The State Machine: Politics, Ideology, and Computation in Chile, 1964-1973

by

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To Mom and Dad,

for setting the stage,
and enjoying the show.

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Abstract

This dissertation argues that Chile's history of computing is tightly interwoven with the history of the Chilean state. It begins by documenting the government use of mechanical tabulating machines during the 1920s and 1930s and concludes with the disbanding of the state computer enterprise known as ECOM in 1991. The dissertation pays particular attention to the period between 1964 and 1973, which was marked by the presidencies of Christian Democrat Eduardo Frei Montalva and Socialist Salvador Allende Gossens. The dissertation addresses three central questions. First, it asks how Chilean economic policies and political events shaped the country's technological history. Second, it asks what we can learn from computers if we treat them as texts for understanding historical processes in Chile, the Latin American region, and the developing world. Finally, it addresses how Chile's political leaders used computing machines in their attempts to control Chile's social, economic, and political development and to forward their plans to modernize the Chilean nation. It argues that computers proved valuable not only in producing the Chile of today but in articulating national goals that changed over time. Government use of computers both reflected and made possible the ideological programs of developmentalism, socialism, and neoliberalism that dominated Chilean politics during the period under study. Based predominantly on archival research and oral history interviews, the dissertation follows a narrative format. It shows how computing technologies contributed to the practice of statecraft, influenced ideas of modernization, and reflected the tensions between Chile and the industrialized nations of the developed world.

Thesis Supervisor: David A. Mindell
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Acknowledgements

Years ago, when I was trying to decide where to attend graduate school, a friend of mine commented, "well, if you want to study technology, you should follow the geeks to their Mecca." He was referring to MIT and his logic, while a bit of stretch, nonetheless proved persuasive. Now, as my time at the Institute comes to a close, it is a pleasure to single out the many others who made this pilgrimage with me and whose support was invaluable to my journey through graduate school.

I am first and foremost grateful to the members of my committee: Peter Winn, Hugh Gusterson, and my advisor David Mindell. Each has brought their distinctive expertise and perspective to this project and each used their ability to challenge and inspire at critical moments. I thank them for their continued interest in my research, for serving as mentors as well as teachers, and for reading and discussing multiple drafts of this manuscript.

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I was able to bring my dissertation research to a wider audience thanks to the efforts of Bruno Latour, Peter Weibel and the staff of artists at the ZKM Center for Digital Art and Media in Karlsruhe, Germany; Juan Andrés Gúzman from the Chilean publication *The Clinic*; freelance journalist Virginia Rioseco; and journalists working for National Public Radio and the *Guardian*. The MIT Western Hemisphere

Project kindly invited me to present my findings to the members of the MIT community. The Design School at the Pontificia Universidad Católica de Chile and the History Department at the Universidad Academia de Humanismo Cristiano provided a public forum where I could present my work to a Chilean audience.

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Successful work depends on time for play. As such, this dissertation owes a tremendous debt to the *almuerzos, onces,* happy hours, and *carretes* spent with my Chilean family and friends. My "mamá chilena" Rosa Moscosa and my Chilean sister Francisca "la flaca" Mancilla provided a home away from home. Claudio Garvizo and José Luis Navarrete were the best roommates a gringa could ask for and fellow gringa Lea Newfarmer was the ideal partner in crime for navigating the "Chilean jungle."

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Altunata. Fellow grad student and close friend Pei-Lin Hsiung provided a model for work ethic and the pursuit of a balanced life. It was an honor and a pleasure to live with her for my five years in Boston and I honestly don't know what I would have done without her camaraderie at the end of the day. Equally crucial was the love and continued support from my "extended family"—Sara, Michael, Aaron, Sonia, and Corey Baum. Grandma Maly was my ever-present inspiration for overcoming obstacles.

To the individuals who generously opened their homes, trusted me to document their experiences, and/or took a risk by giving me access to their web of connections, I thank you. It is difficult to do justice to the lifetimes of accomplishment that now reside on my interview tapes; I hope this text is worthy of the confidence these individuals have shown its author.

To Cristian, I thank you for all you have sacrificed to make my work possible and for teaching me to love your homeland. You are a constant reminder of what makes Chile so special.

I dedicate this dissertation to my parents. It is a small acknowledgement for the lifetime of love, support, and encouragement I have been so fortunate to receive. I hope they see this work as the fruit of their labors just as it is of mine.

