, "Reefs of Myths: Towards the History of Cybernetics in the Soviet Union," in *2014 Third International Conference on Computer Technology in Russia and in the Former Soviet Union*, 2014, 177, doi: 10.1109/SoRuCom.2014.46.

reflections, Kolman wrote of his fortuitous grant of access to Wiener's work: "Wiener's fundamental work was among the *libri prohibiti* […] the librarians would not allow me to read it. So I sent a letter of protest to one of the secretaries of the central committee of the Communist Party and to my surprise all these writings were granted to me".[20] Kolman's experience highlights the bifurcation between writers and scientists who studied cybernetics in the early 1950s. Writers, who could not actually read Wiener's work, repeated and extended earlier ideological attacks, whereas scientists and military researchers were able to study the new discipline on its own terms. During the period when cybernetics counted as *libri prohibiti,* expert reception in some scientific circles provided an important lifeline to the discipline in the Soviet Union before its rehabilitation after Stalin's death.[21]

While cybernetics' military applications drew initial attention within the Soviet Union, the economic applications of control and communication rapidly became the primary concern among Soviet researchers. The possibility of rationalizing central economic planning generated increasing interest from different elements of government, including the powerful Central Statistics Agency. As Egle Rindzeviciute has noted, the early years of cybernetic reception in the Soviet Union highlight the extent to which threats to ideology could be overlooked, at least behind closed doors, if economic and technological applications might emerge from a competing philosophical or scientific system.[22] A similar pattern of ideological flexibility was seen in the GDR where a wave of cybernetic advocacy took hold during the 1960s, but Soviet cybernetics was characterized more by practical research initiatives than the philosophical debates about cybernetic socialism which dominated in East Germany.

[20] Ibid.
[21] Gerovitch, "Russian Scandal," 566
[22] See Rindzeviciute, "Purification and Hybridisation of Soviet Cybernetics," introduction.

Despite its vitriolic denunciation in the early 1950s, the scientific appeal of cybernetics prompted the field's rapid rehabilitation after Stalin's death in 1953. As Nikita Khrushchev plotted a new course for the Soviet Union in the mid-1950s, cybernetics was recast as an important tool for economic invigoration and increased competitiveness with the West. During the Twentieth Party Congress in 1956, during which Khrushchev inaugurated the Thaw with his famous "Secret Speech", the Soviet leader also spoke of the importance of automation for future economic competitiveness: "The automation of machines and operations must be extended to the automation of factory departments and technological processes and to the construction of fully automatic plans."[23] In a notable contrast to years prior, Khrushchev and other Soviet leaders would continue to trumpet the ideas of cybernetics and automation in increasingly enthusiastic terms. One contemporary observer, John Diebold, reported that Khrushchev had remarked: "Automation is a good thing. It is through this means we are going to beat the capitalists."[24] The end of anti-cybernetic rhetoric in the Soviet Union, did not emerge from an easing in anti-Western sentiment, but rather from a newfound belief that cybernetics could be turned against the capitalists.

Official sanction of cybernetics from the highest echelons of the Soviet state prompted several research and ideological initiatives, which sought to elaborate the scientific and socialist foundations for cybernetics within a communist state. Arnosht Kolman, who had read Wiener's works earlier in the decade, published, "What is Cybernetics" in 1956, which emphasized the scientific contributions of Russian thinkers to the development of cybernetics.[25] Kolman's article, which was republished in the GDR and other satellite states, helped open a new field of debate about the harmonization of cybernetics with dialectical materialism. At the same time, the Soviet

[23] Peters, "Normalizing Soviet Cybernetics," 152.
[24] Diebold, *New Views on Automation*.
[25] Ernst Kolman, "Was Ist Kybernetik?," *Forum* 23, no. 9 (1955), 20-29.

state was taking serious steps to advance practical research in cybernetics and automation. In the same year Kolman published his article, a Ministry for Automation was established and in following years, several government and university institutes devoted to cybernetics would appear across the USSR.[26] Within a decade, at least a dozen research centers on cybernetics had been established, with the most prominent - the Institute for Cybernetics in Kiev - boasting 3,000 employees by 1971.[27]

Although Kolman's work helped increase the palatability of cybernetics by emphasizing the discipline's indebtedness to Soviet science, serious theoretical challenges remained concerning the relationship between cybernetics and dialectical materialism. In the Soviet Union, dialectical materialism reigned supreme as the sole theory of scientific and human progress which posited "that [the] motion of any given stage of society is to be understood in terms of the character of the contradictions of its constituent social elements."[28] Through the resolution of contradictions between social elements, human society achieved improved levels of economic and social organization. An axiom of dialectical materialism, which proved particularly challenging to square with cybernetics, was the primacy of human beings. Under orthodox dialectical materialism, humans were viewed as the ultimate being, an organism that emerged from biological and physical dialectics over the course of millennia. The resolution of these dialectics had endowed humans with the unique capacity to think, exercise judgment, and reason. The final proof for dialectical

[26]Mary E. Murphy, "Computer Developments in the Soviet Union," *The Journal of the Academy of Management* 3, no. 2 (1960): 99.
[27] Barry Boehm, "Extensive Tour Yields Report on Current Soviet Computing," ed. Wade Holland, *Soviet Cybernetics Review* 1, no. 1 (February 1971): 4.
[28] Stephen Whitfield, "Dialectical Materialism," in *The Concise Oxford Dictionary of Politics and International Relations*, ed. Iain McLean and Alistair McMillan (Oxford: Oxford University Press, 2018). See also Loren R. Graham, *Science, Philosophy, and Human Behavior in the Soviet Union* (New York: Columbia University Press, 1987).

materialism lay in the mental superiority of human beings, the ultimate evidence for the resolution of dialectical processes over time.

Cybernetics, however, posited that machines could, at least theoretically, rival humans as rational agents. The challenge to socialist scientific doctrine was quickly identified and analyzed by American intelligence officials in the early 1960s. In a 1964 report entitled, "Cybernetics and its Development in the Soviet Union," an analyst from the RAND Corporation acknowledged that cybernetics sat uncomfortably within Marxist-Leninist thought and posed a theoretical dilemma for Soviet socialism:

> There is the problem that arises from the claim of some cyberneticians that machines can be made to "think." This is, of course also a source of controversy in the West, but it does not strike at the tenets of any Western ideology holding apposition comparable to that held by Marxism-Leninism in the Soviet Union. […] there is a qualitative difference between a living organism and a machine that can never be removed. Machines can never take part in intellectual processes, a form of motion, because that form is peculiar to man.[29]

Although the clear ideological challenge to Marxism-Leninism had no obvious resolution, by the early 1960s, Soviet debate around the topic had begun to entertain the possibility that machines could exhibit what is now called artificial intelligence. One of the Soviet Union's foremost mathematicians, Andrey Kolmogorov, had initially rejected the possibility of thinking machines, but subsequently revised his belief and became a strong believer in the capacity of machines to exhibit human-like intelligence.[30] Kolmogorov's change of stance helped permit what one

[29] Roger Levien and M.E. Maron, "Cybernetics and Its Development in the Soviet Union" (Santa Monica, California: RAND Corporation, July 1964, 28.

[30] Kolmogorov's support of cybernetics highlights the fields attraction to some of the century's greatest minds. Kolmogorov is widely seen as one of the twentieth century's most important mathematicians, and his work on probability forms the foundations of the discipline. His interest in cybernetics attests to the fact that major academics, not just cybernetic specialists, viewed the subject as a significant intellectual development. For more on Kolmogorov's later career, see A. P Youschkevitch, "A. N. Kolmogorov: Historian and Philosopher of Mathematics on the Occasion of His 80th Birthday," *Historia Mathematica* 10, no. 4 (November 1, 1983): 383–95, https://doi.org/10.1016/0315-0860(83)90001-0.

observer called a "freer" level of debate about cybernetics that opened the door for more speculative research into early artificial intelligence.[31] . Even if Kolmogorov's belief in thinking machines had helped open new fields of debates, Soviet scientists remained largely unenthusiastic about the prospect that computers might one day rival humans. One such example of Soviet ambivalence is found in the notes from a speech given by Norbert Wiener in Moscow. In the plenary address to the International Federation of Automatic Control in 1960, Norbert Wiener was, according to an audience member, greeted with rapturous applause when he proclaimed, "the creativity of man would always find a higher level than the creativity of a machine."[32]

Although cybernetics threatened to undermine dialectical materialism, the economic applications of Wiener's new science demanded that Soviet theorists attempt to reconcile the two schools. One approach to unification sought to limit the scope of cybernetics. This line of thinking viewed cybernetics as a field of inquiry, rather than an epistemological framework. On this view, cybernetics could be deployed as a tool within dialectical materialism while never undermining the philosophical credibility of socialist doctrine.[33] This may strike the reader as an unsatisfying philosophical workaround because it failed to address how dialectical materialism can withstand a sub-theory that permitted thinking machines. But political enthusiasm for cybernetics made such questionable philosophical reasoning acceptable in light of the potential economic benefits.

Despite its dubious philosophical compatibility with dialectical materialism and Marxism-Leninism, Soviet theorists worked hard to develop an appropriate socialist form of cybernetics. In 1965, the commentator Maxim Mikulak authored an essay entitled, "Cybernetics and Marxism-Leninism," in which he analyzed the ongoing effort to unify the two schools of thought. Although

[31] Ibid.
[32] Edward Feigenbaum, "Soviet Cybernetics and Computer Sciences, 1960," *Communications of the ACM* 4, no. 12 (1961): 570.
[33] Maxim W. Mikulak, "Cybernetics and Marxism-Leninism," *Slavic Review* 24, no. 3 (1965): 456.

the history of socialist ideology in the Soviet Union has traditionally emphasized its intellectual rigidity, Mikulak concluded the opposite and suggested that, "Soviet Marxists have managed to demonstrate the flexibility of dialectical materialism and its compatibility with cybernetics."[34]Although Mikulak may have mistaken political interest in cybernetics with philosophical flexibility, it is clear that official party documents from 1960 onwards emphasized viewpoints which were more compatible with cybernetics than strict dialectical materialism.

The story of cybernetic rehabilitation in the late 1950s and early 1960s highlights an important tension between the exigencies of economic progress and the philosophical dictates of state-sponsored socialism. Although the turn away from Stalinism afforded cybernetics the discursive space to be rehabilitated in the Soviet public sphere, the hegemony of dialectical materialism never permitted a full philosophical reconciliation with cybernetics. The unresolved philosophical tensions between Marxism-Leninism and cybernetics suggest a certain pragmatism on the part of Soviet leadership. The economic dictates and the appeal of cybernetics trumped the desire for ideological purity, and Soviet leadership was willing to permit a degree of philosophical ambiguity to pursue cybernetics.

The initial resistance and ultimate acceptance of cybernetics in the Soviet Union did not only turn on the role of "thinking machines" and scientific epistemology. Instead, cybernetics was crucially linked to the practical applications of automated industrial production and the possibility of developing a computerized Soviet economy. Ironically, the relationship between labor, output, and technological progress was central both to the initial rejection of cybernetics and its ultimate acceptance in the late 1950s. In fact, it was Wiener's statements about the impact of cybernetics on labor that initially fueled the anti-cybernetic campaign. In 1948, Wiener had written:

[34] Mikulak, "Cybernetics and Marxism-Leninism," 464.

"[cybernetics] is [bound] to devalue the human brain, at least in its simpler and more routine decisions [until] the average human being of mediocre attainments or less has nothing to sell that it is worth anyone's money to buy."[35] The linkage, which Wiener drew between his theoretical study of feedback mechanism with labor and jobs, remained a central theme in Soviet scientific discourse after the rehabilitation of cybernetics. Just as American thinkers in the 1960s began to wrestle with the effects of computers on jobs and welfare, communist ideologues in the Soviet Union developed new lines of reasoning to justify automation.

Cybernetics, Socialist Abundance, and a Soviet Internet

By the early 1960s, the reforms of Khrushchev and the rehabilitation of cybernetics had led to the acceptance of automation as a crucial tool for the achievement of a communist society. In 1960, a Soviet theorist writing in the journal *Kommunyist*, argued: "As distinct from capitalist countries where various firms create each for itself separate automated systems of control, under socialism it is perfectly possible to organize a single complex automated system of control of the country's national economy. Obviously, the effect of such automation will be much greater than that of automating control of individual enterprises."[36] As the quotation from *Kommunyist* implies, the centralized nature of Soviet economic planning made automated production and the deployment of statewide cybernetic systems a particularly attractive development strategy from the 1960s onward. The potentially transformative effects of a cybernetically-driven economy in the Soviet Union was cause for concern within the RAND Corporation during the early 1960s, and American intelligence responded by closely monitoring advances in Soviet computing. Once it had been rehabilitated, cybernetics and, by extension, automation became an important point of divergence

[35] Wiener, *Cybernetics*, preface.3
[36] *Kommunyist* 9, (1961): 23, as quoted in Paloczi-Horvath, *The Facts Rebel*, 92.

between American and Soviet thinkers. As both sides attempted to apply new technologies to industrial systems, socialist and capitalist commentators were forced to develop new arguments which justified changes to labor allocation that would accompany a more automated future.

In his study of American-Soviet technological competition from 1964, the Hungarian observer Gyorgy Paloczi-Horvath argued that the rehabilitation of cybernetics in the Soviet Union had ushered in a "Communist Reformation" in which science and economics had gained primacy over ideology and politics.[37] For Palozci-Horvath, cybernetics represented a third way that was neither capitalist nor socialist; cybernetics had become a philosophy stripped of ideology. In retrospect, Palozci-Horvath's reflection about a cybernetic third way was clearly misplaced, as any reading of Soviet theoretical literature from the period reveals how socialist ideologues repeatedly denigrated capitalist applications of cybernetics. As seen in the excerpt from *Kommunyist*, cybernetics and automation had become a new battlefield in the Cold War rather than a de-ideologized Third Way. Nonetheless, Paloczi-Horvath's argument is intriguing because it captured a unique form of techno-optimism that captivated commentators on both sides of the Iron Curtain. Like Bell in the American context, Paloczi-Horvath imbued technological progress with a capacity to transcend geopolitical and ideological boundaries, but within the Soviet Union, cybernetics had become inextricably linked to socialist views of progress and economic planning.[38] When Palozci-Horvath wrote, "They [scientists] recognized in cybernetics a heaven-sent chance to regain some measure of scientific freedom," he spoke to a general belief about technology as a vital instrument for progress, but he also seriously underestimated the extent to which political dictates influenced the direction of cybernetics research in the USSR.[39] Even if Palozci-Horvath's idealism about

[37] Palozci-Horvath, *The Facts Rebel*, 21
[38] See chapter one for discussion of Daniel Bell.
[39] Palozci-Horvath, *The Facts Rebel*, 98.

cybernetics' liberating potential was misplaced, he keenly perceived a change in Soviet discourse about the role of abundance in socialist society.

In parallel to the American thinkers discussed in chapter one, Soviet theorists in the early 1960s began expounding the importance of material and even spiritual abundance as a precondition for true communism. Whereas Theobald and American cybernation theorists argued that a massive leap in productivity would necessitate a fundamental rethinking of the capitalist economic bargain, Soviet thinkers began to argue that automation was necessary for the achievement of communist abundance. The emphasis on communist abundance appeared in a variety of official texts from these period, and Soviet ideologues frequently cited socialist abundance as a foil to capitalist excess. In 1959, Khrushchev officially rejected Stalin's *Short History* and commissioned a new text to serve as the theoretical basis for Soviet communism: *The Fundamentals of Marxism-Leninism*.[40] In the 1961 edition of *Fundamentals*, automation was accorded a central role in the ultimate "transition to communism," and the fruits of automated labor were viewed as necessary for "creating the material and technical basis of communism."[41] But *Fundamentals* went further than preconditioning socialism on material abundance. In a text which bore the name of Marx in its title, the *Fundamentals* remarkably called for the abolition of manual labor: "The main trend in the rapid expansion of production is to complete the mechanization of all labor-processes and to oust manual labor from all branches of the economy." The section continued to justify the "ousting" of manual labor on humanistic grounds: "the aim [of automation] is to complete the liberation of man from arduous, monotonous work and save his mental energy for creative purposes."[42]

[40] Peters, "Normalizing Soviet Cybernetics," 152.
[41] Kuusinen and Dutt, *Fundamentals of Marxism-Leninism*, 795.
[42] Ibid., 796.

It is worth pausing to reflect on how radically the 1961 *Fundamentals* deviated not only from Stalinism but any form of mainstream Marxism. In articulating a new socialist future, *Fundamentals* implied that technology would be the ultimate "liberator" of humankind. The working classes were entirely absent from this commentary, which is unsurprising given the forecasted decline in work as a means of production. As the following chapter will describe, East German writers also rethought the role of Marxism within a cybernated future, and even argued that Marx himself was a proto-cybernetician. Both in the Soviet and East German case, the appeal of cybernetics permitted a range of revisionist thinking about Marxist theory and history, which radically broke from traditional readings of socialist development. The extremes of revisionist thought highlight the importance socialist thinkers accorded cybernetics and automation. It is hard to imagine such revisions applied to other fields, where such statements about Marx would likely have been deemed heretical. Notwithstanding the reality of Soviet automation initiatives in this period, the 1961 edition of *Fundamentals* offered one of the first clearly articulated visions of a communist future. It was a future without work.

This reading of *Fundamentals* might at first suggest that Palozci-Horvath was right in describing cybernetics as a non-ideological Third Way, but the 1961 text explicitly placed socialist automation and cybernetics in juxtaposition to equivalent capitalist efforts. The key point of divergence between socialist and capitalist approaches to automation was the social protections afforded workers during the transition to a post-work world:

> *Socialist automation* is in no way a threat to the working people […] Capitalist automation, as is known, is seriously alarming to the working class, because it involves increased unemployment and a drop in wages for considerable masses of working people. Of course, socialist automation also reduces the number of workers at one or another enterprise, or even an entire branch of industry. But this does not

> create an employment problem because the workers released as a result of automation at once find jobs in new plans or branches of industry.[43]

The Soviet distinction between capitalist and socialist automation efforts is, at once, interesting and unsatisfying. As historian Ricardo Campa has suggested in his work on technological unemployment, the social effects of technological deployment depend crucially on the economic and social system in which technologies are implemented.[44] For Soviet thinkers, the job guarantee ensured that technological progress would be enjoyed by all through improved work opportunities: mind-numbing manufacturing jobs would be replaced by intellectually fulfilling occupations.

Despite *Fundamentals'* optimism about the compatibility of socialism with automation, no explanation was given for the ultimate transition to a post-work future. A vision of a post-work world was clearly articulated in the text, but the mechanism through which workers would begin to decrease work was never made clear. On this point, Soviet theorists encountered the same problem faced by their American counterparts. Labor was so central to both socialism and capitalism that a fully automated economy could not be accounted for in either system. In the United States, futurists like Theobald called for the overthrow of scarcity-based capitalism and argued for the necessity of a guaranteed annual income. But in the Soviet Union, socialist ideologues were silent on the issue. Given the highly underdeveloped state of automation in both the United States and the Soviet Union, questions about the transition to a post-work world remained strictly theoretical. Soviet thinkers, nonetheless, expressed confidence in the socialist forms of labor allocation even if their system could not express a clear pathway to a socialist post-work utopia.

[43] Ibid., 756.
[44] Riccardo Campa, "Technological Unemployment. A Brief History of an Idea" 6 (December 31, 2018): 73.

The theoretical shortcomings notwithstanding, American intelligence officials took great interest in Soviet cybernetic and automation efforts. From the beginning of the 1960s, officials from the RAND Corporation began to write detailed accounts of Soviet cybernetic developments and their implications for American security and economic interests. According to a report from 1964, cybernetics and its many applications were worthy of close attention for three reasons: one, cybernetics incorporated many areas which were relevant to technology and the space race; two, cybernetics had many potential military applications, and the Soviet Union had a military cybernetics unit; and three, cybernetics provided a view on the negotiation between ideology and technological progress within Soviet state socialism.[45] For these reasons, American intelligence viewed cybernetics as both an area of competition as well as a window onto developments in Soviet society.