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Map of Chile

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Chapter 1

Introduction

Touch my shoulders. Feel that? They are different. After the National Stadium, they have never been the same.

-Vicente Poblete, Santiago, Chile, July 2003

VICENTE POBLETE spent 744 days incarcerated in a Chilean prison camp during the military dictatorship of Augusto Pinochet (1973-90). As one of the many detained in Chile's National Stadium, Poblete endured physical and psychological torture, the effects of which are still evident more than thirty years later. The military government detained him because he was a socialist, a label he wore proudly during the presidency of socialist Salvador Allende (1970-73) but distances himself from today. In a 2003 interview he insisted that he was not a leftist but rather an academic who used his training in sociology to assist Allende's Popular Unity government. Before Allende's election in 1970, Poblete had taught sociology at the State Technical University and in Brazil as a visiting scholar. When Allende came to power, the government decided to apply Poblete's academic prowess to the restructuring of the Chilean industrial sector and assigned the former professor to manage a recently nationalized textile factory. Poblete recalled bringing the small factory back from the dead. As his reward, the government appointed him to serve as the general manager of the Yarur textile mill, the largest such plant in the country and the first factory nationalized as a result of pressure from workers.

Figure 1: Vicente Poblete holding a text he has drafted of his experiences during the Pinochet dictatorship. Photograph taken by the author.

In agreeing to take the job at Yarur, Poblete placed himself at the forefront of the Chilean economic revolution. Although Yarur had not appeared on the government's original list of factories that it intended to nationalize, political and economic considerations, combined with mounting worker enthusiasm for expropriating Yarur, made the mill appealing to the government, which was looking for a test case for its power to requisition industry. Nationalizing the Yarur textile mill was also important symbolically, as it was the first step toward eliminating the private monopolies controlled by wealthy Chilean "capitalist" families—such as the Yarurs—who were well known for exploiting workers and smaller businesses. In his extensive study of the Yarur nationalization process, Peter Winn observed that "the socialization of the Yarur mill . . . was both a symbolic and efficient way of beginning the decisive phase of the Popular Unity's campaign 'to gain control of the commanding heights of the economy.' "[1] Thus Yarur became the flagship factory to undergo the industrial transformation described in the Popular Unity economic program; its success was critical.

The Chilean Economic Ministry gave the factory the best resources the government could offer. Ministry officials took pains to secure qualified state-appointed managers like Poblete. They met with worker representatives and encouraged Poblete and his management team to apply new scientific management techniques and technologies that were designed to increase production levels and to introduce new forms of management that incorporated worker participation. The government sent university-educated engineers to the Yarur mill, where they created factory production models by applying techniques derived from cybernetic science and operations research.

The Yarur mill became one of the first factories linked to an experimental communications network that used the electronic computer to record and map daily production activities with unprecedented speed and completeness. This system, known as the Cybersyn Project, used a network of telex machines to connect factories in the social property area (APS) to a central mainframe computer and processed production data using a suite of customized software programs. Once completed, the system would provide government officials and factory managers alike with a tool capable of responding to the rapid fluctuations of the Chilean economy and of predicting crises before they occurred. The project represented a

[1] Peter Winn, *Weavers of Revolution: The Yarur Workers and Chile's Road to Socialism* (New York: Oxford University Press, 1986), 152.

remarkable and innovative undertaking for the time period (1971-73), arguably years ahead of its time. Its development seemed so extraordinary, in fact, that it inspired me to explore its history for this dissertation and led me to Vicente Poblete's doorstep.

Poblete is now an old man, retired and widowed, with a soft voice, impeccable manners, and a tendency to freely link memories from different periods of his life with an understandable nostalgia. During our three-hour interview the conversation quickly transcended the themes one might consider typical for a history of technology. Poblete's narrative tumbled out in a halting mix of recollection, rambling, and uncertainty, a hybrid resulting from the confusion wrought by time and old age, as well as the act of articulating memories long buried, forgotten, and then remembered. As it turned out, Poblete did not recall the computer system that had led me to him, although he did remember other episodes from his time at Yarur. Our conversation, while not directly applicable to the history of the Cybersyn Project presented in chapters 5 and 6, nonetheless proved illustrative of a larger phenomenon that I encountered while pursuing this research topic.

Conducting the oral history interviews for a dissertation set in Chile in the years under consideration transcended the general purpose of collecting information about events from the past and main players' impressions of them; the interviews contribute to the ongoing process of restoring the national memory.[2] For three hours my presence was the catalyst for Poblete's reclamation of disappeared, forgotten, or silenced recollections of the past. My experience with him, as well as with many of the oral history participants whose accounts are interwoven in this text, reflected

[2] The events commemorating the thirtieth anniversary of the military coup also heightened the willingness of Chileans to participate in this study, which in turn further fueled the process of national remembering.

the exceptionality of the moment when I was conducting most of my research for this study, namely, the thirtieth anniversary of the 1973 military coup that brought Pinochet to power. I am grateful to the individuals who participated in the study for allowing me to share in this process with them and for permitting me to record and share their personal histories.

I opened with Poblete's story not only to put a human face on the study of technology but also to illustrate the unique challenges of conducting historical research in Chile. There, a history of computing will inevitably intersect with a history of political violence and repression--or, at the very least, a history of contentious politics; this had a fundamental effect on the research questions that I addressed and the methodologies that I used for drawing conclusions. Any recent history of Chile, technological or otherwise, will inevitably confront the controversies of the Chilean historical landscape, where members of the political Right, Left, and Center still negotiate how history should be remembered and how it should be allowed to shape the present. These considerations have helped shape the arguments that I make in the pages that follow as well as the methodological approach that I chose and will present in greater depth later in this chapter.

The coup of September 11, 1973, undoubtedly created the greatest rupture in recent Chilean history, yet it was one of many ideological shifts and political upheavals that this slender South American country underwent in the twentieth century. The swinging pendulum of ideological change that has characterized Chilean politics and the aftershocks of international political events felt in the South American region have helped form Chile's material landscape, set national priorities, and define the range of options available for economic, political, and social transformation. For these reasons a history of technology set in Chile will appear quite different from one set in the United States or other geographies of the industrialized world.

Today Chile boasts the reputation of being one of the most wired nations in Latin America. First-rate science and engineering programs channel an increasingly skilled workforce into flourishing high-tech industries nurtured by free-trade agreements. Describing these achievements as the fruit of an "economic miracle" obscures the economic, political, and ideological work that the country has undertaken since the mid-1970s and the groundwork laid earlier in the twentieth century. Chilean political leaders regularly assert that information technologies play a vital role in creating the next generation of educated citizens, ensuring the present and future successes of Chilean industries, and ultimately in surviving in the global, privatized, neoliberal marketplaces of the twenty-first century. At the same time, the government in recent years has maintained a strong position of economic and technological neutrality, allowing the market, with no intervention from the state, to act as the central force in determining the future of Chilean technological development.[3] Most Chilean computer professionals have spent their lives working under the assumption that computerization and privatization occurred as concurrent and mutually reinforcing phenomena. This was not always the case. The history that I present here tells a different story of computer technology and the Chilean state: a history of computers as technologies of the state, what I refer to as "state machines."

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[3] Some argue, correctly I believe, that the idea of technological neutrality is an illusion. By refusing to favor or even grant equal status to certain technologies, such as free software, the government is complicit in Chile's economic dependence, which threatens the security of state computer systems. See Jens Hardings and Werner Westermann, *¿Neutralidad Tecnológica? Desencuentros de la política tecnológica chilena*, 2004,

The dissertation was inspired by and stands in contrast to a body of literature about the history of computing that has focused almost exclusively on the evolution of computing machines within the business, military, and academic institutions of the United States. The chapters that follow implicitly examine the Chilean history of computing in contrast to that of the United States. In so doing, I address three central questions. First, I ask how computing machines have been adopted and employed in parts of the developing world and explore how Chile's economic and political dependency influenced the history of this technology. In the process, I show the movement of these machines from one national context to another and how bringing these technologies and related practices to another continent required the formation of international networks that linked human and nonhuman actors. The second question asks what we can learn from computers if we treat them as historical texts for understanding historical processes beyond those that pertain to technical and technological spheres. One recurring theme is how these machines can be used as windows for examining state understandings of modernity, the assumptions underlying state modernization efforts, and the practice of bringing state-directed modernization programs to fruition. Anther recurring theme is how Chilean officials used these machines as symbols to position Chile with respect to the developed world and the models that they sought to emulate through modernization. Finally, the dissertation asks how Chile historically has linked computing machines to notions of controlling social, economic, and administrative practices. Different uses of computers grew out of the distinctive goals and ideologies of consecutive political administrations and contributed to Chile's changing ideas of

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http://www.softwarelibre.cl/modules.php?op=modload&name=News&file=article&sid=288&mode=thread &order=0&thold=0, (8 March 2004).

nationhood, the international structure of power, and the relationships between the Chilean government and its citizenry.