Because of its centrally planned economy, American intelligence analysts believed that the Soviet economy stood to benefit greatly from the implementation of a statewide computer network. The idea of "industrial rationalization," a buzzword in many official documents from this period held promise because of implementation inefficiencies within a command-control economy.[46] Both the perennial labor shortage and poor total factor productivity both arose from the inability of workers to be reallocated between industries due to the rigidity of socialist labor policy. Because of these endemic inefficiencies, cybernetic rationalization became a topic of major scientific interest as important Soviet scientists, like Aksel Berg and Viktor Glushkov began to develop systems for nationwide economic control and communication. Viktor Glushkov was one of the Soviet Union's foremost mathematicians and as director of the premier cybernetics institute in Kiev, he had wide latitude to pursue ambitious technical projects, and in the early 1960s he turned

[45] Levien and Maron, "Cybernetics and Its Development in the Soviet Union," 16.
[46] Ibid., 26.

his attentions to building a cybernetic system that could serve state socialism. While Glushkov's early training was in mathematics, he became an early pioneer of cybernetics in the Soviet Union and his contributions to computer science, cybernetics, and mathematics would ultimately win him the Lenin Prize in 1964.[47]

For Glushkov, the development of the so-called "All State Automated System" (OGAS) became a decades-long, but doomed effort to network the Soviet Union. OGAS underwent many revisions before its slow death at the hands of the Politburo in the early 1970s, but at its core, Glushkov proposed a series of networked databases that would collect and distribute economic information to nodes across the Soviet Union. The networks' distributed nature has drawn comparisons to modern-day cloud computing in which dedicated server centers house information and software that can be accessed and modified from any networked machine.[48] OGAS promised improved exchange of data about production targets, consumer preferences, and distribution requirements that would simulate the information transfer found in market-based systems. By way of comparison, capitalist economies can be viewed as a massively parallel computer network in which market-derived price signals communicate information about supply and demand.[49] The Soviet economy could not rely on markets for the efficient exchange of economic information, but OGAS offered a new, non-market-based means for establishing information.[50] Rather than relying on price signals to approximate consumer demands, OGAS would predict consumer desires and

[47] "Viktor Glushkov, 58, Soviet Computer Expert," *The New York Times*, February 7, 1982, sec. Obituaries, https://www.nytimes.com/1982/02/07/obituaries/viktor-glushkov-58-s-oviet-computer-expert.html.
[48] Benjamin Peters, *How Not to Network a Nation: The Uneasy History of the Soviet Internet* (Cambridge, Massachusetts: The MIT Press, 2017), 112.
[49] For further reading on the computational power of markets, see Eric A. Posner, *Radical Markets: Uprooting Capitalism and Democracy for a Just Society* (Princeton ; Oxford: Princeton University Press, 2018), introduction and chapter one.
[50] Early versions of Glushkov's plans even envisioned OGAS as a means to achieving the communist goal of a money-free society through a distributed payment system.

communicate them to networked manufacturing plants, which would adjust output accordingly. The system would model the entire Soviet economy as a classical cybernetic feedback loop.

Despite Glushkov's technical genius and ambition, OGAS never became a precursor to a Soviet internet as ARPANET did in the United States. As Benjamin Peters' recent work on the subject has argued, internal rivalries between different elements of the Soviet planning apparatus doomed OGAS. Motivations differed from agency to agency, but in the end, neither the military nor the Central Statistical Agency was willing to champion the project. According to Peters, the military was unwilling to lead the project for fear that military brass could be held accountable for the success of a domestic economic initiative. The Central Statistical Agency, and its leader Vladimir Starovsky, feared that the establishment of a well-funded networking initiative would undermine his own power and the influence of his institution.[51] Although scientific and economic initiatives were centrally planned, different factions within the Kremlin often refused to collaborate for self-interested reasons, and OGAS became a major victim of bureaucratic infighting under Khrushchev. In his own writings about OGAS, Glushkov evidenced a keen awareness of the political machinations that would determine the fate of his project:

> The fact is that the major resources for increasing the efficiency of management of the national economy are concentrated in the "junctions" of the various departmental systems. But utilizing these resources presents great difficulties. To solve this problem it is not sufficient just to coordinate work on the development of departmental automated management systems. An entirely new approach and a special technical base is required.[52]

In Glushkov's view, the cybernated junctions at the intersection of different ministries were key to unlocking the efficiency gains of a networked planning system. Ironically, Glushkov saw

[51] Benjamin Peters, *How Not to Network a Nation, 151.*
[52] Glushkov, "Address to Supreme Soviet," 18.

improved collaboration between different ministries as the primary benefit of OGAS, and yet it was a failure of ministerial collaboration that ultimately prevented his vision from being enacted.

Beyond the bureaucratic failings surrounding OGAS, serious technical limitations in both hardware and software also stood in the way of a cybernated Soviet Union. During the 1960s, the consensus within the American intelligence community held that the Soviet Union was approximately one decade behind the United States in terms of computing power.[53] By the early 1970s, the one-decade timeline was likely an underestimate, as recurring delays in the next generation of computing hardware, the so-called *Ryad* series, continued to underperform expectations. In 1972, lackluster results from the *Ryad's* debut earlier in the year prompted serious criticism from high-ranking party members who had grown increasingly skeptical of the utility and high costs associated with autarkic hardware development.[54] Such was the failure of *Ryad* that Glushkov himself even suggested the project be abandoned in favor of a new system built from scratch. Despite his enthusiasm for networked computer hardware, Glushkov harbored no illusions about the challenges that lay ahead: "Naturally, the sate-wide automated control system will not be developed at once. Years of intense work will be required to accomplish this task. Important and laborious work lies ahead."[55] Despite the optimism and rhetoric of the 1960s, it had become clear to Glushkov and other leading scientists that continued technical limitations and an ever diminishing political will had effectively ended the prospect of a networked Soviet economy.

As a project for economic rationalization, OGAS represented a new form of planning in the Soviet Union that would leverage technological insights from cybernetics to overcome the

[53] "Prospects for Computers in the Soviet Economy" (CIA Directorate of Intelligence, January 6, 1967), Freedom of Information Act Online Reading Room.
[54] Wade Holland, "Highlights," *Soviet Cybernetics Review* 3, no. 3 (May 1973), 3.
[55] Viktor Glushkov, "Management Systems Promise Large Returns," ed. Wade Holland, trans. Irene Agnew, *Soviet Cybernetics Review* 1, no. 5 (September 1971), 20.

endemic challenges of information processing in a centrally planned economy. The failure of the project provides insight into the anti-collaborative practices within the monolithic ruling party in the Soviet Union, but within the larger scope of postwar cybernetic reception , OGAS represented a highpoint in the practical enactment of cybernetic ideas. Whereas cybernetics in the United States largely dissolved into more specialized fields, like computer science and computational biology, Soviet cybernetic research actively developed and advocated for an economy-wide cybernetic system. [56] Within the American intelligence community, the potential for effective implementation of cybernetics within a centrally planned industrial economy gave rise to serious concern and several specialized reports.[57]

Soviet Cybernetics: A Field of Cold War Intrigue

The application of cybernetics to economic planning was a central theme in American intelligence analysis of Soviet technological development from the 1960s onward. By drawing on declassified intelligence materials from the RAND Corporation and the CIA, this section will demonstrate that the American intelligence community viewed Soviet cybernetics as a significant threat to long-term economic and technological superiority. As American intelligence officials and computer scientists tracked developments in Soviet automation and cybernetics, they routinely remarked on comparative advancements in the United States. Interestingly, the relative advances in Soviet and American cybernetic capabilities developed into a minor conflict between analysts at the CIA and the RAND Corporation, who offered different assessments of the state of Soviet computing.

[56] While the Soviet Union's research represented the most extensive project in the socialist world, recent work has shone light on another socialist cybernetic project in Chile: Eden Medina, *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile* (Cambridge: MIT Press, 2011).
[57] Mikulak, "Cybernetics and Marxism-Leninism," 26.

Although analysts from the RAND Corporation were confident that the United States maintained a significant computing advantage throughout the 1960s and 1970s, they recognized that this advantage derived from better organizational structures rather than fundamental know-how. The CIA, however, concluded that the United States maintained a decisive computing advantage and would remain unchallenged by the Soviet Union. On the basis of reports from both organizations, the lackluster development of Soviet cybernetics was attributed to a state-wide failure to coordinate research across a variety of different institutes, research centers, and military units. Theoretical advancements in Soviet computer science, mathematics, and cybernetics were frequently lauded by American analysts at RAND, but as the OGAS initiative demonstrated, the centrally planned research agenda was less able to coordinate broad-based advancement than the decentralized market-based structures in the United States.

From as early as 1955, American publications had begun to document the first efforts at industrial-scale automation in the Soviet Union. In a brief technical article from the journal *Nature*, the American computer engineer, W.G. Cass, wrote: "The U.S.S.R. claims to have achieved the automatic factory, but little detail is available."[58] The *Nature* article proceeded to detail scientific developments published by the Soviet scientists, I.I. Arbotolevski and N.N. Shumilovskii, who had both given papers on automation within consumer goods factories in the Soviet Union. Although the Cass report appeared in a non-classified scientific journal, his review of Soviet automation prefigured many of the themes which appeared in later intelligence briefings on the subject. First, the paucity of information and the difficulty in assessing Soviet claims emerged as a central theme. In the absence of technical reports on the "automatic factory," Cass, like later American analysts, was forced to assess Soviet claims through indirect evidence like journal

[58] W.G. Cass, *Nature*, "Automation in the Soviet Union," 1955.

articles and conference proceedings. On numerous occasions, Soviet publications exaggerated their advancements in automation, but the lack of concrete information made it very difficult for American scientists to make accurate assessments of Soviet advancements in cybernetics or automation. Second, the Cass report highlighted the high level of theoretical sophistication in Soviet science. Like reports from subsequent decades, the contributions of Soviet theoreticians were frequently praised for their ingenuity - especially in mathematics - but the gap between theoretical advancement and practical realization remained large.[59]

Although articles in both scientific publications and the popular press continued to cover Soviet advancements in automation and cybernetics during the 1960s and 1970s, the RAND Corporation took the lead in studying Soviet cybernetics and disseminating their reports to the intelligence community. These reports offer valuable insight into the state of Soviet cybernetic development, as well as concerns of the American intelligence community during these crucial years of the Cold War. RAND's coverage of Soviet cybernetics began in earnest with a report authored by the Berkeley computer scientist Edward Feigenbaum which appeared in autumn 1960. The Feigenbaum report recorded the experiences of the American delegation at the IFAC (International Federation of Automatic Control) congress which was hosted by Moscow in July 1960.

Unlike many later reports which exclusively analyzed technical documents, Feigenbaum's colorful narrative offers interesting reflections on the personalities of his Soviet hosts and the nature of cross curtain scientific dialog in the 1960s. During his time in the Soviet Union, Feigenbaum and other members of the American delegation were taken on tours of several research institutes, including the Institute of Automation and Telemechanics in Moscow, the Ukrainian

[59] Ibid.

Academy of Sciences, and the Leningrad Cybernetics Institute.[60] Despite the concerted efforts of Feigenbaum and his colleagues, they were routinely unable to attend talks and meet scientists with whom they had hoped to collaborate. After repeated attempts to meet with an eminent Russian cybernetician in Leningrad, Feigenbaum acidly remarked that the lavish closing dinner in the Kremlin did little to mollify the "bitterness felt by many of the delegates."[61] Feigenbaum was particularly incensed by the inability to meet informally with Soviet colleagues, and he noted that several American colleagues were turned away from talks even when they held personal invitations from the speakers. In Feigenbaum's account, the possibility for meaningful cross-curtain collaboration on a field as sensitive as cybernetics and automation was effectively impossible.

Feigenbaum nonetheless succeeded in securing a meeting with none other than Viktor Glushkov in Kiev, where he had a fruitful conversation about emerging ideas in theoretical cybernetics. Although he never referenced his automation initiative explicitly, Glushkov did reveal to Feigenbaum that he hoped for "large scale economic planning by machine" to be undertaken in the future and that he saw cybernetics as the primary instrument to achieve this goal. In his reflections on the conversation with Glushkov, Feigenbaum noted the potential utility of Glushkov's proposed planning initiative, which would later become known as OGAS. Feigenbaum, like virtually all American scientists, was deeply impressed with Glushkov's intelligence and ambition, but his technical prowess stood in stark contrast to the realities of Soviet computing and led Feigenbaum to conclude:

> Soviet research in the computer sciences lags behind Western developments, but […] the gap is neither large nor based on a lack of understanding of fundamental principles…the Soviets will move ahead rapidly if and when priority, in terms of accessibility to computing machines, is given to their research.[62]

[60] Feigenbaum, "Soviet Cybernetics and Computer Sciences, 1960," 560-652.
[61] Ibid., 566.
[62] Ibid. 573.

The final assessment revealed a decided American advantage in computer science, but it was a hardly a permanent advantage in Feigenbaum's view.

Throughout the 1960s, the RAND Corporation continued to disseminate reports on Soviet Cybernetics, and by the beginning of 1970s, they began publishing an intelligence journal, entitled the *Soviet Cybernetics Review*, which provided translations of Russian texts on cybernetics alongside expert commentary on the state of Soviet cybernetics. According to reports from the *Review*, the field of Soviet cybernetics had grown tremendously and by 1971, the largest cybernetics institute employed 3,000 people and had plans to expand to 8,000.[63] By comparison, the Moscow Institute of Space Research only had 500 workers on staff, and the Academy of Computer Sciences a mere 200. On the basis of size alone, cybernetics had clearly become a field of tremendous scientific and practical interest in the Soviet Union. The 3,000 workers at the Kiev Institute of Cybernetics were divided between five departments, which reflected the capacious scope of cybernetic research: engineering cybernetics, economic cybernetics, biological cybernetics, theoretical cybernetics, and system science.[64] Despite this investment of resources, the lack of centralization and the inability to decide on a concrete plan of research remained a serious hindrance for advancement. The same issues that plagued cybernetic research according to Feigenbaum's report from 1960 remained unresolved by 1971:

> As long as centralization is not carried out, I think the United States will stay comfortably ahead in computer technology and usage. However, as indicated above, our lead in space and military applications will probably be less than our lead in general-purpose computing.[65]

[63] Boehm, "Extensive Tour Yields Report on Current Soviet Computing," 4.
[64] Ibid., 3.
[65] Ibid., 5.

Throughout the duration of the RAND Corporation's study of Soviet cybernetics, the real potential for Soviet advancement was repeatedly contrasted with the practical constraints of implementing technological advancement in the Soviet economy.

In addition to RAND's research, analysts at the CIA undertook their own investigations into Soviet cybernetics. The topics of CIA analysis offer a fascinating glimpse onto the spectrum of cybernetic applications which drew the attention of Cold War intelligence analysts. Recently declassified documents from this period reveal CIA interest in cybernetics as a method for automation, weapons development, but also more outré applications, such as mind reading. One classified report from 1965 bore the title, "Soviet Capabilities in Thought Detection," and soberly asserted, "the prospect for Soviet use of a 'mind reading' technique seems to be relatively good."[66] Although such uses of cybernetics never amounted to a mainstream concern, CIA reports attest to the many theoretical use-cases of this transformative new technology.

Like their colleagues at RAND, the CIA was primarily interested in the economic applications of cybernetics, but unlike the highly technical reports produced by computer scientists at RAND, CIA reports were less detailed and more pessimistic about Soviet advancements. Cybernetics first appeared in the context of the CIA intelligence work after a controversial report, entitled "Soviet Economic Problems Multiply," appeared in 1964.[67] In a strange break from normal operational practice, the CIA publicly released their findings which concluded that the Soviet Union was falling further behind United States on major economic benchmarks.[68] The report omitted all discussion of cybernetics and prompted two acerbic editorials in the *Washington Post*.

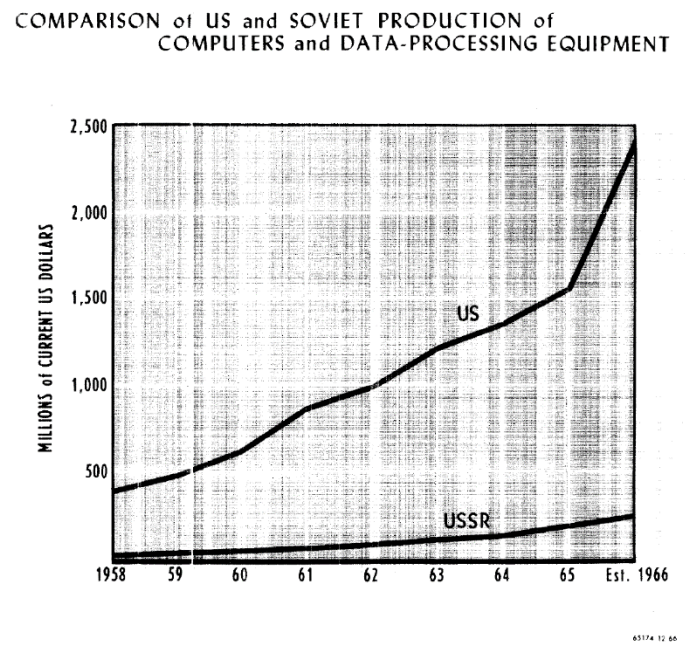
[66] Donald Chamberlain, "Soviet Capabilities in Thought Detection," Memorandum for Director of Central Intelligence (CIA, September 3, 1965), 1.
[67] "Soviet Economic Problems Multiply" (CIA, January 9, 1964), https://www.cia.gov/readingroom/docs/DOC_0000500555.pdf., 1
[68] Ibid., 3.

The first editorial harshly criticized the CIA's decision to release a classified intelligence report and argued that the report's failure to address cybernetics represented a massive oversight in the assessment of the Soviet economy:

> What these critics [CIA analysts] overlook is the evolution and application of Soviet cybernetics, the science of control and communication invented in the West, and now widely and specifically applied to the Soviet economy in order to overcome their monumental data handling problem. The politico-economic structure of the Soviet Union is ideally suited for electro-mechanical control systems in support of their economy.

The publication of this response to the CIA report and a subsequent editorial suggests that Soviet applications of cybernetics generated some serious attention from informed citizens outside of the intelligence community.

Despite contrary views from editorial writers, CIA analysts continued to take a dim view of Soviet economic advancement through cybernetic means. In 1967, the CIA produced a report which specifically addressed the use of computers in state-wide economic planning in the Soviet Union. A rather dramatic graphic (below) was included at the beginning of the report to illustrate the major discrepancy between American and Soviet computer deployment during the 1950s and 1960s.



Although the report acknowledged the Soviet ambition to develop a fully computerized economy (OGAS) to coordinate production, distribution,

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and planning across the entire country, this challenge was deemed all but impossible: "The problems of developing a comprehensive cybernetic system are staggering. The construction of a model capable of controlling the entire Soviet economy would require mathematical tools that have not been developed even in theory."[69] On the basis of these theoretical limitations, the CIA concluded that the Soviets would focus on developing more commercially profitable, i.e. less ambitious and smaller computer products, before exploring a fully "cybernetic system" in the next decade.

The CIA analysis differed in several important factors from the contemporaneous RAND studies. First and perhaps most importantly, the RAND Corporation devoted significantly more resources to the study of Soviet cybernetics. The CIA never issued a publication devoted to the topic, and given their criticisms of Soviet cybernetic capabilities, it seems reasonable that an intelligence agency would devote less energy to the subject. The relative lack of attention accorded to Soviet cybernetics reveals what was an important misreading of Soviet scientific capabilities. The CIA's outlook on state-wide cybernetics in the Soviet Union concluded that theoretical limitations were the ultimate barrier to successful Soviet deployment of full cybernetic deployment. This assessment contradicted the RAND Corporation's view that practical, rather than theoretical obstacles, were the chief hindrance for Soviet cybernetics. Based on this discrepancy, it appears that CIA analysts were less familiar with the significant theoretical insights which computer scientists at RAND frequently lauded in their own assessments of Soviet technological advancement. Although both RAND and the CIA came to a similar conclusion about the feasibility of Soviet-wide cybernetic coordination, their conclusions rested on a very different understanding about the state of Soviet science.

[69] "Prospects for Computers in the Soviet Economy" (CIA Directorate of Intelligence, January 6, 1967), 2.

With the benefit of hindsight, it is now possible to make informed conjectures about why the Soviet Union was unable to match American advancements in the economic deployment of computer technologies: 1) ideological ambivalence from party leadership; 2) scientific disagreement about cybernetic applications; and 3) unwillingness to import computer technologies from the West.

Although official party documents like the *Fundamentals* championed the idea of socialist cybernetics, concerns about the "cult of computers" and the potential subordination of humans to machines repeatedly intervened and diminished the party's willingness to consolidate cybernetic research. An article from *Pravda* in 1971 cast suspicion on the ultimate role of computers in a socialist society:

> While we are enthusiastic about the immense capabilities of computers, we do not make a cult of them. Plans are developed by people, for people. People program the operation of the machine and use the results of that operation…we are not attempting to alter the theory of socialistic planning, as some mountain-top economists, creating some sort of super-idealized, ultra-optimized plan with the help of mathematical methods and electronics, are trying to do.[70]

American analysts writing in the *Soviet Cybernetics Review* understood the *Pravda* article as an implicit criticism of the Central Economic Mathematics Institute, an organization which took a particularly technocratic approach to planning. As a contemporary analyst at RAND noted, the philosophical underpinnings of cybernetics vis-à-vis Marxism-Leninism were unsatisfying to different segments of the party apparatus, who remained more committed to ideological purity than technological progress.[71] Other articles from Soviet publications even used the term "mass

[70] Artur Zvezdov, "Party Congress Emphasizes Computer Technology," *Soviet Cybernetics Review* 1, no. 6 (November 1971): 8.
[71] Ibid.

psychosis" to describe the infatuation with cybernetics on the part of some scientists.[72] Despite its tremendous promise as an economic tool, the ideological impurity of cybernetics slowed its full-scale deployment in the early 1970s as Soviet ideologues struggled to reconcile cybernetics with orthodox Marxism-Leninism. A similar rebuke of cybernetics occurred in the German Democratic Republic and while the GDR's leadership change in 1971 precipitated a more dramatic rejection of cybernetics, the idea of fully socialized cybernetics never conquered all segments of government across the Socialist Bloc.