The dissertation is divided chronologically into four parts, beginning with the arrival of the first IBM tabulating machines in Chile during the 1920s and continuing through the Alliance for Progress government of President Eduardo Frei Montalva (1964-70) and the brief socialist presidency of Salvador Allende (1970-73). It concludes with a brief overview of state computing during the early years of the Pinochet dictatorship and its relation to the neoliberal restructuring and social repression that followed. Computer technologies assumed varying roles within the state apparatus of each administration, advancing policies of state-led growth, state-directed growth, and, finally, free-market economics. Within this context computing machines have played an important role in Chile's formidable state bureaucracy, helping it to push the limits of an interventionist state. These machines have also served as canvases for differing ideological visions of modernity and modernization while serving as tools for realizing policies grounded in an ideologically based set of assumptions. Computing machines did not simply play a role in producing the Chilean nation; they contributed to a particular articulation of the Chilean nation that changed over time. This observation supports the larger argument that examining the history of technology is especially valuable in enhancing our understanding of Latin America.

State and Nation

Readers familiar with computer science or programming will no doubt recognize the play on words in the title of this dissertation. Most computer science and engineering students encounter the abstract model known as the finite state machine, or simply the state machine, in their first programming or logic design course. A state machine has several different "states," and a set of rules governs the transition from one state to the next. Given the computer-oriented focus of this work, this double entendre seemed appropriate, even though I do not discuss the finite state machine, either historically or as a conceptual model. I refer to computers as "state machines" because their history is so closely bound with the history of the Chilean state.[4] Computers have assisted government agencies in tackling such tasks as census taking, economic regulation, and coordination among various state organs. The historian Jon Agar has shown how computing machines made possible the expansion of the size and scope of the British government during the nineteenth and twentieth centuries. A similar story emerges in the Chilean case, often in direct response to British activities occurring across the Atlantic.[5]

In Chile, government bureaucracy grew in tandem with the increasing state emphasis on accurate record keeping. In addition to the long lines and reams of paperwork that continue to plague relations between Chileans and their public officials, the desire to quantify and record national activities spawned new forms of state visibility and accountability. These new record-keeping technologies and practices, including early computers and tabulating machines, in turn allowed state

[4] Discussions of the use of machine metaphors in describing government operations have appeared in Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (New York: Oxford University Press, 1967); Jon Agar, *The Government Machine: A Revolutionary History of the Computer* (Cambridge, Mass.: MIT Press, 2003); and Yaron Ezrahi, *The Descent of Icarus: Science and the Transformation of Contemporary Democracy* (Cambridge, Mass.: Harvard University Press, 1990). Louis Althusser has also equated the state with a "machine of repression." See Louis Althusser, "Ideology and Ideological State Apparatuses," in *Essays on Ideology* (London: Verso, 1976).

[5] Agar, *The Government Machine.* It is worth noting that Agar's book fits into a larger corpus of literature on office technology and the growth of management in both business and government. See JoAnne Yates, *Control Through Communication: The Rise of System in American Management* (Baltimore: Johns Hopkins University Press, 1989), and James R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge, Mass.: Harvard University Press, 1986), for

officials to plan economic policies and simulate their effects; map the national population statistically with increasing accuracy; and keep detailed inventories of national resources. The resulting databases in turn shaped future economic policies and their underlying theoretical frameworks, the behavior of international lending agencies, perceptions of government efficacy, and levels of public satisfaction. They also created new forms of state control.

Like the creation of a national history, the teaching of a common language, and the constructed demarcation between self and other, acts such as assigning national identification numbers and categorizing populations through census data contribute to the imagination and realization of a unified nation. Benedict Anderson writes that a nation functions as an "imagined political community – and imagined as both inherently limited and sovereign."[6] However, national communities must also be maintained. The vast networks of machines, public officials, and government agencies responsible for the massive generation, collection, and distribution of data contribute to not only the day-to-day operation of the state but also to its production. This history, therefore, is not just a technological history but a history of the changing social networks that connected these technologies to the function of the state and its management.

The historian Mario Góngora illustrates how the evolving character of the state created the Chilean nation.[7] Using his encyclopedic knowledge of Chilean history, Góngora traces the changing goals and infrastructure of the Chilean

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alternative readings of how computers and other office technologies historically have increased management capabilities of U.S. business and government.