A second reason for the lackluster development in the Soviet Union was a technical disagreement over the best application of cybernetics to state-wide industrial production. An article by Professor Valery Sergeev in *Izvestiyaa,* entitled "A Strategy for Total Industrial Automation" argued for the importance of universal automation, while acknowledging the various proposals for how to achieve a fully automated Soviet economy. Disagreement in the cybernetics community emerged over whether a local or a global approach for automation should be undertaken. Within the scientific community, certain factions advocated for a centrally administered computer system which would be rolled out across all industrial sectors and coordinate information uniformly across the entire economy. Another camp of cybernetic experts, including Sergeev, argued that individual industries should develop specific automated systems, which could be linked together into a hierarchical structure composed of multiple interlocking sub-units.[73] The debate about how to deploy a state-wide computer network seemed to paralyze wider adoption of automation technologies during the 1960s, but by the early 1970s, the American analyst, Wade Holland concluded that a consensus was emerging around the Sergeev proposal, which more closely

[72] Wade Holland, ed., "A.N. Kolmogorov: Mathematician," trans. Irene Agnew, *Soviet Cybernetics Review* 1, no. 6 (February 1971): 39–44. 43.
[73] Valery Sergeev, "A Strategy for Total Industrial Automation," trans. Irene Agnew, *Soviet Cybernetics Review* 1, no. 2 (March 1971).

aligned with Glushkov's OGAS system.[74] As noted, however, scientific consensus did not translate into rapid deployment, and the failures of the *Ryad* system and the slow-rolling of OGAS effectively halted any meaningful deployment of cybernetic technologies in the early part of the 1970s.

A final stumbling block likely arose from party reticence to import Western technology for use in the Soviet economy. Although small numbers of American computers had been export to socialist states, significant imports were never permitted by the party leadership.[75] Reticence to import foreign technologies led Soviet hardware developers to rush the production of the third-generation computers which were debuted in 1972 with little success. Like previous projects, the *Ryad* was plagued by serious delays and was, according to expert opinion, at least five years behind state-of-the-art machines in the United States. Despite its clear deficits relative to comparable American devices, the *Ryad* was doggedly pushed through production to satisfy increasing demand from Latvia and the GDR, two states that were particularly eager to employ the new computer series in their own economies.[76]

The many challenges with the *Ryad* were a source of serious embarrassment for Soviet leaders, and public-relations failures surrounding the *Ryad* soured party leaders to the renewed effort at cybernetic competition. Although party directives from 1972 continued to identify cybernetics as a key aim for the 1971-1975 plan, party leadership was unwilling to tolerate the risks associated with an ambitious cybernetics initiative.[77] The political reticence towards ambitious computing projects led to the appointment of a little-known figure, Andrei Zhimerin, as

[74] Ibid.
[75] M. Korolev, "Assigning Responsibility for Computer Crisis," ed. Wade Holland, trans. Irene Agnew, *Soviet Cybernetics Review* 3, no. 1 (January 1973): 9.
[76] Ibid., 10.
[77] Wade Holland, "SCR Commentary," *Soviet Cybernetics Review* 3, no. 1 (January 1973): 11.

head of "Statewide Automated Management," in what many commentators saw as an implicit rebuke of industry wide automation. The intellectual leader of Soviet computing, Viktor Glushkov, had succeeded in gaining support for the hierarchical, sub-unit approach to industrial scale automation, but the promotion of Zhimerin effectively sidelined Glushkov and seriously retarded the growth of both automation initiatives and Soviet cybernetics more generally.

Soviet Cybernetics did not cease as a discipline despite political hostility toward the project from the 1970s onward. Significant theoretical work continued to emerge from leading Soviet scientists like Kolmogorov, Glushkov, and others who clearly understood that computers would be vital to future economic success. The rapid decline of research into state-wide automation in the Soviet Union did, however, undermine the necessity for a publication like the *Soviet Cybernetics Review*, and in 1973, RAND cut funding for the journal. The CIA, however, would continue to monitor developments and throughout the 1980s, a smattering of reports and translations of articles continued to appear in classified publications within the organization.[78] Unlike the intelligence literature from the 1960s, later discussion of cybernetics reflected an ossification in the technological race between the United States and the Soviet Union. When analysts from RAND first began reporting on Soviet advancements in cybernetics in 1960, the possibility of a statewide computer system built on a new cybernetic architecture represented a real threat to American economic dominance. In addition, computer scientists from RAND were aware of the significant brainpower which the Soviet state could deploy for solving challenging technical problems. By the mid-1970s, however, after a series of scientific disagreements and waning political support, cybernetics quietly disappeared from the foreground of Soviet technological policy. Even if cybernetics could never have been the silver bullet for the Soviet

[78] "USSR Report: Cybernetics, Computers, and Automation Technology" (Foreign Broadcast Information Service, March 2, 1987).

economy, the field's potentially lucrative applications were fatally handicapped by an inability to coordinate research agendas across the Soviet Bloc.

Conclusion

Cybernetics research and automation initiatives in the USSR advanced in stops and starts throughout through the postwar period. Despite attempts to bring cybernetics within a Marxist-Leninist framework, the American science always rested uncomfortably within Soviet state socialism. American interest in the Soviet cybernetic project evidenced genuine concern about the development of a functioning state-wide computer system, but the challenges of scientific research in the Soviet Union prevented meaningful advancements in industrial automation. The shortcomings in Soviet cybernetics and the inability to achieve a socialist cybernetic state were not, however, foreordained. Rather, the failure of Soviet cybernetics to achieve the aims of rationalized economic planning emerged from endemic problems with the organization of knowledge and ability to implement coherent economic plans across the Soviet Union.

Just as the Soviet Union pursued cybernetic research throughout the 1960s, other Soviet Bloc states began to assimilate Wiener's new discipline. In the German Democratic Republic, which the next chapter will study, a charged and highly philosophical engagement with cybernetics emerged during the 1960s when Walter Ulbricht pursued a program of socialist modernization. While the GDR only began serious study of cybernetics after the discipline was rehabilitated in the Soviet Union, East German thinkers pursued unique lines of inquiry and produced a remarkable body of theoretical literature on cybernetics and Marxist-Leninism. East German scientists never achieved a comparable level of automation and computing technologies to those developed in the Soviet Union, but practical limitations did not inhibit new forms of socialist thought which envisioned an automated communist future. Ulbricht's last decade in power and the attendant

fascination with scientific and technological revolution came to represent the acme of socialist modernism during the postwar period.

A parallel to the United States and West Germany also emerges when we consider the relative emphases of cybernetic research in the Soviet Union and the GDR respectively. In the West, the United States was the leading center for practical cybernetic research, but as noted in chapter two, states like West Germany, pursued unique forms of cybernetic reception which studied the field's impact on aesthetics and philosophy. In a similar vein, the Soviet Union led research into the economic applications of cybernetics within Socialist Bloc, but East Germany nonetheless studied the discipline from a philosophical and ideological perspective. While neither West nor East Germany could match their respective patron states in practical cybernetic applications, they extended the boundaries of cybernetics to a range of disciplines outside of the economics and industrial planning.

Chapter IV

From Cybernetics to Industry Robots in the German Democratic Republic

> The new science of cybernetics, with all its social, scientific, and world-view consequences, is, alongside the technological mastery of nuclear energy and space travel, the most important scientific development of our time. Cybernetics reaches deep into our material and spiritual being. Its revolutionary effects can easily be viewed in parallel to the discoveries of Copernicus, Darwin, or Marx.[1]

In January of 1963, the leader of East Germany's Socialist Unity Party (SED), Walter Ulbricht, set out an ambitious goal to remake socialism through a scientific-technical revolution: "The complete rebuilding of socialism requires methodical support and development of the sciences. In the second half of the twentieth century, natural sciences and technology will play a larger role than ever before in the history of humankind."[2] By the early 1960s, Ulbricht and an increasingly influential faction of the Politburo, represented by Erich Apel and Günter Mittag, had recognized that rapid technological advancement would be crucial for the SED's continued legitimacy and the GDR's economic competitiveness in its second decade of existence. In outlining his vision for a scientific and technical revolution, the SED leader issued a brief sentence that would be repeated countless times in philosophical journals, popular press outlets, and technical documents in the ensuing decade: "Cybernetics should be especially supported [Kybernetik ist besonders zu fördern]"[3].

[1] Georg Klaus, *Kybernetik in Philosophischer Sicht*, 4th ed. (Berlin: Dietz Verlag, 1965), 20.
[2] Walter Ulbricht, *Das Programm des Sozialismus und die geschichtliche Aufgabe der Sozialistischen Einheitspartei Deutschlands* (Berlin: Dietz Verlag, 1963), 344.
[3] Ibid., 345

After cybernetics had been rehabilitated in the Soviet Union in the mid-1950s, East German philosophers, planners, and members of the intelligentsia brimmed with enthusiasm about the application of cybernetic methods to the economic planning apparatus. The explosion of interest in cybernetics emerged during a decade which some commentators have called a highpoint of socialist modernity in the German Democratic Republic.[4] The protection afforded by the newly constructed Berlin Wall and the establishment of the controversial New Economic System (NES) in 1963 opened the possibility for a new kind of socialism, which utilized Western technologies within a socialist value system to protect and improve the lives of East German workers.[5] But within a decade, the ideological and political tides had once again turned against cybernetics. After the turmoil of 1968, the repudiation of the NES, and Honecker's accession to power, cybernetics had been relegated to an ideological backwater – rejected by SED chief ideologue, Kurt Hager, and denounced as a pseudo-science by Erich Honecker himself.[6]

The historical literature on East German cybernetics has largely ended with the subject's demise in the early 1970s, but as this chapter will demonstrate, cybernetics experienced a vibrant afterlife during the 1980s in the form of industry robots and microelectronics. While explicit support for cybernetics certainly diminished in the early 1970s, the ideas and rhetoric around cybernetics reemerged forcefully in the subsequent decade when SED leadership turned towards industry robots and microelectronics as a solution to mounting international debt, low productivity

[4] Oliver Sukrow, "Networks: On the Utopian Qualities of Technology, Cybernetics, and Participation in the GDR of the Late 1960s," ed. Richard Wetzell and Patricia Sutcliffe, *Bulletin of the German Historical Institute*, no. 14 (2019): 92.
[5] Benjamin Robinson, "Socialism's Other Modernity: Quality, Quantity and the Measure of the Human," *Modernism/Modernity* 10, no. 4 (2003): 707
[6] Kurt Hager, "Die Entwickelte Sozialistische Gesellschaft," *Einheit* 26, no. 11 (1971); Jérôme Segal, "Kybernetik in der DDR – Begegnung mit der marxistischen Ideologie," *Dresdner Beiträge zur Geschichte der Technik und der Technikwissenschaften* 27 (2001): 47–75.

growth, and high oil prices.[7] By viewing cybernetics across two decades, rather than focusing exclusively on the 1960s, this chapter offers a rereading of East German cybernetics by examining the continuities and discontinuities between the two periods of cybernetic interest in the GDR. This view challenges the prevailing understanding that cybernetics was fully rejected in the 1970s, and instead presents the early 1970s as a reorientation away from cybernetics toward other fields of technology. The caesura in cybernetic interest was not permanent, however, and many of the same actors who wrote against cybernetics in the 1970s, such as SED chief ideologue, Kurt Hager, actively promoted the related ideas of microelectronics and industry robots by the 1980s.

In contrast to the drive for industry robots in the 1980s, the early reception of cybernetics in the GDR was characterized more by philosophical inquiry than practical deployment. The philosophical attempts to marry cybernetics with Marxist-Leninist doctrine, which were championed by the philosopher Georg Klaus, helped provide the ideological foundation on which later writers justified the deployment of industry robots in East German factories. Klaus's extensive writings on cybernetics during the 1960s also offer a window into the space for philosophical dissent during a heady period of attempted modernization under Ulbricht. The debates, which Klaus and his students sparked in the pages of the SED's theoretical journal *Einheit* and the *Deutsche Zeitschrift für Philosophie* (*German Journal of Philosophy*), demonstrate how and to what extent Western inventions could be harmonized with the dogmas of Marxist-Leninism. Because of the relative backwardness of the East German IT industry during the 1960s, cybernetics was almost exclusively a philosophical rather than practical topic. This philosophical orientation stands in contrast to the industry robot and microelectronics initiative from the 1980s which consisted of quantitative deployment targets and production goals.

[7] Reinhold Bauer, "Ölpreiskrisen und Industrieroboter: Die siebziger Jahre als Umbruchphase für die Automobilindustrie in beiden deutschen Staaten" (Göttingen: Vandenhoeck & Ruprecht, 2008).

The existing literature on East German cybernetics has focused almost exclusively on the 1960s and Georg Klaus's theoretical contributions to the discipline under Ulbricht. The works of Jérôme Segal and Frank Dittman's collected volume on the subject have helpfully elucidated the works of Klaus and his students, but they have failed to look beyond cybernetics' official rejection in Honecker's early years.[8] Other studies of the 1960s, such as Dolores Augustine's work on East German engineers and Benjamin Robinson's volume on socialist modernity, have only made passing mention of cybernetics within Ulbricht's larger program of economic reform.[9] Augustine, Robinson, and Thomas Baylis's insights into technocracy from the 1960s have nonetheless provided an informative view of the changing power structures within the SED planning apparatus, and this study will build on their work by showing how cybernetics became an important element of technological revisionism from the period.[10] Studies of the IT-related initiatives from the 1980s from the likes of Rüdiger Hachtmann and Ralf Ahrens have viewed the industry robot initiative as a distinct historical phenomenon from the cybernetic discussion of the 1960s.[11] While Hachtmann and Ahrens' respective works provide great insight into the details of industry robot deployment, their focus on specific initiatives partially overlooks the longer-term trends in East German technology which set the stage for rationalization in the 1980s.

The goal of this chapter is to combine these two previously distinct segments of East German historiography by examining the continuities and discontinuities between cybernetics

[8] Segal, "Kybernetik in der DDR – Begegnung mit der Marxistischen Ideologie;" Frank Dittmann, "Kybernetik in der DDR - Eine Einstimmung," in *Kybernetik steckt den Osten an: Aufstieg und Schwierigkeiten einer interdisziplinären Wissenschaft in der DDR*, ed. Frank Dittmann and Rudolf Seising, 1st ed. (Berlin: Trafo, 2007).
[9] Dolores L. Augustine, *Red Prometheus: Engineering and Dictatorship in East Germany, 1945-1990* (Cambridge, Mass: MIT Press, 2007); Robinson, "Socialism's Other Modernity."
[10] Thomas A. Baylis, *The Technical Intelligentsia and the East German Elite: Legitimacy and Social Change in Mature Communism* (Berkeley: University of California Press, 1974).
[11] Hachtmann, "Rationalization, Automation, and Digitalization: Transformations in Work," in *A History Shared and Divided: East and West Germany since the 1970s*, edited by Frank Bosch, 239-92, (New York, Oxford: Berghahn Books, 2018); Ralf Ahrens, „Rationalisierungseuphorie und Innovationsschwäche: Industrieroboter im Werkzeugmaschinenkombinat "Fritz Heckert" um 1980," in T*echnikgeschichte* 79 (2012), 61-77.

debates from the 1960s and the industry robot initiatives from the 1980s. While East German ideologues in the 1980s were clearly indebted to Georg Klaus's philosophical frameworks, they refused to investigate the more problematic aspects of automation within a socialist context. As part of this dissertation's larger investigation into the cross-curtain reception of cybernetic ideas, East Germany is a particularly interesting case-study because of its complicated relationship with Western notions of technological progress. At various points from the 1960s onward, cybernetics fell in and out of favor as SED leaders changed their stances on assimilating a Western technology into their vision of "real-existing socialism." Cybernetics as an ideology proved a dangerous and politically untenable model in the GDR, but cybernetics as a technology retained enormous promise throughout the GDR's forty-year existence.

Socialist Modernity and East German Cybernetics, 1960-1971

While cybernetics only began to attract widespread interest during the 1960s, Norbert Wiener's new discipline of communication and control did receive modest academic coverage in East Germany during the 1950s. Unlike the subsequent decade in which enthusiastic support from Walter Ulbricht and the pioneering philosophical works of Georg Klaus established a distinctly East German flavor of cybernetics, the 1950s witnessed a more measured reception of the discipline which hewed to the Soviet Union's ideological direction.[12] As discussed in the previous chapter, Soviet commentators had initially pilloried cybernetics as a bourgeois discipline before it was rapidly rehabilitated under Khrushchev and became a major focus of Soviet research.[13] In accordance with the Soviet model, the first mention of cybernetics in East Germany appeared in a

[12] Kevin Baker, "Red Helmsman: Cybernetics, Economics, and Philosophy in the German Democratic Republic" (Master's thesis, Georgia State University, 2011), 22-23.
[13] See Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge: MIT Press, 2002).

1952 article from *Neue Welt*, entitled "Cybernetics – A new 'science' of obscurantism," which was a translation from the Russian that had appeared earlier in the year.[14] This lone article on cybernetics during the period when Soviet theorists were vociferously denouncing the new American science of bourgeois imperialism highlights the relative quiescence on the topic from East German writers. The relatively quiet East German presses may help explain why the discipline was able to achieve greater appreciation in the subsequent decade. Although the sixties-era reception of cybernetics was not without its detractors, cybernetics in East Germany did not bear the scars of a once tarnished discipline as it did in the Soviet Union.

Across all the case studies in this dissertation, cybernetics has proven a highly malleable concept, which fell in and out of scientific, political, and ideological favor in both socialist and capitalist contexts. The GDR was no exception to this pattern, and in l955, the East German monthly *Forum* reprinted the Soviet theorist Ernst Kolman's speech, "A Soviet View of Cybernetics", which opened the door for cybernetics' rehabilitation in the Soviet Union and the communist bloc, more generally.[15] As historian Benjamin Peters has noted, Kolman's attempt to inscribe cybernetics with a Soviet prehistory helped increase the ideological palatability of the discipline and provide philosophical justification for its acceptance.[16] The generality of cybernetics as a discipline and its possible applications to everything from automation to economic planning necessitated socialist philosophers to provide a philosophical justification for the discipline. Because cybernetics proposed an alternative scientific epistemology which posited the ability for machines to think, East German politicians and philosophers were forced to develop an appropriate ideological treatment for cybernetics that would make the discipline compatible with Marxist-

[14] Segal, "Kybernetik in Der DDR – Begegnung mit der Marxistischen Ideologie", 50.
[15] Kolman, "Was Ist Kybernetik?"
[16] Benjamin Peters, "Normalizing Soviet Cybernetics," *Information & Culture* 47, no. 2 (2012): 160-161.

Leninism's emphasis on human cognition. In addition, the self-regulating nature of cybernetic feedback patterns challenged the state's role as the ultimate controller of economic processes within socialism.

The philosophical preparation of cybernetics began to gain momentum and establish a uniquely East German voice with the publication of an edited volume, entitled *Was ist Automatisierung*, in 1957. The publisher's introduction to the text marked a new effort to engage, explain, and problematize ideas around automation and cybernetics for a socialist audience: "This work was written by a group of scientists with the aim of providing our workers with answers to the most important questions about automation and the industrial transformations that are appearing in both capitalist and socialist contexts."[17] In contrast to the more nuanced and philosophically sophisticated texts that appeared during the 1960s, the contributors to *Was ist Automatisierung* wrote frankly about the predicted benefits of automation within socialism and the comparative privations that would arise in capitalist countries. A common theme which characterized the essays in *Was ist Automatisierung* was the acknowledgment that new technologies would permit a level of automation incomparable to earlier periods of human progress.[18] The argument about a qualitative and unprecedented leap in productive capacities mirrored similar rhetoric in the United States and it is clear that the editor, Heinz Emmerich, and his fellow contributors were closely monitoring the state of automation outside of the GDR. In a chapter entitled, "The Social Effects of Automation in Capitalism", the East German writer Herbert Meissner stated plainly: "It has been shown that automation leads to massive reductions in the number of workers required. Under capitalist conditions, this leads simply and clearly to one thing:

[17] Heinz Emmerich, ed., *Was ist Automatisierung* (Berlin: Dietz Verlag, 1957), frontmatter.
[18] Ibid., 4-5

job-loss!"[19] Despite his anti-capitalist rhetoric and cynicism toward American uses of cybernetics, Meissner did entertain possible policy solutions, including the introduction of a guaranteed annual income in the United States.[20]

While the contributors to *Was ist Automatisierung* eagerly denounced capitalist uses of automation, they provided little insight into the practical ways that socialist states would exploit automation for the good of all. Beyond assurances that the fruits of automated labor would be equitably shared across all levels of society, the writers of *Was ist Automatisierung* did not attempt to explain how automated labor squared with traditional Marxism or how the totalizing claims of cybernetics could be reconciled with the materialism of Marxist-Leninism. Although the writers were clearly enthusiastic about the possibilities of automation within socialism, their work reflected the philosophical immaturity of early attempts to harmonize automation with socialism. It was only through the works of Georg Klaus and his many followers that cybernetics would achieve a surer philosophical footing within the German Democratic Republic.

Georg Klaus was a figure of impeccable socialist pedigree. A member of the KPD since 1933, Klaus's burgeoning chess career and study of mathematics in Erlangen were delayed by six years imprisonment in Nurnberg and then Dachau at the hands of the National Socialists.[21] Despite the remarkable interruption to his studies, Klaus was able to complete a PhD by 1949, where he was supervised by none other than Max Bense, the man who would later champion Information Aesthetics in the parallel postwar world of West Germany.[22] As a student of Bense, Klaus studied semiotics and developed a keen interest in the intersection of technology, society, and philosophy.

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[19] Herbert Meissner, "Die Sozialen Auswirkungen Der Automatisierung Im Kapitalismus," in *Was Ist Automatisierung,* ed. Heinz Emmerich (Berlin: Dietz Verlag, 1957), 16
[20] Ibid., 26
[21] Baker, "Red Helmsman: Cybernetics, Economics, and Philosophy in the German Democratic Republic.", 25.
[22] Frank Dittmann, "Kybernetik in der DDR - Eine Einstimmung," in *Kybernetik steckt den Osten an: Aufstieg und Schwierigkeiten einer interdisziplinären Wissenschaft in der DDR*, ed. Frank Dittmann and Rudolf Seising, 1st ed. (Berlin: Trafo, 2007), 23

Despite their common philosophical interests, Bense and Klaus did not share a similar politics, which was exemplified in 1948, when Bense absconded from Jena to the Western occupation zone where he would spend the rest of his career.[23] Klaus remained enthusiastic about his *Doktorvater*, nonetheless, and even joked about their philosophical differences in a letter from 1949, shortly after Bense had left the Eastern zone. [24] With the founding of the German Democratic Republic in 1949, Klaus found an ideologically hospitable home for his philosophical work, and he quickly launched a formidable academic career in the East. By the early 1960s, Klaus had established himself as a leading socialist theorist in the GDR and his forceful, yet politically tactful advocacy for cybernetics, played a decisive role in the explosion of cybernetic interest from politicians and philosophers throughout the 1960s.

Before turning to Klaus's work on East German cybernetics, it is necessary to understand the constellation of political and economic factors that made the cybernetic debates possible during the 1960s. Of primary importance was the construction of the Berlin Wall in 1961, which helped stem the loss of East German scientific talent to the West and provided SED leadership with greater flexibility to pursue new directions in economic planning. As Dolores Augustine has noted, the construction of the Wall did not improve the treatment of East German scientists and there is evidence to suggest their treatment even worsened, but the Wall certainly increased the radius of acceptable academic inquiry, which the likes of Klaus and his cybernetically-inclined colleagues eagerly pursued.[25]

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[23] Georg Klaus et al., *Kybernetik und Interdisziplinarität in den Wissenschaften: Georg Klaus zum 90. Geburtstag : gemeinsames Kolloquium der Leibniz-Sozietät und der Deutschen Gesellschaft für Kybernetik im November 2002 in Berlin* (Berlin: Trafo Verlag, 2004), 391.
[24] Georg Klaus to Max Bense reprinted in *Kybernetik und Interdisziplinarität in den Wissenschaften.*
[25] Dolores L. Augustine, *Red Prometheus: Engineering and Dictatorship in East Germany, 1945-1990* (Cambridge, Mass: MIT Press, 2007).

Empowered by the security of the "Antifascist Protection Bulwark," Politburo members Erich Apel and Günter Mittag succeeded in introducing reforms to the East German economy which culminated in the New Economic System (NES) launched in 1963. The NES represented a significant departure from the model of traditional socialist planning by devolving some measure of planning capacity to regional publicly owned enterprises or *Volkseigene Betriebe* (VEB).[26] Under the traditional model, the administration of the GDR's economy, like virtually all facets of East German society, was centrally planned and implemented by decisions of the Politburo. By ceding some control to individual VEBs, Apel, Mittag, and Ulbricht hoped to achieve a more flexible system of socialist production that could respond more easily to microeconomic stimuli. While the NES has received extensive treatment in the history of the East German economy, comparatively little attention has been paid to the relationship between cybernetics and the emergence of the NES. The chief architect of the New Economic System and the head of the politburo's Economic Commission, Erich Apel, actively advocated expanded research into advanced automation at the highest levels of state economic planning. In the minutes from a 1961 meeting of the Economic Commission, it was noted that the "Central Institute for Automation has until now taken on only marginal problems, and not, as is now required, addressed complex automation tasks that are necessary for the economy, in general. The task is now set for the Central Institute to take on complex automation tasks."[27] From the early 1960s, revisionist members of the Politburo, like Apel and Mittag, recognized the relationship between cybernetics and the ultimate success of their economic reforms.

[26] André Steiner, *Von Plan zu Plan: eine Wirtschaftsgeschichte der DDR.* (Munich: Deutsche Verlags-Anstalt, 2004), 129-130.
[27] "Protokoll (II) der Sitzung der Wirtschaftskommission des Politbüros" (Politbüro der SED, April 28, 1961), DY 30/70599, SAPMO-Bundesarchiv, 20

But Apel and Mittag were not alone in their enthusiasm for cybernetics, automation, and economic reforms, and their visions was largely shared by SED chief Walter Ulbricht, who trumpeted the idea of a scientific and technological revolution within the GDR. Ulbricht's commitment to scientific and technical revolution ushered in a decade which the historian Wolfgang Engler has characterized as a period of socialist Avant-gardism.[28] It was in this economic and political context that Georg Klaus became director of the Central Institute for Philosophy alongside his professorship at the Humboldt University and began to lay the philosophical foundations for East German cybernetics. By the 1960s, Klaus was already well-versed in the subject of cybernetic philosophy and the problems associated with integrating cybernetics into socialism. In 1957, Klaus and his student Heinz Liebscher had already published on the subject, but it was from 1961 onward that broader academic interest in the subject emerged in the GDR.[29] After a successful conference on cybernetics in 1961, Klaus arranged for the establishment of a cybernetics department in the Academy of Sciences, which would remain in existence until the 1980s. Alongside organizing academic conference on the subject, Klaus published his first major book on cybernetics in 1961, entitled *Cybernetics in Philosophical View*.

Cybernetics in Philosophical View exemplified the complex philosophical casuistry required to harmonize a capitalist scientific invention with the ideological dictates of the GDR. But Klaus was hardly an unsophisticated thinker, and his commitment to socialism as an ideology and cybernetics as a science prompted him to reinterpret Marx and offer a new vision for a socialist future. Klaus' attention to detail and philosophical nuance differentiated his work from that of Emmerich and earlier writers who did not engage more challenging questions about cybernetic

[28] See Wolfgang Engler, *Die Ostdeutschen als Avantgarde* (Berlin: Aufbau Taschenbuch Verlag, 2004), introduction. Also, cited in Sukrow, "Networks: On The Utopian Qualities of Technology, Cybernetics, and Participation in the GDR of the Late 1960s." 92.
[29] See Dittmann, "Kybernetik in der DDR - Eine Einstimmung," 23, note 46.

and socialist compatibility. For Klaus, cybernetics represented one of the great technological advances of the era, and he began the preface to *Philosophical View* with an arresting opening:

> The new science of cybernetics, with all its social, scientific, and world-view consequences, is, alongside the technological mastery of nuclear energy and space travel, the most important scientific development of our time. Cybernetics reaches deep into our material and spiritual being. Its revolutionary effects can easily be viewed in parallel to the discoveries of Copernicus, Darwin, or Marx.[30]

To place cybernetics alongside space travel and nuclear energy represented significant rhetorical risk, which only his combination of communist credentials and socialist political correctness would allow him to get away with.

Cybernetics was anything but a natural philosophical bedfellow to Marxist-Leninism, and Klaus intended to "root out" the capitalist ideology that had corrupted cybernetics from its founding.[31] In *Philosophical View* and later writings on the topic, Klaus undermined capitalist arguments of cybernetic feedback by arguing that capitalist feedback loops had no concept of worth. In describing cybernetic regulation of a capitalist economy, Klaus noted how the system would ostensibly self-correct by responding to changes in consumer demands and adjust output accordingly. According to the capitalist framework, the self-correcting feedback loops of market exchange represented a true cybernetic system. But for Klaus, such a system represented a "political economy without the category of worth", or a system in which the production of goods was disconnected from overall utility or societal benefit.[32] Within a socialist system, however, a self-regulating economy combined with the concept of worth would unleash the true potential of cybernetics for all members of society. Unlike self-regulating markets, Klaus imagined a future in which the socialist *Wertgesetz* or "law of worth" would function as the ultimate economic regulator

[30] Georg Klaus, *Kybernetik in Philosophischer Sicht*, 4th ed. (Berlin: Dietz Verlag, 1965), 20.
[31] Ibid., 488.
[32] Ibid., 488

to ensure both economic stability and the production of truly valuable goods.[33] This rereading of cybernetic political economy through a Marxist-Leninist lens of worth marked a new level of philosophical sophistication in the reception of cybernetics in the GDR that differed from the more simplistic argument of the 1950s.

Outside the realm of political economy, more challenging questions remained about the compatibility of cybernetics with certain scientific precepts of Marxist-Leninism. In response to these challenges, Klaus strengthened his stance about the relationship between Marxism and cybernetics, and in his 1964 book, *Cybernetics and Society*, he suggested that Marx himself was a materialist cybernetician: "The classics of Marxism describe numerous cybernetic laws, even without using today's cybernetic terminology […] We have for many years advanced the notion that Marx himself was a materialist cybernetician"[34] Despite his assertion that Marx was a proto-cybernetician, serious philosophical ambiguities remained unresolved. In particular, cybernetics' view of information as a primary element of the universe on a par with energy and matter required special attention. Dialectical materialism, the philosophical foundation of Marxist-Leninism propounded the view that energy and matter were the sole fundamental elements of the universe. As a result, the primacy of information within cybernetics represented a major revision to dialectical materialism. Klaus, however, refused to accept that the cybernetic view of information represented a fundamental incompatibility with dialectical materialism:

> Norbert Wiener, the founder of cybernetics, has stated: information is neither matter nor energy, but rather just information. Steinbuch [a West German cybernetician] and many other cyberneticians who have come to philosophy through cybernetics, but who have otherwise no philosophical training have amplified this idea. But whoever is familiar with Lenin's definition of matter will recognize Wiener's statement as either banal or completely false – depending on your own interpretation. There is no information that is not tied to a material substrate, for

[33] Georg Klaus, "Die Kybernetik, das Programm der SED und die Aufgaben der Philosophen," *Deutsche Zeitschrift für Philosophie* 11, no. 6 (1963): 705
[34] Georg Klaus, *Kybernetik und Gesellschaft.* (Berlin: Deutscher Verlag der Wissenschaften, 1964), X.

> instance signals […] If one is to take Wiener's statement as a philosophical claim, then one must utilize a philosophical conception of matter![35]

Klaus' simple but elegant attempt to harmonize dialectical materialism with the cybernetic view of information rested on the idea that all information must be encoded in a material substrate. By invoking Lenin's definition of matter, Klaus was able to justify the utility of information within a cybernetic framework, while still acknowledging dialectical materialism as the fundamental framework for scientific understanding.

Cybernetics, and its natural extension into industrial automation, also sat uneasily within a socialist state that derived its political legitimacy from the working class. The GDR, which some observers have called a *Arbeitergesellschaft* or "workers' society," enshrined a job guarantee in article 24 part 1 of the East German constitution, and viewed work as a social and political virtue.[36] In such a society, the prospect of automated manufacturing and the use of cybernetic technologies threatened, in the long term, to violate the job guarantee, and in the near term, reduce workers to machine tenders. On this front, Klaus once again faced the issue head on and acknowledged the challenges that cybernetics posed to traditional notions of socialist work. For Klaus, the increased capacity for humans to undertake creative or mental labor represented a revolutionary consequence of cybernetics:

> If the orientation of socialist work towards creative work and the gradual overcoming of schematic intellectual labor, i.e. its transition to machines, is a development according to socialist law, then the philosophical clarification of the idea of work becomes all the more important. […] The position of workers and the members of the intelligentsia in this new machine-world will, in the end, require a new definition of workers and the intelligentsia. [37]

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[35] Georg Klaus, "Kybernetik und ideologischer Klassenkampf," *Einheit* 25, no. 9 (1970): 1188.
[36] Manfred G. Schmidt, "Social Policy in the German Democratic Republic," in *The Rise and Fall of a Socialist Welfare State: The German Democratic Republic (1949-1990) and German Unification (1989-1994)* (Berlin: Springer-Verlag, 2013), 32 and 38.
[37] Klaus, "Die Kybernetik, das Programm der SED und die Aufgaben der Philosophen," 700-701.

With his characteristic nuance, Klaus accepted that cybernetics would require work to be redefined in the future, and he even proposed a possible conflation between the intelligentsia and workers, who would take on increasingly intellectual work. Although Klaus did not propose a full redefinition of the socialist worker, he concluded that "the highly trained worker who works alongside complex electronic machines in automated factories is not a worker in the traditional sense."[38] Despite Klaus' enthusiasm for cybernetics and his acceptance that cybernetics challenged certain fundamental principles of socialist labor, he offered few concrete philosophical resolutions and concluded his essay that East German intelligentsia must busy itself "quickly and energetically" with these challenging questions about cybernetics and socialist worker.[39]

Even if Klaus could not offer a concrete redefinition of the cybernetic worker in socialism, he still advanced the comparatively radical claim that automation would facilitate the transition to true communism. In a 1962 essay, Klaus invoked the words of Khrushchev and quoted from the "Statutes of the Communist Party of the Soviet Union" to support the goal of full automation: "the machine-world of communism, which forms the basis for the transition to communist principles of work and distribution of goods, will be a cybernetic machine-world! [The transition to full mechanization] is no longer about freeing humans from heavy labor, but also from uncreative intellectual work!"[40] Here, Klaus imagined a future in which "uncreative intellectual labor" – activities such as arithmetic calculations, book-keeping, or task scheduling - would also be removed in a cybernetic machine-world. The capacity for cybernetics to facilitate a transition to true communism proved a provocative, but also popular idea, which Klaus's student, Heinz Liebscher explored in a book-length treatment from 1964.[41] According to the historian Jérôme

[38] Ibid., 701.
[39] Ibid., 707.
[40] Georg Klaus, "Für und wider die Kybernetik," *Deutsche Zeitschrift Für Philosophie* 10, no. 5 (1962): 590.
[41] Heinz Liebscher, *Kybernetik und Leitungstätigkeit* (Berlin: Dietz, 1966).

Segal, Liebscher's book, entitled *Cybernetics and Management Activity*¸ proved a relative popular success and more than 20,000 copies were ultimately published.[42] For Liebscher, the cybernetic transition entailed a change from economic control to economic regulation, in which planning authorities would adjust rather than dictate production levels. A state of self-regulating production was, according to Liebscher, the key for attaining a true communist state without the need for a central governing authority.

Interest in cybernetics was hardly confined to the pages of socialist philosophical journals, but in fact, reached to the very highest echelons of the Politburo. NES architects Erich Apel and Günter Mittag were enthusiastic about both automation and cybernetic applications to economic planning. As the decade progressed, Walter Ulbricht became so vocal in support of cybernetics that the West German weekly, *Der Spiegel*, sardonically remarked in a 1967 article that "Walter Ulbricht, 74, who knows Russian alongside his mother tongue, has in his old age learned a new language. The SED Chief speaks fluent cybernetics."[43] The West German interpretation, as articulated in *Der Spiegel*, viewed Ulbricht's enthusiasm for cybernetics as an admission that earlier forms of economic planning had failed to achieve their stated aims. Despite the article's caustic tone toward Ulbricht's cybernetic language, there is ample evidence to suggest that Ulbricht and a significant faction of the East German intelligentsia had come to view cybernetics as key to improving the system of economic planning.[44] A 1965 article by an East German academic entitled, "The Cybernetic Character of the New Economic System and the Model Structure of Perspective Planning as a Goal-oriented Cybernetic Process," argued that the NES would only succeed if it were able to assimilate cybernetic patterns of feedback and self-

[42] Segal, "Kybernetik in Der DDR – Begegnung Mit Der Marxistischen Ideologie", 62.
[43] "DDR/Regierung: Neue Welt," *Der Spiegel*, July 23, 1967.
[44] Wolfgang Salecker, "Lesematerial zum Vortrag 'Die Kybernetik als Instrument rationeller sozialistischer Wirtschaftsführung'" (Berlin, October 1967), DY 30/87272, SAPMO-Bundesarchiv.

regulation.[45] In an echo of Liebscher's *Cybernetics and Management Activity*, the article also argued that cybernetics would bring about a transition from control to regulation, that would facilitate improved productivity, labor allocation, and economic surplus.

Growing interest in cybernetics also resulted in the design and founding of the short-lived Academy of Marxist-Leninist Organization (AMLO), which was designed by one of East Germany's most prominent architects, Richard Paulick (see Figure 1).[46] The academy, which only existed from 1969 to 1972, displayed the most advanced East German computers in a gallery-like hallway, and represented the physical embodiment of Ulbricht and Mittag's commitment to a new kind of socialist modernity.[47] By the time of the AMLO's founding in 1969, however, the highpoint of East German cybernetics had passed, and its many detractors found increasing support in the likes of SED chief ideologue, Kurt Hager, and the ascendent Erich Honecker.

[45] Karl Wustneck, "Der Kybernetische Charakter Des Neuen Ökonomischen Systems und die Modellstruktur der Perspektivplanung als Zielstrebiger, Kybernetischer Prozess," *Deutsche Zeitschrift Für Philosophie* 13, no. 1 (January 1, 1965): 5.
[46] Sukrow, "Networks: On the Utopian Qualities of Technology, Cybernetics, and Participation in the GDR of the Late 1960s," 103.
[47] Ibid., 105.

Figure 1. The façade of Richard Paulick's AMLO in Berlin Wuhlheide. The building was opened to much fanfare in 1969 but shuttered only three years later.

Philosophical objections to cybernetics had existed since early in the decade and the historian of philosophy Hermann Ley proved one of cybernetics most effective critics in the GDR. Ley's 1961 book *Dämon Technik?* refused to accept that cybernetics could be purged of its capitalist roots and took especial issue with the possibility that cybernetics would lead to a convergence between capitalism and socialism. [48] The notion of convergence theory proposed that capitalism and socialism shared a common teleology and would therefore converge, as each system assimilated the beneficial aspects from each other.[49] In his refutation of cybernetics, Ley rejected cybernetic reductionism that permitted claims about socialist and capitalist convergence: "From the theoretical basis of a highly developed discipline in natural science he [Norbert Wiener] attempts to analyze all problems on heaven and earth and is afraid of absolutely nothing. The identity of schemata interests him because it occurs in information technology. […] He transfers this way of looking at things to calculating machines and to man. Man is naturally neither a schema nor a shadow but is made of flesh and blood."[50] Like earlier socialist refutations of cybernetics,

[48] Hermann Ley, *Dämon Technik?* (Berlin: VEB Deutsche Verlag der Wissenschaften, 1961).
[49] Jenny Andersson, *The Future of the World: Futurology, Futurists, and the Struggle for the Post Cold War Imagination* (Oxford: Oxford University Press, 2018), 123
[50] Herman Ley, *Dämon Technik?*, 69 as translated in Michael Csizmas, "Cybernetics, Marxism, Jurisprudence," trans. Patrick McNally, *Studies in Soviet Thought* 11, no. 2 (1971): 96.

Ley held that the primacy of human beings in socialism precluded the possibility for convergence with a system that viewed humans and machines as coequal.

While Klaus and his followers rejected the convergent implications of cybernetics, the discipline's Western origins and its fraught philosophical relationship with Marxist-Leninist orthodoxy became ammunition for a faction of the Politburo that opposed Ulbricht and Mittag's commitment to technocracy and scientific-technical revolution. The reforms of the New Economic System, the emergence of cybernetics, and an increasingly influential set of technocrats within the planning apparatus threatened the traditional power structures within the SED. The works of Thomas Baylis and Peter Ludz on the East German intelligentsia have observed that members of the technical intelligentsia gained increased prominence in the corridors of SED power during the 1960s, and an extensive CIA report from 1970 offers further evidence that certain factions of SED leadership had come to view cybernetics as a pernicious force that could undermine their political status.[51] The secret report from the CIA's Special Research Staff, entitled "The Prussian Heresy: Ulbricht's Evolving System," viewed the GDR as a "pacesetter for the [communist] bloc in matters of scientific leadership" and argued that a possible conflict between scientists and political leadership could erupt during the period of so-called "cybernetic revisionism."[52] The CIA report posited that Ulbricht's cybernetic revisionism was characterized by four distinct elements: 1) an expanded role for technocrats rather party traditionalists, 2) the division of the economy into self-regulating units, 3) a limited acceptance of convergence theory, 4) an implicit revision of certain aspect of Marxist-Leninist economic planning. These four elements certainly represented a

[51] See Peter Ludz, *Parteielite im Wandel. Funktionsaufbau, Sozialstruktur und Ideologie der SED-Führung. Eine Empirisch-Systematische Untersuchung* (Cologne: Westdeutscher Verlag, 1968) and Baylis, *The Technical Intelligentsia and the East German Elite*.
[52] John Kerry King, "The Prussian Heresy: Ulbricht's Evolving System" (CIA Directorate of Intelligence, June 29, 1970), https://www.cia.gov/readingroom/docs/esau-45.pdf.

significant departure from earlier socialist reforms, and the report acknowledged that Soviet resistance or internal resistance from party hardliners would possibly slow Ulbricht's vision for cybernetic transformation.

The CIA's prediction that cybernetics would meet serious political headwinds in the GDR proved accurate, as chief ideologue Kurt Hager and Erich Honecker began to voice their opposition to cybernetics in increasingly public venues in the early 1970s. The traditional reading of cybernetics' demise in the GDR has linked the end of cybernetics with the clampdown on dissent in 1968 and the resulting rejection of economic reforms like the NES and its successor programs.[53] While the events of 1968 certainly contributed to cybernetics' fall from political favor, there is ample evidence that the reforms of 1968 were not the proximate cause of cybernetics' demise. The CIA report from 1970 acknowledged that cybernetics had begun to reemerge after a "temporary postponement" in 1968.[54] As further evidence, the Academy of Marxist-Leninist Organization, which represented a serious effort to advance practical cybernetics, came into existence only after the upheavals of 1968.[55] Advocates of cybernetics also continued to write after 1968 and published extensively in *Einheit* and the *German Journal of Philosophy* well into the 1970s. Even within the Politburo, interest in cybernetics hardly disappeared, and in 1969, Mittag chaired a conference on complex automation in preparation for the GDR's twentieth anniversary.[56] While the lockdown on political dissent of 1968 spelled the end of the New Economic System, broader attempts to modernize East German society through cybernetics and automation were only temporarily paused.

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[53] Baker, "Red Helmsman: Cybernetics, Economics, and Philosophy in the German Democratic Republic," Dittmann, "Kybernetik in der DDR - Eine Einstimmung."
[54] Kerry King, "The Prussian Heresy: Ulbricht's Evolving System."
[55] Sukrow, "Networks: On the Utopian Qualities of Technology, Cybernetics, and Participation n the GDR of the Late 1960s."
[56] "Information für das Politbüro" (Zentralkomittee der SED, January 28, 1969), DY 30/49943, SAPMO-Bundesarchiv.

1968 may not have killed the East German cybernetic project, but Kurt Hager and Erich Honecker's increasingly oppositional stance began to recast the discipline as an ideological threat to Marxist-Leninism. Kurt Hager, whose position as chief ideologue of the SED granted him enormous power to set the terms of political discourse, was widely viewed as a check on Ulbricht's reformist impulses throughout the 1960s.[57] While Hager certainly represented a traditional faction of party hardliners within the SED, he did not explicitly denounce cybernetics until late in the decade, and in the view of CIA analysts, Hager harbored ambivalence towards the cybernetic project.[58] Hager's ambivalence was made clear when he spoke on the topic of "Fundamental Questions of Intellectual Life" at the annual conference of the Central Committee of the SED. In his speech, Hager firmly acknowledged that cybernetics could never replace dialectical materialism, but he posited that Marxist-Leninism could appropriate new technological advances, like cybernetics:

> The objective requirements of our social development demand new scientific thought. We must therefore acknowledge the new methods, including the science of logic, cybernetics, system theory, operations research, etc. and make use of them more than we have previously […] The scientific insights of cybernetics, system theory, operations research, etc. are compatible with the fundamental principles of dialectical materialism. They are not, however, identical to the Marxist-Leninist worldview and cannot replace the tasks of [Marxist-Leninism]. This must be stated without equivocation. The specific duty of scientific Marxist-Leninist worldviews cannot be displaced by any other science.[59]

While Hager clearly affirmed the primacy of Marxist-Leninism vis-à-vis cybernetics, his speech highlighted a continued openness to cybernetic contributions. Hager's ambivalence towards the topic highlights a unique challenge that cybernetics posed to SED leadership. The promise of

[57] Kerry King, "The Prussian Heresy: Ulbricht's Evolving System," 10.
[58] Ibid., 13
[59] Kurt Hager, "Grundfragen des geistigen Lebens im Sozialismus," *Berliner Zeitung*, April 30, 1969, 118 edition, 4.

cybernetics prevented Hager from rejecting it out-of-hand, but by 1969, the discipline's ideological unpalatability required stronger language from the chief ideologue.

When Erich Honecker replaced an aging Walter Ulbricht with a promise to improve living standards and provide material comforts comparable to those in the West, cybernetics came under increasing attack. Under Honecker, Hager took a stronger stance in a 1971 *Einheit* article in which he argued that cybernetics and information technology deny the worth of socialist factory workers, and he warned that the "language of a science must not become the language of the party."[60] Despite the turn against cybernetics from SED leadership, Klaus continued to publish, but his writing from the early 1970s was marked by an increasingly defensive stance. His 1970 essay, "Cybernetics and Ideological Class Conflict", for instance, placed great emphasis on the emancipatory qualities of cybernetics for the working class, arguing that "cybernetics can be a weapon in the hand of the victorious revolutionary working class."[61] Klaus's language also suggests that he intended to rebut specific arguments advanced by Kurt Hager. In the same essay, Klaus repeatedly used the German verb *ersetzen* – displace or replace – a verb used in Hager's critique, but he claimed that cybernetics could not and would not displace dialectical materialism as Hager feared.[62] Unfortunately for Klaus, Hager was not his only opponent. In the early 1970s, anti-cybernetic sentiment began to appear in other segments of East German society, most notably the world of letters, where the famed writer Christa Wolf, portrayed a cybernetic dystopia in her 1970 short story, "Neue Lebensansichten eines Katers."[63] As the literary scholar, Marcus

[60] Hager, "Die Entwickelte Sozialistische Gesellschaft", 315.
[61] Klaus, "Kybernetik Und Ideologischer Klassenkampf," 1180.
[62] Ibid., 1182.
[63] Christa Wolf, *Neue Lebensansichten Eines Katers / Juninachmittag* (Stuttgart: Philipp Reclam Jun Verlag, 1981).

Twellman has observed, Wolf's story represented a rejection of technocracy which exhibited parallels to West German anti-technocratic arguments from the period.[64]

The growing momentum against cybernetics on the political and literary front culminated in Erich Honecker's pronouncement at the VIII Party Congress in 1971 that "cybernetics is now understood to be a pseudoscience".[65] As Honecker consolidated political control around a new vision of East German society that prized consumer goods over technological investment, cybernetics was dealt what appeared to be a death blow by the new SED chief. While Georg Klaus was never punished for his work during the anti-cybernetic backlash, his death in 1974, hastened the discipline's departure from mainstream academic circles in the GDR.[66] Cybernetics was never an obvious compliment to the GDR's Marxist-Leninist orthodoxy, but during Ulbricht's ambitious period of reform in the 1960s, Norbert Wiener's new discipline achieved considerable standing in the East German philosophical community. Although cybernetics received sustained attention during the highpoint of East German modernity, its practical applications to industrial automation and economic planning were limited. While reformists, like Mittag and Apel, led consultations on industrial automation and rationalization of economic planning through cybernetic means, the GDR's relative backwardness in computer hardware prevented any meaningful deployment of cybernetic technology during the 1960s.[67] Unlike the Soviet Union where ambitious, often unrealistic cybernetic systems, were studied within government laboratories, the GDR remained focused on the philosophical challenges of cybernetic socialism in the absence of practical initiatives. Even if the philosophical contributions of East German cybernetic theorists resulted in

[64] Marcus Twellmann, "Kyber-Sozialismus? Zu Christa Wolfs Neuen Lebensansichten Eines Katers," *Deutsche Vierteljahresschrift für Literaturwissenschaft und Geistesgeschichte* 82 (2008): 323.
[65] Segal, "Kybernetik in der DDR – Begegnung Mit Der Marxistischen Ideologie," 64.
[66] Harald Wessel, "Ein Schöpferische Denker im Dienste der Arbeiterklasse," *Neues Deutschland*, August 2, 1974.
[67] The CIA report from 1970 noted that the requisite hardware would not be unavailable in East Germany until 1980 at the earliest; Kerry King, "The Prussian Heresy: Ulbricht's Evolving System," 18.

few concrete implementations during the 1960s, their work laid the theoretical foundations for the industry robot and microelectronic initiative that came to dominate East German technical planning in the late 1970s and 1980s. While the term cybernetics was no longer used, Honecker, Hager, Mittag, and others returned to the promise of automation and information technology during the economic uncertainty of the late 1970s. Honecker may have come to power with a rejection of cybernetics and a turn away from technology, but within a decade, he would revisit technological revolution as a tool for overcoming slow growth, low productivity, and a ballooning foreign debt. As the subsequent section will argue, the turn toward industry robots and microelectronics in the late 1970s represented an afterlife for East German cybernetics with increased industrial applications. The story of East German cybernetics did not die under Honecker. It entered a period of dormancy before it was resurrected in a new and practically focused form, which drew implicitly on the cybernetic model propounded in the 1960s.

A Cybernetic Afterlife: Industry Robots and Microelectronics in the Honecker Era

By the late 1970s, the East German economy was facing serious headwinds. For Honecker and leading East German officials, the solution to economic stagnation and capitalist aggression lay in technological advancement that promised to liberate workers from thankless toil, improve the competitiveness of East German exports, and dramatically increase productivity. While the term cybernetics was not rehabilitated, the push for industry robots and microelectronics represented a new incarnation of the cybernetic revisionism that had prevailed under Ulbricht. As part of a "rationalization push" or *Rationalisierungsschub*, the use of robots across East German manufacturing sectors promised significant relief from the labor shortage and abysmal productivity

growth that had plagued the GDR's centrally planned economy.[68] Although the deployment of industry robots never achieved the unrealistic benchmarks laid out in party directives from the mid-1970s, the attempt to rationalize the economy through robots and microelectronics represented a serious effort to reform the East German economy in line with contemporary economic trends in the capitalist West.

In the historical literature on East German decline during the 1980s, historians like Ralf Ahrens, Rüdiger Hachtmann, and Charles Maier have suggested that ideological inflexibility on the part of SED leaders led to the GDR's economic collapse during the 1980s and its ultimate implosion in 1989.[69] Although the SED certainly demonstrated a pathological unwillingness to change in the later 1980s, the story of industry robots in the earlier part of the decade paints a different picture of the party leadership. Party directives from this period reveal an earnest desire to adapt the East German economy in the image of high-tech capitalist economies, like Japan and the United States, where robotics and industrial automation was more widespread. Interestingly, East German political documents, popular publications, and news coverage frequently cited robotic developments in Japan, the United States, and West Germany. Although East German discussions of capitalist robotic initiatives were always accompanied by ideological critique, technological developments within capitalism provided an important model which the SED sought to emulate. In addition, Honecker's willingness to pursue industry robots and microelectronics represented something of a course-correction after his initial rejection of cybernetics from 1971. The failure of industry robots was not, therefore, a failure of inflexibility or a lack of foresight. It

[68] Ralf Ahrens, „Rationalisierungseuphorie und Innovationsschwäche: Industrieroboter im Werkzeugmaschinenkombinat "Fritz Heckert" um 1980," in T*echnikgeschichte* 79 (2012), 61-77.
[69] Charles S. Maier, *Dissolution* (Princeton, NJ: Princeton University Press, 1997); Rüdiger Hachtmann, "Rationalization, Automation, and Digitalization: Transformations in Work," in *A History Shared and Divided: East and West Germany since the 1970s*, edited by Frank Bosch, 239-92. (New York, Oxford: Berghahn Books, 2018).

was a failure of a technologically underdeveloped regime, whose political dictates demanded autarkic development of advanced robotic and electronic technologies.[70]

The East German experiment with industry robots also functioned as a field for Cold War ideological differentiation. Unlike its capitalist rivals, East German planners carefully coordinated the usage of industry robots and planned to maximize economic effectiveness while also improving living and working conditions. The social consequences of widespread automation never materialized in the GDR, but the push for industrial rationalization and the use of automated labor inspired a range of theoretical texts on the role of robots in a socialist society. East German advocates of industry robots as a *Schlüsseltechnologie* emphasized the fundamental compatibility of automation and socialism. Whereas rent-seeking capitalists deployed robots to exploit the working classes, so it was argued, government control and the wisdom of SED planning would ensure that the fruits of economic output would be enjoyed by the whole populace. Concepts like technological unemployment or robot apocalypse which bedeviled discourses around automation in the United States and West Germany, were absent from the works of East German theorists.

In a state like East Germany where the job guarantee was a constitutionally protected right, robots could never threaten to displace workers; workers would simply be moved to more fulfilling and meaningful work through the planning apparatus. For East German politicians and ideologues, the deployment of industry robots became a defining feature of egalitarian socialist progress, which placed considerations about work and well-being above profits. The SED may have hoped to emulate the technological advances of the United States and Japan during this period, but East German ideologues never missed an opportunity to trumpet the superiority of socialist robots over

[70] Gary Geipel, "Politics and Computers in the Honecker Era," in *Science under Socialism: East Germany in Comparative Perspective*, ed. Kristie Macrakis and Dieter Hoffmann (Cambridge, Mass.: Harvard University Press, 1999), 240.

their capitalist counterparts. In contrast to the 1960s, socialist writing about IR in the 1980s lacked the philosophical nuance which characterized earlier investigations into cybernetics. By the 1980s, a hardened propagandistic model of industry robots prevailed and limited the range of debate as ideologues resorted to common refrains about job guarantees and capitalist exploitation. Unlike the period of cybernetic revision from the 1960s, which emerged in a period of relative security and stability in the GDR, the microelectronic and IR drive from the late 1970s emerged as a solution to a highly unstable economy.[71]

Economic instability helps explain why the program for industry robots and microelectronics became such an important policy and propagandistic goal for the SED leadership from the late 1970s onward. The precarious economic situation arose from a combination of Honecker's overemphasis on consumer goods and external factors, such as unstable energy markets and Western monetary policy. Under Erich Honecker, the so-called "unity of economic and social policy" promised a new era of prosperity in East Germany that would focus more on consumer goods and housing rather than industrial or scientific investment.[72] In practice, this policy reorientation delayed structural economic reforms and diverted funds from basic research to the production and import of expensive consumer goods. The shuttering of the AMLO in 1971 and numerous other research initiatives, for instance, represented a serious break from Ulbricht's program of modernization. Houses and goods had replaced cybernetics and computers. By the end of the decade, however, Honecker's new vision of consumer-friendly socialism had effectively mortgaged the country's future economic competitiveness to satisfy short term consumer

[71] See Reinhold Bauer, "Ölpreiskrisen und Industrieroboter: Die siebziger Jahre als Umbruchphase für die Automobilindustrie in beiden deutschen Staaten" (Göttingen: Vandenhoeck & Ruprecht, 2008); Werner Plumpe and André Steiner, eds., *Der Mythos von der postindustriellen Welt: Wirtschaftlicher Strukturwandel in Deutschland 1960 bis 1990* (Göttingen: Wallstein Verlag GmbH, 2016); Charles S. Maier, *Dissolution* (Princeton: Princeton University Press, 1997).

[72] Dorothee Wierling, "Work, Workers, and Politics in the German Democratic Republic," *International Labor and Working Class History* 50, no. 50 (1996): 46.

demands.[73] The attempt at productivity intensification in the 1970s and early 1980s developed as a response to changing economic and geopolitical conditions which upset Honecker's promise of greater material prosperity.

During Honecker's first years in power, East Germany enjoyed relative economic stability compared to the turmoil which roiled the West following the energy crisis of 1973. States within the COMECON, the economic collective of socialist states led by the Soviet Union, received the majority of their petroleum and natural gas from Soviet fields in Siberia and the oil-rich coasts of the Black Sea. The oil treaty negotiated between the GDR and the Soviet Union guaranteed petroleum imports at a set price for the five-year period from 1970 to 1975. In effect, the Soviet Union was providing East Germany and other COMECON states an oil subsidy by insulating the socialist states from volatile energy markets after the OPEC embargo of 1973.[74] For the GDR, cheap oil was a major boon not only as fuel for East German Trabants and Wartburgs, but also because refined petroleum products were one of the GDR's only competitive economic exports to the West. With artificially low oil prices during the early 1970s, East Germany could sell petroleum distillates to the West, thereby mitigating an otherwise untenable trade deficit with the FRG. This favorable energy arrangement ended in 1975 when the Soviet-GDR oil agreement expired and the Soviet Union increased oil prices by fifty percent.[75] The renegotiation of the five-year oil treaty attempted to claw back the rents the Soviet Union had forsaken when world oil prices were higher during the previous five years. The newly inflated oil price put enormous strain on East Germany's energy sector and its trade balance, but the energy situation only worsened as the decade progressed. When the Soviet Union further decreased oil exports from nineteen to

[73] Maier, *Dissolution*, 60.
[74] Ibid.
[75] Reinhold Bauer, *Ölpreiskrisen und Industrieroboter: Die siebziger Jahre als Umbruchphase für die Automobilindustrie in beiden deutschen Staaten*, (Göttingen: Vandenhoeck & Ruprecht, 2008), 72.

seventeen billion tons in 1980, oil prices stood at ten times their level when Honecker had become SED chairman in 1971.[76]

Volatility in oil prices shook East Germany's economic foundations throughout the 1970s, but an unstable energy sector was only one of many forces that combined to imperil Honecker's vision of socialist material prosperity. The end of the Bretton Woods system in 1973 further weakened the prospects for the GDR's exports as the East German Mark depreciated relative to the dollar and other dollar-correlated currencies in the West.[77] Currency devaluation in addition to the technical difficulties of monetary accounting in East German "valuta marks" decreased the competitiveness of East German exports in Western markets. Honecker had planned to fund his investment in consumer goods through the export of East German automobiles, but the combined effects of oil price shocks and a depreciated GDR mark all but killed his plan for export-driven economic stimulus.[78]

A further structural issue, which provided impetus for the rationalization drive, was a chronic labor shortage across the East German industrial sector. The loss of three million East Germans to the West before the construction of the Berlin Wall in 1961 had lasting effects on the number and quality of workers available to East German industry.[79] The provision of a work guarantee in the East German constitution also eliminated any prospect of unemployment, but it also eliminated the efficiencies of a competitive labor market. The inability for workers to easily switch jobs or for employers to fire incompetent workers led to serious talent misallocation across East German industry. The resultant labor shortage, a predictable effect of a centrally administered

[76] Maier, *Dissolution*, 60 and Bauer, *Ölpreiskrisen und Industrieroboter*, 77.
[77] Werner Plumpe and André Steiner, eds., *Der Mythos von der postindustriellen Welt: Wirtschaftlicher Strukturwandel in Deutschland 1960 bis 1990* (Göttingen: Wallstein Verlag, 2016), 81.
[78] Bauer, 76.
[79] Mary Fulbrook, *The People's State: East German Society from Hitler to Honecker* (New Haven: Yale University Press, 2005), chapter 2.

labor market, and the attendant inefficiencies in job allocation led to extremely low productivity growth throughout the 1970s. The labor shortage, which Rüdiger Hachtmann has called "invisible unemployment," was the clearest manifestation of the allocation inefficiencies associated with a non-competitive labor market.[80]

As the economic situation deteriorated through the 1970s, efforts like the Schwedter Initiative prefigured the rationalization drive and industry robot deployment which would emerge in the early 1980s. The Schwedter Initiative, an attempt to improve productivity in the petrochemical industries in the late 1970s, aimed to release 3% of the workforce per year through improved use of microelectronics and plant management. Despite the initiative's catchy slogan – "less produces more [Weniger produzieren mehr]" – the plan failed to achieve the ambitious productivity improvements intended within petrochemicals.[81] Unfortunately for the workers in Schwedt, supply constraints in socialist oil markets during the late 1970s hindered meaningful productivity enhancements in the sector. Notwithstanding its nominal failure to achieve the stated productivity gains, the initiative was an important model for industry robots in the 1980s, and as historian Wolfgang Zimmerman has argued, the initiative heighted interest in the application of data processing to different economic sectors.[82] While the forms of data processing and automation were still rudimentary, ever improving computer power gave rise to the idea of S*chlüsseltechnologien* - key technologies - that East German planners believed would help the GDR catch up and overtake its Western competitors.[83]

[80] Hachtmann, *Rationalization, Digitalization, and Automation*, 244.
[81] André Steiner, *Überholen ohne einzuholen: die DDR-Wirtschaft als Fussnote der deutschen Geschichte?*, Forschungen zur DDR-Gesellschaft (Berlin: Ch. Links Verlag, 2006), 199.
[82] Wolfgang Zimmermann, *Die industrielle Arbeitswelt der DDR unter dem Primat der sozialistischen Ideologie* (Münster: LIT, 2002)¸ 155.
[83] Ibid., 126.

The pivot towards industry robots and rationalization in the early 1980s followed a tumultuous decade which challenged the economic principles of both capitalist and socialist systems. This account of the 1970s East German economy largely accords with the works of Konrad Jarausch, Charles Maier, and Erich Hobsbawm who point to 1973 as a crucial turning point when the end of the postwar boom and energy market volatility forced capitalist and socialist regimes to re-engineer their economic systems.[84] Economic historian André Steiner has also suggested that the move away from heavy industry and increased outsourcing of manufacturing to the Far East diminished the long-term prospects of East German manufacturing[85]. Given the export markets within the COMECON which remained open to the GDR even as capitalist countries began to outsource manufacturing to East Asia, it seems implausible that the GDR's inability to transform itself into a post-industrial economy was a proximate cause of its economic collapse.

A bruising decade had forced Honecker to reconsider his stance on technology, and by the Tenth Party Congress in 1981, the SED leader renewed calls for industrial automation: "In this decade, socialist rationalization depends more than ever on a closer relationship with automation."[86] With these words, Erich Honecker set the tone for a new decade of industrial achievement that would place automation at the center of a newly rationalized East German economy. Alongside microelectronics, industry robots headlined the East German effort to improve productivity, increase economic competitiveness, and reduce a perennially increasing trade deficit with the FRG. While the term cybernetics did not appear in official documents from

[84] For an overview of this scholarship, see Konrad Jarausch, "Introduction" in *Der Mythos von der postindustriellen Welt*, 14. See, as well, Charles S. Maier, "Consigning the Twentieth Century to History: Alternative Narratives for the Modern Era," *The American Historical Review* 105, no. 3 (2000): 806-831; Eric J. Hobsbawm, *Age of Extremes*, Reprint. (London: Abacus, 1997), 100-110.
[85] André Steiner, „Eine alte Industrie vor neuen Herausforderungen Aufbrüche und Niedergänge im ost- und westdeutschen Maschinenbau seit den 1960er Jahren" in *Der Mythos von der postindustriellen Welt*, 17.
[86]Erich Honecker, *Bericht des Zentralkomitees der Sozialistischen Einheitspartei Deutschlands an den X. Parteitag der SED* (Berlin: Dietz Verlag, 1981), 55.

the period, the focus on industry robots and microelectronic shared fundamental similarities with its parallel from the 1960s. Party ideologues frequently recycled arguments about automation's ultimate compatibility with automation, but by the 1980s, the push for industry robots was not exclusively a theoretical matter.

The initial goal of deploying 9,000 functioning robots by 1985 was revised upward to an impressive 45,000 a mere two years after the plan was decided.[87] According to the plan, each robot would release 2.5 workers and allow these "liberated" workers to pursue other more productive occupations.[88] Despite its ambition and a considerable amount of party support, the dramatic plan to overhaul the East German economy never achieved its stated aims. Because of serious deficits in robotics knowledge and a paucity of economically viable industrial applications, officials at East German manufacturing plants resorted to rewriting the definition of robots to achieve their overly ambitious targets.[89] Through rewriting definitions and classifying simple manufacturing devices as robots, the goal of 45,000 was ultimately achieved on paper, but the impact of such an impressive number was not reflected in terms of real economic output.[90]

The first industry robots in the GDR were deployed in the manufacture of automobiles in 1976 as part of an effort to build an export worthy East German car by 1984.[91] These early efforts, however, were extremely limited due to the primitive flexibility of robotic arms and the inability for robots to perform multiple tasks. According to an official report that was circulated to SED

[87] Klaus Krakat, "Rationalisierungsschub in der DDR, aber: Einsatz von Robbies nicht effektiv genug," March 18, 1983, https://www.computerwoche.de/a/einsatz-von-robbies-nicht-effektiv-genug,1178007.
[88] Michael Schoeneich, "Robotertechnik in Der DDR von 1980 Bis 1990 - Robotertechnik in der Deutschen Demokratischen Republik am Beispiel des VEB Sachsenring Zwickau," 2012, https://www.gtg.tu-berlin.de/ws/index.php/tagungen/rueckblick-wissenschaftliche-jahrestagungen/134-2009-geschichte-n-der-robotik-offenbach-am-main/501-michael-schoeneich-robotertechnik-in-der-ddr-von-1980-bis-1990.
[89] Zimmermann, *Die Industrielle Arbeitswelt*, 155.
[90] Ibid.
[91] Bauer, *Ölpreiskrisen und Industrieroboter*, 76.

leadership, only 150 industry robots were in active use across the entire economy by 1979.[92] The lackluster numbers did not hinder the propaganda apparatus, however, as industry robots began to receive increasing coverage in SED-controlled media outlets. In March of 1975, a brief article on a Japanese robot described a device with "two arms…whose hands, however, only have two fingers, but nonetheless can lift various objects and apply differential pressures."[93] The brief report went on to note one of the robot's most valuable potential uses: "The robot can be used for the repair and cleaning of nuclear reactors or for other tasks dangerous to humans." Despite its brevity, this report on Japanese robotics highlights two important themes which appeared frequently in later literature on the subject. First, Japan was invoked as a model of industrial innovation in robotics and as an example of impressive industrial development. Although articles about robotics in the Soviet Union and other Soviet Bloc countries did appear from this period, Japan was the prime example of robotics innovation. This is particularly noteworthy, not only because Japan did not share East Germany's economic or political system, but also because Japan represented a model of economic progress through technical innovation. A recurrent theme in later writing about industry robots was the potential for technological progress to overcome other structural disadvantages in the East German economy. Japan, a nation similarly decimated by the Second World War, proved an unlikely, but important reference point for trajectories of economic development for East Germany.[94]

A second conclusion from the 1975 article was the potential use-case for robots. Robots were viewed as critical to improving productivity, but they were also seen as an important means to improve the conditions of work. The Japanese example referred to "work dangerous for

[92] "Stand der Vorlaufforschung auf dem Gebiet Industrieroboter an der AdW der DDR" (Berlin: Zentralinstitut fur Kybernetik und Informationsprozesse, June 7, 1981), DY 30/27230, SAPMO-Bundesarchiv.
[93] "Industrieroboter," *Neues Deutschland*, 22 March 1975.
[94] Irene Fischer and Karl Hartmann, *Industrieroboter im Sozialismus* (Dietz, 1983), chapters 1 and 2.

humans" and the safety benefits of automation became an important propagandistic trope in East German writing. In 1979, the year when SED leadership decided to attach serious importance to industry robots, another article appeared in *Neues Deutschland* on the relationship between robots and working conditions. The article, entitled *Perspectives on Industry Robots*, detailed automation efforts at the *Kombinat "7 Oktober"* in Berlin and considered the ultimate goal of automation:

> In the future, many of these so-called "finishing processes" will be completed by insertion devices or … industry robots. This will take place gradually and in full accordance with the opportunities of the People's Economy [*Volkswirtschaft*]. There [*in the Kombinat*] was begun the process that will necessarily release man from difficult, monotonous, and dangerous work."[95]

While Georg Klaus was not explicitly cited in the quotation above, his arguments about "schematic" labor and the redefinition of socialist work from the 1960s are a clear influence. Klaus focused primarily on cybernetics in his own works, but the same arguments about improved working conditions were equally applicable to cybernetics' close cousin, industrial automation. His work from the 1960s helped provide an appropriate socialist framing which permitted widespread public engagement with industrial automation that emerged after his death. Even if Klaus' contributions were not mentioned directly, his theoretical contributions provided fertile soil for extensive automation propaganda by the 1980s, which prompted one journalist to remark: "hardly a day goes by in which the media of our republic does not report on the deployment of industry robots.[96]

But small-scale implementation of industry robots in automobile manufacturing and at the *Kombinat "7. Oktober"* were only prelude to the major rationalization drive articulated in the Five-Year Plan for 1981-1985. Following the eleventh convention of the *Zentralkomittee* in 1979, the

[95] "Perspektiven für Industrieroboter," *Neues Deutschland,* March 10, 1979.
[96] Matthias Schlegel, "Utopische 'Wesen aus Stahl' Bleiben Vorerst Literatur," *Neues Deutschland,* September 5, 1979.

SED issued a directive for the deployment of 9,000 functioning robots by 1985.[97] In his report on the Tenth Party Day of the SED from April 1981, Erich Honecker justified this major intensification in the push for industry robots by citing several key areas for economic improvement for the ensuing five years: "Our economic strategy for the 1980s aims to meaningfully increase work productivity. This is about achieving higher levels [of productivity] across the board. In certain sectors, we will make productivity gains through rationalization. The saving of jobs must be made possible in order to allow our workers to take on other roles. Work is the source of societal wealth." [98]

Honecker's message and other reports from the tenth *Parteitag* also underscored another important facet of the rationalization drive from this period: improved labor allocation. For economic planners in the SED, the prospect of widespread automation through industry robots was viewed as a key mechanism for better matching workers to their work. With the guarantee of full employment, no workers in the GDR would lose their jobs through automation, but instead, workers would be "set free" to engage in more productive economic activities. In the official party directives from the tenth *Parteitag*, Willi Stoph expressed the importance of liberating workers in striking language:

> A central question consists in the sparing of workplaces and the acquisition of new work forces for the implementation of new production capacities and the elevation of shift work. There is no other alternative than setting workers free in previously unknown numbers through socialist rationalization.[99]

For SED leadership, the imperative of releasing workers to achieve new levels of output was characterized in almost dire terms: there was no alternative. As the above quotation demonstrates,

[97] Willi Stoph, *Direktive des X. Parteitages der SED zum Fünfjahrplan für die Entwicklung der Volkswirtschaft der DDR in den Jahren 1981 bis 1985* (Berlin: Dietz, 1981), 105.
[98] Erich Honecker, *Bericht des Zentralkomitees*, 52.
[99] Stoph, *Direktive des X. Parteitages*, 11.

the term rationalization had come to encompass a wide range of new technologies which earlier had been called cybernetics. After cybernetics' demise in the early 1970s, the more neutral term rationalization had subsumed many of the ideas of feedback and self-regulation which had their roots in Wiener's work.

Honecker's renewed emphasis on technological innovation after his dismissal of cybernetics in 1971 represented an important, albeit doomed, attempt to correct the GDR's economic trajectory. The ambivalence that party leaders like Kurt Hager exhibited in earlier writings on cybernetics had given way to a new techno-optimism after the economic convulsions of the late 1970s. In a surprising turn-of-events, chief ideologue Hager would prove to be an important instigator for the industry robot initiative in the 1980s. As the prior section noted, Hager always hedged his criticisms of cybernetics by arguing that the technological insights of the discipline were necessary even if its ideological implications were problematic. By 1981, Hager directly petitioned Honecker to increase investment in the industry robot initiative. In a private message addressed to "Dear Erich", Hager wrote:

> On the basis of the attached report [on Industry Robots], we should discuss together with Comrade Mittag the research program, and the need, in my view, to increase the number of participating scientists […] In accordance with the decision of the Politburo on the economic improvements through the deployment of industry robots, a modular system, higher reliability through simplicity, and the transition from single-functions to multi-modal uses in the automated manufacturing sectors will become increasingly important.[100]

Interestingly, the report on industry robots, which Hager referenced in the above quotation, was produced by the Central Institute for Cybernetics and Information Processing within the Academy of Sciences, the successor organization to Klaus's commission on cybernetics. While the public-facing documents about industry robots and microelectronics never mentioned cybernetics,

[100] Kurt Hager, "Zentralkomitee Hausmitteilung," Hausmitteilung, 7 1981, DY 30/27230, SAPMO-Bundesarchiv.

internal deliberations within the highest echelons of power built on the ideological and institutional foundations laid during the period of cybernetic enthusiasm in the 1960s

Even if SED leadership began the 1980s with a bullish outlook on robots and a renewed commitment to technology, the reality of implementing such a dramatic economic reconfiguration quickly revealed itself to be technically unattainable. From the very outset, the overly ambitious production targets set in the 1980-1985 plan generated concerned reports about the feasibility of attaining the revised goal of 45,000 robots. In May of 1981, Günter Mittag received a report that the number of deployed robots did not "correspond" to the goals set forth in the tenth party day.[101] In addition to recommending increased research investment in the sector, the report noted a need for greater collaboration with the Soviet Union to meet their ambitious production targets. Perhaps surprisingly, Soviet contributions to East German automation were relatively limited. As the historian Gary Geipel has noted, the GDR pursued a largely autarkic program of IT development favoring East German-made chips over their Soviet counterparts.[102] The strategic importance of microelectronic and automation technologies caused SED leadership to focus on homemade technologies rather than relying on any external partner. In complex engineering fields like microelectronics, the GDR's autarkic program would require massive investment and fundamental research, which ultimately crippled the effort.

As the report to Mittag highlighted, however, scientists within the GDR recognized the practical necessity of cooperation with other states: "Deepening the collaboration with the Soviet Union and other socialist states is of particular importance for economically effective uses of

[101] "Bericht und Festlegungenn zum Ökonomisch Effektivsten Einsatz von Robotern bei der Vorbereitung und Durchfuhrüng von Investitionsvorhaben" (Berlin, Mai 1981), DY 30/70657, SAPMO-Bundesarchiv.
[102] Gary Geipel, "Politics and Computers in the Honecker Era," 240

robotics technology."[103] Although an agreement between the Soviet Union and GDR to foster technological collaboration was struck in 1982, there is little evidence to suggest that the agreement led to meaningful practical improvements within East Germany.[104] As the previous chapter has highlighted, the Soviet Union chronically overpromised and underdelivered on the production of computer hardware. The Soviet Union's inability to reliably supply its satellite states with computers, which was typified by the enormous failure of the *Ryad* series, led to a lack of trust between SED leadership and their Soviet counterparts on the technological front and pushed the GDR towards an unsustainable program of autarkic development. The unfavorable currency situation also made trade with Western technology firms prohibitively expensive, which left the GDR few options other than developing a homegrown tech industry largely from scratch.[105]

By 1983, reports on the progress of IR deployment in the GDR suggested that neither the goal of 9,000, let alone 45,000 robots by 1985 was achievable. A study from the Chamber of Technology in the GDR found that only twenty-five percent of robots in use were economically viable two years into the five-year plan.[106] West German news coverage quickly brought attention to this report and an article by Klaus Krakat appeared in March of 1983 entitled: "Deployment of Bots: Not effective enough." Krakat, who had previously written about robotics deployment for a West German audience, criticized both the implementation and the ambition of the East German robot initiative in light of the economic failures. In his article, Krakat also noted how the East German redefinition of robots in 1981 allowed for more devices to be classified as robots for the purpose of achieving the politically dictated benchmarks: "The challenges with the growing

[103] "Bericht und Festlegungenn zum Ökonomisch Effektivsten Einsatz von Robotern bei der Vorbereitung und Durchfuhrüng von Investitionsvorhaben" (Berlin, Mai 1981), DY 30/70657, SAPMO-Bundesarchiv.
[104] "Abkommen," 1981, DL 2/16850, SAPMO-Bundesarchiv.
[105] Geipel, "Politics and Computers in the Honecker Era," 233.
[106] Krakat, "Rationalisierungsschub in der DDR."

problems of planned production automation has led to the introduction of simple hand-held devices under the name 'industry robots', which, however, are entirely different from the planned technologies".[107]

Despite its limited macroeconomic impact, the industry robot initiative prompted largely positive responses from factory workers according to internal party documents and labor union reports. While these reports must be read with an understanding of socialist discursive practices and censorship in the GDR, many workers pointed to specific examples in which robots had improved their working conditions. Further, the workers also noted challenges that arose in their use of robots, which permit us to read these sources as reasonably candid accounts of the lived experience of working alongside East German robots. In a conference on robotics technology from 1982, factory workers from the Dresden area submitted feedback on their experiences in the workplace. Comrade Horst Lamm, a brigadier in the Riess Pipe Factory, reflected positively on his experience:

> I am responsible for the entire industry robot system, which entails the monitoring of the technological functioning, as well as quality control. Through the introduction of robots, my tasks have been greatly expanded. Through the introduction of robots [sic], three workers have been freed and our productivity has improved 200%. At the same time, the quality of the work has been improved and conditions of work have improved through the removal of smoke nuisances and monotonous, almost stupid use of handling methods. In this way, the quality of my years long work has taken on a completely new character.[109]

Lamm's highly positive description reinforced the party line about robotic enhancements to work safety, but he also spoke frankly about the challenges which accompanied the robotic deployment: "I do not want to hide that during the development and transition phase certain problems arose and

[107] Ibid.
[109] "Protokoll: Konferenz des Bezirkes Dresden zur Robotertechnik" (Dresden, June 23, 1982), DY 30/29153, SAPMO-Bundesarchiv.

doubts were raised about whether we could learn the new technology or whether it would actually prove helpful."[110]

Other accounts from the period which were collected by the East German labor union (FDGB) suggest that workers had concerns about losing their jobs and the challenges of switching to new work. The FDGB was the exclusive trade union in the GDR, and it was an important body for mediating between workers and SED leadership. In this capacity, the FDGB took an interest in the relationship between workers' well-being and the new automation technologies. In 1982, the FDGB's Department for Work Protection undertook a study to assess "if the freed [freigesetz] workers have been sufficiently prepared for the transition for the new positions."[111] The report concluded that few issues around worker displacement or work-place safety had arisen due to robotics' deployment, which is unsurprising given how few useful robots had entered production by 1982. Nonetheless, the report suggests that workers, and their representatives in the labor union, were aware of the potential negative consequences of robotics. Despite assurances that the SED would provide quality, safe, and dependable labor to all citizens, the FDGB still undertook its own investigations to verify the state's claims about technological progress and work security.

Given its ultimate failure to invigorate the East German economy, what then can the industry robot deployment tell us about socialist economic planning in the early 1980s? For one, the focus on industry robots, microelectronics and other so-called S*chlüsseltechnologien* reflected the serious attention that East German planners had given economic and technological developments in the West. Frequent references to American and Japanese robotics initiatives highlighted an openness on the part of SED leadership to capitalist technological developments, which mirrored and expanded upon the cybernetic discourse from the 1960s. Although Hachtmann

[110] Ibid.
[111] FDGB, "Bericht" (Freier Deutscher Gewerkschaftsbund, 1982), DY 34/17563, SAPMO-Bundesarchiv, 1.

and Maier have noted important instances when East German leadership failed to adapt to broader economic and political trends, the push for industry robots uncovers an instance of impressive foresight in GDR economic planning. The turn toward high technology also evidences the willingness of senior SED leaders, like Honecker and Hager, to change course and return to technological developments that had previously been disavowed.

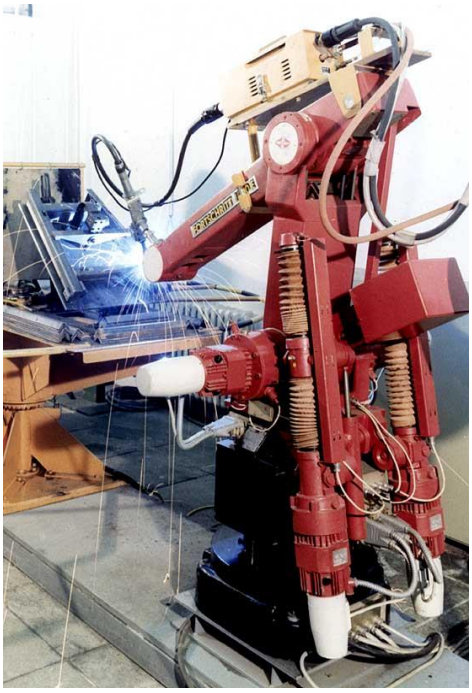

Figure 2. Photos of advanced uses of industry robots rarely corresponded to the actual applications of such devices. By 1983, only a quarter of all robots deployed were economically viable. (Left) A robotic arm, embossed with the word *Fortschritt* or "progress" solders an electronics device.

The industry robot initiative continued until the GDR's ultimate dissolution, and historians Dolores Augustine and Gary Geipel have suggested that an excessive focus on the IT sector helped bankrupt the state and prevent the SED from pursuing more fundamental economic reforms in the late 1980s.[112] While the impulse to reinvigorate the East German economy through high technology represented a forward-thinking program of reform during the 1970s, the poor deployment of actual robotics and microelectronics technology rendered the program a fruitless cost-drain by the end of

[112] Augustine, *Red Prometheus*, 310; Geipel, "Politics and Computers in the Honecker Era," 230.

the decade. In the end, the GDR's inability to transform itself into a highly automated export-driven economy lay in its economic, rather than political, inflexibility. The use of production targets, as opposed to market forces, produced a serious moral hazard within the East German economy, which led to doctored figures about the quantity and efficacy of robots. Notwithstanding the program's ultimate failure, the push for industry robots stimulated a significant body of theoretical work on the relationship between automation and socialism.[113]

"Same technology, two worlds:" The Propaganda Model for Industry Robots in the 1980s

SED ideologues who wrote about industry robots in the 1980s went to great lengths to justify the compatibility of socialism and automation. Unlike the period in which Klaus, Liebscher and others first wrote about cybernetics, the ideological justifications for industry robots had become a practical necessity by the 1980s when robots and microelectronics were appearing in East German factories. The numerous texts on East German IR clearly borrowed from Georg Klaus's work, but they refrained from the more complex philosophical and political-economic problematics which were debated in the 1960s. Ideological justification of industry robots in the 1980s was characterized more by propagandizing than philosophical inquiry. These works, nonetheless, provide insight into the ways that socialist thinkers justified robotics technology and used technology as a platform for Cold War ideological differentiation. For SED ideologues, industry robots served as an important test case to underscore the benefits of socialist planning and highlight the perversity of monopoly capital. For the East German leadership, the stakes of economic rationalization through industry robots and microelectronics could not have been higher: the success of the socialist project hung in the balance.

[113] Photos from "Industrierobotersteuerungen und Industrieroboter," Die Geschichte der Computertechnik der DDR, https://www.robotrontechnik.de/index.htm?/html/computer/industrieroboter.htm.

Discourse on automation in the GDR was premised on the assumption that robotization and socialism were fundamentally compatible and mutually re-enforcing forces. In this context, something as disruptive and transformative as automation, a topic which generated serious anxiety in the capitalist West, was treated as a desirable and necessary feature of socialist progression. In the pages of *Neues Deutschland*, East Germans were told to welcome automation because it would improve the conditions and nature of work: "The deployment of industry robots will have a considerable influence on productivity, but above all else, the quality of work."[114] Beyond the praise of robots in widely consumed newsprint, SED theorists were exploring the more theoretical implications of industrial-scale automation. In a 1984 edition of *Einheit*, members of the East German intelligentsia justified the push for automation by describing the salutatory benefits of greater automation: "With modern technologies we hope to achieve work that, through greater productivity, will be more content-rich, that will diminish physically taxing labor, and will improve work hygiene."[115] The long-standing argument about improved working conditions, which had been elaborated two decades prior, would become a common refrain in 1980s industry robot propaganda.

Although automated work promised fewer physical dangers, East German intelligentsia were careful not to demean the importance of factory work, the kind of labor upon which the economic and political legitimacy of the SED rested. In an article entitled "Scientific-Technical Progress and the Content of Work," the Dresden-based academic Adolph Bauer wrote:

> The effects of scientific-technical progress on the content of work will result in the fact that, in the process of partial automation and [full] automation, increasingly intellectually demanding work functions will replace energetically-taxing work […] From this, however, it must not be concluded that physical work loses meaning or is lacking a position. Quite the contrary! […] it must be understood that […]

[114] "Perspektiven fur Industrieroboter."
[115] Herbert Weiz, "Technologie in Unserer Technologischen Strategie," *Einheit* 3, no. 84 (1984): 200.

> certain jobs will still require manual labor and that new requirements for manual labor will develop.[116]

Bauer's view articulated a recurring uneasiness between the economic ambitions of robotization and its impact on the Marxist-Leninist principles which governed East German social organization. Bauer's forceful commitment to "physical" work represented a clean break from Klaus's suggestion that workers and the intelligentsia may merge in a highly automated socialist future. In contrast to Klaus, Bauer declined to hypothesize about a fully automated future, which suggests that a new limit on politically acceptable automation discourse had emerged in the 1980s. Whereas the 1960s witnessed a wider range of philosophical theorizing about work and automation, the industry robot initiative of the 1980s permitted a more limited range of philosophical inquiry.

In the more propagandistic and less philosophical writings about automation in the 1980s, East German politicians and ideologues emphasized the stabilizing effects of automation within socialism.[117] Willi Stoph, who authored the directives from the tenth *Parteitag*, closed the section on industrial rationalization with a rousing reaffirmation of guaranteed employment in the GDR: "It [the job-guarantee] is a fundamental constitutional right and such is the commonplace experience of people in socialism. No capitalist state in this world can guarantee man such a right. The truth of this is evidence in the history of Workers' Movement and the political reality of the present."[118] Stoph's insistence on the importance of the work guarantee in the face of the automation initiatives suggests that the possibility of full automation was hardly realistic in the early 1980s. But in Stoph's statements and in the work of other SED functionaries, a future of complete automation remained an elusive and theoretically intractable hypothetical. The

[116] Adolph Bauer, *Wissenschaftlich-technischer Fortschritt und Inhalt der Arbeit*, 89.
[117] Gruhn, Fischer, and Hartmann only address this potentiality by suggesting that the party will adopt new educational policies to ensure a better trained workforce.
[118] Stoph, *Direktive des X. Parteitages der SED zum Fünfjahrplan für die Entwicklung der Volkswirthschaft der DDR in den Jahren 1981 Bis 1985*, 19.

superficial affirmation of the job-guarantee in the face of a highly automated future was echoed in a range of East German texts which held steadfastly to the simplistic notion that state-led economic planning would accommodate a future characterized by widespread automation.

The focus on working conditions and the possibility that automation would improve the quality of work was manifested in the language used to describe automation's effects. Throughout the East German literature, the verb *freisetzen* or literally "set free" was the chosen term for expressing the labor-saving effects of robots. Whereas American and West German literature on the topic frequently employed terms like "disruption," "displacement, "lay-offs," and "entlassen" to describe the effects of automation, East German texts explicitly emphasized the emancipatory potential of robotization. The liberating capacities of automation reflected the tension between the promise of full-employment and the necessity for improved labor allocation. According to the logic of socialist progress, workers would be "freed up to pursue other activities," but the mechanism to ensure that "other activities" would serve social or economic purposes was never clarified.[119]Although automation and liberation were linguistically conjoined in the East German nomenklatura, the vision of a liberated future remained undefined.

Like other domains of technological competition, automation became a space where Cold War conflicts frequently surfaced. The East German view of automation, a process of liberating, productivity-enhancing rationalization, was frequently contrasted with capitalist visions of automation. SED writing on industry robots invoked competing visions of prosperity and social organization to argue that robots were only problematic within a capitalist system. In their book length treatment of industry robots in socialism, SED ideologues Irene Fischer and Karl Hartmann devoted an entire chapter to a comparison of automation in the capitalist and socialist frameworks.

[119] Krakat, "Einsatz von Robbies"

Their critique of capitalist automation attacked the role of agency within a market-driven economy and led one West German to conclude: "[According to Fischer and Hartmann] man appears [in capitalism] not as a figure, but rather as a dependent victim of a deterministically unfolding process of productive forces."[120]

As the state of the "workers and peasants [Arbeiter-und-Bauern-Staat]", the German Democratic Republic derived its authority from pursuing economic and social policies that maximized welfare for the working class, rather than profit-seeking corporations. Statewide ownership of all assets, including industry robots and microelectronics, would permit the benefits of automation – namely increased output and a decreased working hours – to be experienced by the workers. In the context of industry robots, Fischer and Hartmann argued that the absence of a capitalist superstructure in the GDR would ensure that the benefits of automation would not accrue to exploitative capitalists, but rather to the very workers from whom the SED derived its right to govern. Although Fischer and Hartmann devoted pages to describing technological advances in Japan, the United States, and West Germany, they strongly condemned the capitalist motivation to automate: "As one of the major trends in the scientific-technical revolution, the increased deployment of industry robots is, quite evidently, aimed at the drive for the extraction of maximum profit through capitalist rationalization"[121] In their propagandistic portrayal of the Western capitalism , workers were depicted as a "socially disturbing" force that was neglected by the advance of impersonal capitalist progress.[122]

The critique of capitalist automation initiatives was repeatedly set in contrast to the humanistic goals of socialist rationalization. The conception of automation as a liberating force

[120] Schoeneich, *Roboter im Sozialimus*, 4 .
[121] Fischer and Hartmann, *Industrieroboter*, 75.
[122] Ibid., 74

within a society of full employment placed the well-being of workers at the center of the GDR's socialist teleology. The concept of "same technology, two worlds" expressed the idea shared by Marxist-Leninist theorists that the ultimate consequences of automation lay not in the technology, but in the socio-political context in which it was implemented. Beyond guaranteeing work, the SED also claimed that the quality of labor also represented a distinction between capitalist and socialist systems.[123] In labor policy, the SED promised to place human considerations alongside economic dictates to ensure that the advancement of personal and social well-being progressed alongside economic statistics. Within the propagandistically saturated public sphere of the GDR, East German writers rarely cited their Western counterparts, like Robert Theobald or Daniel Bell, who proposed modifications to capitalism that placed human-considerations at its core. Instead, writers like Hans Kämmerer blasted the moral impoverishment of capitalist automation, and ignored any efforts at reform from within capitalist states:

> Of course, leading capitalist states also are busying themselves with robotics technologies, as well. But there, such technologies do not serve the interests of the working class. Instead, robotics technologies spread fear. Not infrequently are the "fearful prospects of a robot society discussed" in which machines compete with man, gain the upper-hand over man, and ultimately enslave him […] The workers are at the receiving end of the application of private capitalist uses of modern technology and what they perceive is the inhumanity of such a social system, an inhumanity which manifests itself in increasing unemployment.[124]

For Kämmerer, unemployment was the ultimate symptom of an inhumane economic and social system, which subordinated the interests of the workers to those of capital. As seen in the quotations from both Kämmerer and Stoph, such an outcome in East Germany was ruled out because of the constitutional protection against unemployment. The writings of Fischer, Hartman, Kämmerer and others enacted a rigid propagandistic model about industry robots, which shunned

[123] Wierling, "Work, Workers, and Politics in the German Democratic Republic," 47-50.
[124]Hans Kämmerer, "Industrieroboter - Was Sie können und weshalb wir sie brauchen," *Neues Deutschland*, January 24, 1980, 20 edition.

complex philosophical investigation and favored anti-capitalist rhetoric. The censor's report on Fischer and Hartmann's book commended the authors for their service to the socialist automation drive and pushed for the book's quick publication to ensure East German workers would be properly informed about the new technological initiatives: "I recommend this book to be published as quickly as possible. The importance of the book's insights increases with the speed of changes that are already occurring in our factories."[125]

The program of rationalization through industry robots in the German Democratic Republic represented an ambitious attempt to solve the problems of socialism through technological innovation. Despite its ultimate failure to revolutionize the GDR's economy, the East German *Rationalisierungschub* from the early 1980s highlighted an alternative system of economic and technological progress which placed human considerations at the center of political and economic advancement. The SED's espoused humanity stood in stark contrast to the menacing robots of capitalism which threatened to impoverish and displace workers on a grand scale. Nonetheless, innovations in the capitalist world provided an important benchmark for East German planners who envisioned automation as a method of achieving equitable socialist prosperity. The history of the GDR's experiment with economic rationalization through automation offers an important perspective both on Cold War ideological conflicts and on the relationship between technology and its social applications.

In sum, the failed industry robot and microelectronic initiative in the GDR represented a technology program that built on the model of the 1960s but imposed stricter limits on the range of permissible discourse. The model of Klaus's cybernetics reemerged in a new form, as Hager and Honecker returned to technologies they had once dismissed, but the 1980s did not witness a

[125] Ronald Gericke, "Einige Bemerkungen zur vorgesehenen Publikation von Fischer/Hartmann" (Dietz Verlag, March 29, 1982), DY 30/20386, SAPMO-Bundesarchiv.

second highpoint of socialist modernism. Despite the technological advances of two decades, the planning apparatus in the GDR failed to acknowledge the technical limitations inherent in the GDR's autarkic drive to develop IT technologies without foreign aid. The flourishing of cybernetic technologies, which Klaus had eagerly championed two decades earlier, did not arrive in the form Klaus had imagined. It arrived within a confined propagandistic framework bereft of the challenging intellectual inquiry that had characterized Ulbricht's last decade in power.

Conclusion

How then should we understand the GDR's history of cybernetics and automation in the context of the three other states considered in this study? Like its counterpart across the Berlin Wall, the GDR offered few meaningful technical contributions to the fields of cybernetics and automation during the 1950s and 1960s. The relative lack of computing infrastructure and software products compared to the United States rendered practical implementation of serious cybernetic systems impracticable during the 1960s. As the second chapter has demonstrated, West Germany did not let a lack of infrastructure impede the development of a technically oriented school of art and art criticism which borrowed ideas from cybernetics and early computing technologies. In a similar, but philosophical vein, East German writers, like Georg Klaus and his students, investigated how cybernetics could be harmonized with the prescriptions of state socialism and the laws of dialectical materialism. In a way, Klaus' project represented a form of creative work that developed new historical and philosophical perspective to justify cybernetic technologies within a postwar socialist Germany. The parallels between Information Aesthetics and socialist cybernetics should not be overemphasized, but it is worth recalling that Klaus was a student of Bense and while separated by ideological and physical barriers, both succeeded in advancing different versions of cybernetic inquiry within their respective geopolitical contexts.

In relation to the Soviet Union, the GDR followed the lead of Russian and other Socialist Bloc thinkers who rehabilitated cybernetics in the late 1950s, but the Klaus school established a uniquely East German voice from the early 1960s. Foundational socialist texts in the Soviet Union, such as the *Fundamentals of Marxism-Leninism*, certainly engaged with automated communist futurities, but in many ways, East German writers were more radical in their reinterpretation of Marx. While the likes of Erich Honecker and Kurt Hager ultimately rejected the primacy Klaus accorded cybernetics, the GDR witnessed a more philosophically daring engagement with ideas around automation and socialist labor. The range of philosophical discourse around cybernetics during the 1960s provides further evidence for the notion of high socialist modernity which flourished, albeit briefly, under Ulbricht and Mittag. Klaus's ambitious program of socialist cybernetics paired with Mittag's economic reforms welcomes some historical speculation about an alternative economic trajectory for the GDR had Ulbricht retained power and had the push for socialist modernization resumed after 1968.

Even if Ulbricht and Mittag's vision had been pushed through during the early 1970s, there were many barriers that could still could have impeded a successful modernization campaign. As noted in the previous chapter, the very year in which Ulbricht was deposed, the Soviet Union displayed the *Ryad* computers in what was seen as a massive failure in hardware development. Any serious cybernetic initiative would have required far greater advancements in computing that were not available even by the 1980s when the failed industry robot initiative was undertaken. There is, however, reason to speculate more optimistically about the success of cybernetics within the planning apparatus. It is reasonable to conjecture that industry-specific planning technologies which relied on cybernetic feedback could have brought reasonable productivity enhancements if the scope of such projects was highly focused. Limitations in computing power and

communication infrastructure stood in the way of Glushkov's networked planning apparatus in the Soviet Union, but a cybernetic New Economic System in which different sectors managed their own production requirements with feedback systems could, perhaps, have achieved productivity enhancements with then-available technology. Cybernetic socialism must remain in the realm of historical fiction, but the subsequent advance of computing technologies in the early twenty-first century could certainly provide fictions writers with some entertaining material.

In many ways, the East German cybernetic debates were most similar to those seen in the United States during the 1960s. While East German writers could never question the very foundations of socialism as Robert Theobald and other American cybernation theorists had done in the capitalist context, both American and East German writers probed the edges of their respective ideological frameworks in an effort to accommodate cybernetic insights. Klaus and Theobald each took radical stances and used automation and cybernetics as a tool for imagining a different economic future in their respective countries. Both placed human well-being at the center of their philosophical approaches and while their language differed according to the rhetorical norms of socialist East Germany and the capitalist United States, they viewed automation as a tool for overcoming endemic challenges within the postwar economic order. Klaus was a committed communist, and Theobald a left leaning liberal futurist, but they shared a vision for an automated future that never came to pass in their own lifetimes. By the second decade of the twenty-first century, that imagined future – whether welcome or not – appears to have arrived.

Epilogue

A Cybernetic Legacy or a Cybernetic Present?

From the eschatological predictions of American forecasters to the utopian visions of an automated Soviet Union, cybernetics took on many meanings throughout the Cold War. But in all cases, cybernetics held great promise as a tool for revolutionizing economic production and distribution. That promise, however, was never realized. Massive technological unemployment did not destroy the foundations of capitalism in the liberal West and networked planning systems never achieved the desired productivity gains in the socialist East. What then is the legacy of cybernetics, if its economic and technical promise was never realized?

This concluding chapter will offer some reflections on the cybernetic legacy and challenge the traditional understanding that cybernetics represented a turning point that never turned. The study of cybernetics within universities certainly faded in the final decades of the twentieth century as the discipline splintered into subfields within biology, computer science, and systems theory, but the social and economic questions which cybernetic inquiry inspired have only grown in importance. Since the IT revolution of the 1990s, concerns about technological unemployment, the nature of work, and the role of human labor in a digital society have resurfaced. From a technical standpoint, many of the predicted applications of cybernetic technologies, such as fully automated factories, human-machine interfaces, and large-scale computational networks are being realized in the second decade of the twenty-first century. These developments make the works of Theobald, Michael, Glushkov, Klaus and others only more relevant even if the timeline of their predictions was inaccurate. As we step into an ever more cybernated age, the cybernetic legacy is still being written.

As an academic discipline, cybernetics reached its global highpoint in the 1960s. In the United States, academic work from Wiener and the publications from the Macy Conferences had laid a strong theoretical foundation during the 1950s and by the 1960s, the economic and political dimensions of cybernetics had begun to gain in prominence.[1] In the Soviet Union, pioneers like Viktor Glushkov seized upon the discipline's newfound popularity among political elites to undertake ambitious networking projects. And within both Germanys, cybernetics became an important field for design aesthetics in the West and new strands of revisionist Marxist philosophy in the East. In all cases, however, the discipline's popularity began to wane in the face of economic challenges during the 1970s and a trend toward increased specialization within academic institutions.

In each of the four states considered in this study, cybernetic decline derived from distinct reasons, but the overwhelming technical difficulties of implementing automated production systems were the main drivers in the socialist East. As discussed in chapters three and four, political elites had grown increasingly frustrated with the challenges around the development of computer hardware in the Soviet Union, and the failure of the *Ryad* series undermined remaining support for Glushkov's ambitious networking plans by the early 1970s. In the German Democratic Republic, Honecker's rise to power and the newfound focus on improved living standards displaced attempts to modernize socialism through technological innovation during the 1970s. East Germany was the only state in which cybernetics was explicitly rejected by political leadership, when Honecker labeled the discipline a "pseudoscience" in 1971, but, perhaps surprisingly, East Germany also witnessed the most significant resurgent of cybernetic ideas in the form of industry

[1] See Steve Joshua Heims, *Constructing a Social Science for Postwar America: The Cybernetics Group, 1946–1953* (Cambridge: MIT Press, 1993).

robots.[2] Although the term had been disavowed, the cybernetic ideas around automated feedback remained attractive especially in the face of worsening economic and trade conditions in the 1980s.

In the West, cybernetics underwent a gradual decline through the mechanism of academic defunding. Almost contemporaneous to the Macy Conferences in New York City, a smaller academic gathering at Dartmouth College organized by the computer scientist Marvin Minsky, and the founder of information theory Claude Shannon gave birth to the field of artificial intelligence in 1956.[3] Many of the participants in the famous Dartmouth conference had studied cybernetics, and they did not intend to establish a competitor field, but artificial intelligence increased in popularity and funding over subsequent decades, which led to cybernetics' relative decline within university departments.[4] Although AI traces its origins to the 1956 Dartmouth conference, artificial intelligence derived many of its founding principles from cybernetics. The key difference was AI's emphasis on digital information encoding, which did not exist when Wiener first developed the discipline in the 1940s.

Nonetheless, the concept of neural networks, a foundational idea in contemporary machine learning, which has permitted the development superhuman chess and go engines, borrows heavily from cybernetic conceptions of feedback loops across biological and computational substrata.[5] Neural networks are a machine learning architecture in which algorithms are trained on labeled datasets. The training process tunes the parameters of the neural network until the algorithm can generate predictions based on previously unseen inputs. The training loop employed in neural networks is an automated cybernetic process in which the algorithm adapts itself in response to

[2] Segal, "Kybernetik in der DDR – Begegnung mit der marxistischen Ideologie," 64.
[3] Peter Cariani, "On the Importance of Being Emergent. Extended Review of 'Emergence and Embodiment: New Essays on Second-Order Systems Theory'" *Constructivist Foundations* 5, no. 2 (2010): 86–91.
[4] Ibid.
[5] David Silver et al., "Mastering the Game of Go without Human Knowledge," *Nature* 550, no. 7676 (October 2017): 354–59, https://doi.org/10.1038/nature24270.

continuous feedback. As discussed below, much of the fear around future technological unemployment today derives from concerns about the superhuman abilities of neural networks. Interestingly, such worries could be read as an updated form of the cybernation concerns from the 1960s. Whereas cybernation theorists worried about cybernetic feedback loops in automated manufacturing, technological and economic commentators in the early twenty-first century are concerned with a new incarnation of digitally encoded cybernetic technologies, which are now called neural networks. Even the name - neural network - invokes parallels between biological and physical systems which lay at the core of cybernetic thought. Neural networks do not attempt to replicate biological neural structures, but the design of these algorithms takes inspiration from the reprogrammable neural pathways in the human brain.

AI emerged as the more successful academic discipline by the 1990s, but cybernetics did not disappear. Instead, it merged with other academic fields, most prominently biology, where parallels between biological and mechanical feedback loops gave rise to new research into human-machine interfaces.[6] West German academics were some of the earliest to seize upon biological cybernetics, despite their reticence about cybernetic applications to economic and social issues. The West German journal *Kybernetik* published extensively on biological cybernetics throughout the 1960s until it was renamed *Biological Cybernetics* in the 1970s, the name under which it is still published.[7] In the past decade, the echoes of cybernetic research into human-machine interfaces have exploded with the development of so-called "wearables", such as Google Glass and the Apple Watch. The promise of the Apple Watch, for instance, a device which can measure a range of physiological factors and provide personalized health plans, constitutes a cybernetic

[6] Francis Heylighen and Cliff Joslyn, "Cybernetics and Second-Order Cybernetics," in *Encyclopedia of Physical Science and Technology* (Elsevier, 2003), 155, https://doi.org/10.1016/B0-12-227410-5/00161-7.
[7] See chapter two, section "American Science in Post-Fascist Germany."

feedback loop even though the term is no longer employed. More radical still is the speculative research into direct human computer interfaces, which would allow humans to encode their brains digitally and upload themselves onto a permanent storage medium. While hardly mainstream, these ideas are likely to grow in importance given their financial backing from the likes of Elon Musk, who has already founded a company NeuraLink to develop "ultra high bandwidth brain-machine interfaces to connect humans and computers."[8]

The term cybernetics is largely absent from discussions about contemporary high technology, but the obvious parallels between "wearables", human-machine interfaces, and self-regulating systems have begun to receive greater attention in the past five years. A 2019 article in *Nature Machine Intelligence*, entitled "The Return of Cybernetics," acknowledged that the rise of artificial intelligence had sidelined cybernetics for several decades, but that "there is currently a revival of interest in and appreciation for Wiener's ideas, together with a renewed focus on augmentation of human abilities."[9] This renewed focus has also caught the attention of non-scientific writers, who are beginning to recognize the prescience of Wiener's work. In a recent article from the American magazine, *Slate*, the journalist Seth Lloyd asserted: "Nearly 70 years later, however, *The Human Use of Human Beings* [Wiener's 1950 book] has more to teach us humans than it did the first time around. Perhaps the most remarkable feature of the book is that it introduces a large number of topics concerning human/machine interactions that are still of considerable relevance."[10] Wiener certainly had tremendous insight into the future of human-technological interactions, but as this dissertation has shown, the circle of thinkers who

[8] "Approach," Neuralink, accessed October 17, 2021, https://neuralink.com/approach/.
[9] "Return of Cybernetics," *Nature Machine Intelligence* 1, no. 9 (September 2019): 385–385, https://doi.org/10.1038/s42256-019-0100-x.
[10] Seth Lloyd, "What Would the Father of Cybernetics Think About A.I. Today?" *Slate*, February 28, 2019, https://slate.com/technology/2019/02/norbert-wiener-cybernetics-human-use-artificial-intelligence.html.

investigated how technology could remake society extended far beyond Wiener. The likes of Theobald, Michael, and socialist thinkers like Georg Klaus or Ernst Kolman, are almost entirely overlooked in recent work on cybernetic resurgence. These thinkers, however, provided important extensions to Wiener's own work and their focus on the social implications of technological change makes their work equally, if not more, relevant than Wiener's own contributions.

Outside of the realm of artificial intelligence, cybernetics has also reclaimed its importance in the field of design cybernetics. The application of cybernetic principles to design has a rich history, which includes contributions from English designers, such as Gordon Pask in the 1950s and the pioneering work from cybernetic theorists in Ulm and Stuttgart.[11] In its current form, design cybernetics applies the idea of feedback loops to creating useful and aesthetically pleasing objects. As summarized in a 2019 textbook on the subject, "Cybernetics offers an abstract philosophical approach to design as a creative epistemic practice […] a field that gained initial prominence for control engineering has come to offer itself as an approach to the doings of curious, creative, and ethical humans […] Much of the early control engineering terminology turns out to be suitable to describe aspects of processes that are out-of-control: *feedback*, *variety*, *requisite variety*, *constraint*, *error*, and so on."[12] The recognition that cybernetics can influence and enhance creative work lay at the heart of the West German cybernetic art movement and remains a basic tenet in contemporary design cybernetics. Many prominent institutions at the intersection of technology and design, such as the MIT Media Lab, can also trace their roots to cybernetic initiatives and researchers from the 1950s and 1960s. The Media Lab, which is now a leading body for multi-disciplinary research in the United States, was founded in 1985, but built directly on the

[11] Liss C. Werner, "Gordon Pask and the Origins of Design Cybernetics," *Design Cybernetics*, 2019, 65–84, https://doi.org/10.1007/978-3-030-18557-2_3.
[12] Thomas Fischer and Christiane M. Herr, *Design Cybernetics: Navigating the New* (Cham: Springer, 2019), https://ezproxy-prd.bodleian.ox.ac.uk/login?url=https://link.springer.com/10.1007/978-3-030-18557-2.

Architecture Machine Group, led by Nicholas Negroponte and Leon Groisser, who were important cybernetic practitioners in the 1960s.[13]

The appearance of cybernetic ideas across varied disciplines may also help explain why cybernetics receded from mainstream academic circles in the late twentieth-century. The initial ambition of the cybernetic project which aimed to quantify feedback processes across biological and mechanical substrates made the discipline fundamentally interdisciplinary, or even anti-disciplinary. The possibility of a unifying quantitative framework for studying biological systems alongside engineering or economic systems made cybernetics enormously attractive, but also unwieldy. Cybernetics found applications across highly varied fields, but this wide applicability ultimately diluted the central academic core. By the 1970s, cybernetic methods had gained widespread credibility, but the discipline itself held less promise as it became increasingly diffuse.

In hindsight, it appears that the development of second-order cybernetics also helped hasten the discipline's decline in academic importance.[14] In the 1960s, Heinz von Foerster and Margaret Mead, two leading cybernetic practitioners who played an important role in the Macy Conferences, had begun to study how cybernetic systems could themselves be understood through cybernetic methods.[15] The "cybernetics of cybernetics" constituted a new meta-discipline that understood interactions between cybernetic systems as a reflexive form of cybernetic control. Second-order cybernetics, therefore, took particular interest in the relationship between the observer and the observed system. As one text on the subject summarized: "A second-order cyberneticist working with an organism or social system, on the other hand, recognizes that system as an agent in its own

[13] Werner, "Gordon Pask and the Origins of Design Cybernetics."
[14] Peter Mario Asaro, "Whatever Happened to Cybernetics?," in *Geist in Der Maschine: Medien, Prozesse, und Räume in Der Kybernetik*, ed. Günter Friesinger et al. (Wien: Verlag Turia Kant, 2010), 47–48.
[15] See Heinz von Foerster, *The Beginning of Heaven and Earth Has No Name: Seven Days with Second-Order Cybernetics*, First edition., Meaning Systems (New York: Fordham University Press, 2013); Heinz von Foerster, *Understanding: Essays on Cybernetics and Cognition* (New York: Springer, 2003).

right, interacting with another agent, the observer. As quantum mechanics has taught us, observer and observed cannot be separated, and the result of observations will depend on their interaction."[16] The methodological turn toward self-referential cybernetic systems did not secure the discipline's academic footing, but in fact decreased its popularity within academic circles as concerns arose that the new discipline had divorced itself from reality, or as one observer aptly remarked: "some people feel that the second-order fascination with self-reference and observers observing observers observing [sic] themselves has fostered a potentially dangerous detachment from concrete phenomena."[17]

By the 1970s, cybernetics had a diminished standing in the academic world and the related ideas of cybernation and automated industrial production also began to recede as worldwide energy crises and the onset of stagflation in the United States diminished the practicability of radical economic reforms. The desire for improved productivity through automation certainly did not disappear, but the accompanying reforms, such as the guaranteed annual income or calls for shorter working hours largely disappeared during the economic challenges of the 1970s. The rapid swing from radical reformist attitudes of the 1960s, in which guaranteed income proponents envisioned ending poverty, to the privations of the1970s dealt a serious blow to cybernation and guaranteed income advocates.[18] A parallel development occurred in the socialist world where the practical challenges of producing sufficient computer hardware led political leaders in the Soviet Union and the German Democratic Republic to shift investment away from cybernetics.

[16] Heylighen and Joslyn, "Cybernetics and Second-Order Cybernetics."
[17] Ibid.
[18] Gareth Davies, "War on Dependency: Liberal Individualism and the Economic Opportunity Act of 1964," *Journal of American Studies* 26, no. 2 (1992): 215; Daniel P. Moynihan, *The Politics of a Guaranteed Income: The Nixon Administration and the Family Assistance Plan* (New York: Vintage Books, 1973).

The turn away from cybernetics did not, however, result in the discipline's erasure. Across the Soviet Bloc cybernetic researchers remained active and cross-curtain collaboration even increased as the economic and political importance of cybernetics diminished. Throughout the 1980s, for instance, American and Soviet cyberneticians held academic conferences and published monographs which evidence a high level of collaboration. These fruitful academic conferences stood in stark contrast to the chilly reception experienced by Edward Feigenbaum and his American colleagues in the early 1960s, when cybernetics remained a serious geopolitical issue.[19] Academic collaboration, it appears, only became feasible when the socio-political dimensions of the discipline were in decline.

The final decades of the twentieth century were a period of relative quiescence on the cybernetic front. The rapid advancement in computing power, expressed by Moore's Law, represented a development that the cybernation theorists from the 1960s did not foresee. Moore's Law, which predicted that the number of resistors on a microchip would double approximately every eighteen months, proved empirically accurate for several decades. [20] This unprecedented development in hardware capabilities set the United States on course for exponentially improved computing power, which further distanced its socialist competitors. Instead of cybernetic robotic technologies, personal computers emerged as the dominant technological development of the late twentieth-century. Such was the ascendence of the IT industry that cybernetics' sibling discipline, artificial intelligence, also entered a so-called "AI winter" in the 1980s when personal computing technologies were on the rise.[21] The emergence of cheap and powerful computers, driven by

[19] See Sadovskiĭ and Umpleby, *A Science of Goal Formulation*.
[20] "What Is Moore's Law? | Is Moore's Law Dead? | Synopsys," https://www.synopsys.com/glossary/what-is-moores-law.html.
[21] Sebastian Schuchmann, "History of the First AI Winter," Medium, May 16, 2020, https://towardsdatascience.com/history-of-the-first-ai-winter-6f8c2186f80b.

ascendent tech powerhouses like Microsoft, Apple, and Oracle, in the 1980s and 1990s changed the nature of work dramatically, but widespread unemployment did not occur. Disguised forms of technological unemployment in which low-skilled workers were replaced by those with basic computer literacy skills, certainly led to dislocations across the labor market in the 1990s, but a rapidly expanding economy kept demand for labor high despite the availability of low-cost and widely available computers.[22]

Alongside the emergence of a powerful IT sector, the 1990s also witnessed a limited reawakening of cybernetic thought in the form of sociocybernetics. The discipline never garnered a significant academic or popular audience but sociocybernetics represented a renewed effort to apply cybernetic methods to the study of social phenomenon, such as interpersonal dynamics, the functioning of cities, and other complex systems.[23] The Dutch sociologist, Felix Geyer, championed the discipline and drew heavily from second-order cybernetics in his publications from the 1970s and 1980s. The emphasis on second-order cybernetics, a branch of the field that had fallen from academic favor, probably accounts for the relative lack of interest in sociocybernetics, but the subject served to inspire a new generation of cybernetic thinkers, like Cliff Joslyn, Francis Heylighan, and others who still identify as cyberneticists and hold academic positions in the twenty-first century.

Cybernetics may have undergone a serious academic fall from grace in the late twentieth century, but many of the concepts which this dissertation has examined, such as the income guarantee, changing beliefs about labor, and networked computing systems have reemerged in

[22] Theobald anticipated the prospect of disguised unemployment writing in 1966 that "retraining would constitute a kind of 'disguised' technological unemployment" in *The Guaranteed Income*. The idea of disguised unemployment predates the cybernation theorists and was discussed throughout the 1930s. See Joan Robinson, "Disguised Unemployment," *The Economic Journal* 46, no. 182 (June 1, 1936): 225–37, https://doi.org/10.2307/2225226.
[23] Felix Geyer, "The Challenge of Sociocybernetics," *Kybernetes* 24, no. 4 (January 1, 1995): 6–8, https://doi.org/10.1108/03684929510089321.

force in the last twenty years. The guaranteed annual income, which is now more commonly referred to as a universal basic income, represents one of the most significant legacies of the 1960s cybernation debates. Two strands of basic income advocacy, which are prominent today, trace their roots to the cybernation theorists of the 1960s who authored the Triple Revolution Report.

The first strand is driven by a group of technological teleologists, who fear a rapid increase in productivity brought about by machine learning and robotics. This group is largely comprised of technological elites in the United States, including Mark Zuckerberg and Elon Musk, who have expressed support for basic income based on the belief that productivity enhancement will necessitate a new means of distribution. Zuckerberg has taken a cautious approach, stating, "We should explore ideas like universal basic income to give everyone a cushion to try new things", whereas Musk appears to have accepted the ultimate inevitability of a UBI: "There is a pretty good chance we end up with a universal basic income, or something like that, due to automation […] Yeah, I am not sure what else one would do. I think that is what would happen."[24] In addition to Silicon Valley elites, the American entrepreneur and 2020 presidential candidate, Andrew Yang, led an upstart and remarkably successful campaign centered on an unconditional basic income. Yang's primary justification for the UBI, or what he called the "freedom dividend" also derived from concerns about impending technological unemployment. Interestingly, Yang framed his proposal as a form of "human capitalism", rather than democratic socialism in an effort to harmonize the freedom dividend with American notions of self-advancement. [25] Current worries

[24] Todd Haselton, "Mark Zuckerberg Joins Silicon Valley Bigwigs in Calling for Government to Give Everybody Free Money," CNBC, May 25, 2017, https://www.cnbc.com/2017/05/25/mark-zuckerberg-calls-for-universal-basic-income-at-harvard-speech.html; Catherine Clifford, "Elon Musk: Free Cash Handouts 'Will Be Necessary' If Robots Take Humans' Jobs," CNBC, June 18, 2018, https://www.cnbc.com/2018/06/18/elon-musk-automated-jobs-could-make-ubi-cash-handouts-necessary.html.
[25] John Harwood, "2020 Candidate Andrew Yang: 'The Fundamentals That We Assume to Be True about Capitalism Are Now Breaking Down,'" CNBC, October 2, 2019, https://www.cnbc.com/2019/10/02/why-andrew-yang-says-human-capitalism-beats-democratic-socialism.html.

about technological unemployment closely parallel the rhetoric from the 1960s cybernation theorists. Current debates emphasize machine learning over roboticized manufacturing, but the predictions about technological change and the proposed solutions are remarkably similar. In both cases, basic income advocates view technological changes not as a gradual progression, but rather a qualitative leap that will sunder the foundations of capitalism.

The second strand of UBI advocacy justifies a basic income on the basis of ethical and moral beliefs about citizenship, well-being, freedom, and poverty alleviation. This strand is largely disconnected from the technological teleologists, and the most prominent members come from the academic world and organize under the umbrella of the Basic Income Earth Network (BIEN).[26] For the ethically focused camp, a basic income represents a new kind of sharing economy, in which economic surplus is equitably distributed through a government-funded income guarantee. On this view, a basic income would help break the system of wage slavery and ensure that every citizen enjoy some measure of economic security. These justifications for basic income are untethered from future technological scenarios and emphasize concerns about poverty alleviation and financial precarity.

Ethically focused basic income advocates draw upon a rich and diverse intellectual heritage, which includes the works of the utopian thinker Thomas More, the English-born American philosopher Thomas Paine, and the nineteenth-century economist Henry George.[27] The works of cybernation theorists, however, are normally absent from this intellectual heritage despite their clear commitment to the ethical dimensions of the guaranteed income. The headline-grabbing quotations from the Triple Revolution Report and the predictions of technological rupture certainly

[26] "BIEN — Basic Income Earth Network | Educating about Basic Income," https://basicincome.org/.
[27] For a history of basic income's intellectual history, see Philippe van Parijs and Yannick Vanderborght, *Basic Income: A Radical Proposal for a Free Society and a Sane Economy* (Cambridge: Harvard University Press, 2017).

gained the most publicity in their own time, but as chapter one has demonstrated, Theobald, Michael, and others based their basic income advocacy on conceptions of abundance that were grounded in a redistributive politics. Cybernation theorists from the 1960s share more in common with ethically focused basic income advocates of today, like Guy Standing and Philippe van Parijs, even though their rhetoric around technological change is superficially different.[28]

The absence of references to cybernation by basic income advocates bespeaks a larger trend in current debates about technological change. The world of high technology is remarkably ahistorical and current predictions about technological unemployment almost entirely disregard parallel rhetoric from earlier generations. One such example of historical neglect is found in the popular container orchestration technology, Kubernetes, which was invented by Google in the past decade. The term Kubernetes and cybernetics are different transliterations of the same Greek word for helmsman, and yet the extensive documentation on Kubernetes makes no reference to Norbert Wiener's discipline.[29] Perhaps even more surprising is the fact that Kubernetes, a software product which automatically spins up containers in response to external events, clearly constitutes a cybernetic feedback loop.

One of the goals of this project is to provide historical context for current debates about technological change, which are largely ignorant of cybernetic history. This historical perspective reveals that technological teleologies rarely provide a sound foundation for social or economic change. The fact that cybernetics receded from public attention in the 1970s can be attributed, at least in part, to the fallacious predictions of passionate cybernation theorists. Advocates for radical

[28] Guy Standing, *Basic Income: And How We Can Make It Happen* (London: Pelican, 2017); Guy Standing, *The Precariat: The New Dangerous Class* (London: Bloomsbury Academic, 2016).
[29] "Production-Grade Container Orchestration," Kubernetes, https://kubernetes.io/.

reforms today may see the 1960s as a cautionary tale and choose to frame new proposals for a basic income around ethical and political ideals rather than future economic conditions.

In the second decade of the twentieth century, cybernetics and the economic, social, and technological issues that captured widespread public attention during the Cold War, have never seemed more relevant. As networked wearable technologies powered by machine learning spread across the world, a truly cybernetic era appears to be at hand. Whether this age of cybernetics will precipitate technological unemployment is, as yet, unknown, but how to live in a world defined by instantaneous global communication, automated feedback, and machines with superhuman capabilities remains an unanswered question. The historical actors studied in this dissertation foresaw these developments and took the first steps in proposing solutions for living in a cybernetic era. In 1967, Robert Theobald remarked, "I think I can talk about what humans have to be to live in it [a technological environment]. That is, they have to be honest, responsible, humble and, if they want to survive, loving. It takes the first three of these to keep the system going and the last of them to make life worth-while."[30] To make life worth-while in a technological world is a noble goal and one that demands concerted effort in today's era of technological disruptions. Perhaps the cybernetic past will have something to teach us about our cybernated present.

[30] Robert Theobald, "Interview with Robert Theobald," *Perspecta* 11 (1967): 16, https://doi.org/10.2307/1566929.

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DL 2- Ministerium für Außenhandel und Innerdeutschen Handel (Teil 1: 1945 – 1964)
DN1 - Ministerium der Finanzen (Teil: HA Preise 1945-1956)
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