[6] Benedict R. O'G. Anderson, *Imagined Communities: Reflections on the Origin and Spread of Nationalism*, rev. and extended ed. (New York: Verso, 1991), 6.

[7] Mario Góngora, *Ensayo histórico sobre la noción de estado en Chile en los siglos XIX y XX*, 2nd ed. (Santiago: Editorial Universitaria, S.A., 1986).

government from the war-oriented postindependence period, through the rise of the "protectorate state" that was committed to collective well-being, and ends with a strong critique of the current neoliberal status quo, which threatens to undermine the state and, therefore, Chilean national identity. Because he limited the scope of his analysis to the history of Chile, Góngora's notion of nation is more concrete than Anderson's. Góngora's work provides a useful starting point for thinking about Chile's introduction of state rationalization techniques, which emerged in the 1920s as the new basis for authority and state legitimacy. In contrast to a Marxist vision of a state derived and produced from socioeconomic power structures, Góngora envisions the modern Chilean state in terms of utility, efficiency, and competitiveness. This state is capable of configuring historical processes through its organizational and moral power. Góngora, however, never specifies how these mechanisms of organization and rationalization contribute to the production of national identity or how they express the changing ideological goals of the various administrations. Moreover, he does not clarify which technologies, practices, and methodological frameworks fall under the abstract heading of *técnica*, a word that translates as both technology and technique.[8] The argument presented here provides one possible response to this oversight.

Like Góngora, Michel Foucault equates the historical creation and isolation of categories such as "political economy" and "population" with a new form of

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[8] This is perhaps intentional, given Góngora's scathing critique of government tendencies to give priority to scientific techniques and private industries over culture and history. As he writes, "In Chile [the way of] the firm seems much easier, tradition much more fragile. In globalization processes, the end result is a massification of economics and technique, not a soul." Góngora, *Ensayo histórico sobre la noción de estado en Chile,* 270.

government legitimacy.[9] As he writes, "Thanks to the perception of the specific problems of the population, and thanks to the isolation of the area of reality that we call the economy, . . . the problem of government finally came to be thought, reflected and calculated outside of the judicial framework of sovereignty. . . . Population comes to appear above all else as the ultimate end of government."[10] State dominion over the population and the national economy required techniques of management and discipline, what Foucault terms the "governmentalization" of the state. By "governmentality" Foucault means the complex web of institutions, practices, techniques, calculations, and forms of knowledge that allow the state to exercise power over its citizenry. Although Foucault does not refer to the role played by technologies in the formation and maintenance of his governmental state, we can easily envision how such a connection might be made, particularly with regard to the office technologies—typewriters, calculators, filing systems, and later computers—that came into being during the nineteenth and twentieth centuries.

Computers (a category that includes early tabulating machines) and their related practices are not uniquely responsible for creating a Chilean national identity, a new form of state legitimacy, or type of governance. However, the computer technology used by the Chilean state from the 1920s to the 1980s fueled new opportunities for expanding state power and governmentality and for stimulating the public imagination of the Chile that was and the Chile that could be. In addition to extending the reach of the state and its management capabilities, these technologies played an important role in discussions of state modernization

[9] See chapter 4 of Graham Burchell, Colin Gordon, and Peter Miller, eds., *The Foucault Effect: Studies in Governmentality: With Two Lectures by and an Interview with Michel Foucault* (Chicago: University of Chicago Press, 1991), 87-104.
[10] Ibid., 99-100.

and national development. In combination with other key technological interventions of the twentieth century, the data collection capabilities of early computing machines helped unify a nation spread over a large and varied geographical area. Like the physical mobility provided by the railroads, early computer and tabulating systems made statistical information from the southern tip of Patagonia to the northern reaches of the Atacama Desert mobile, collapsible, and configurable, fortifying the unified, connected national vision articulated by Chilean political leaders and made possible by government technocrats.[11]

Technology and Dependency

History has illustrated the numerous ways in which information collection, storage, and transmission systems have arisen in response to ideologically grounded problems and have offered ideologically grounded solutions. Examples include the data-processing technologies responsible for generating the lists of Jews living in Nazi-occupied territories during the Second World War and the computerized databanks constructed by the military governments of Latin America to store information about suspected political subversives.[12] Within the U.S. context the Cold War push to develop technologies of command, control, and containment spurred well-known innovations such as digital computation, satellite imaging systems, advances in computer simulation, and the Internet, as well as the

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[11] In the Latourian sense, they create new centers of calculation. See Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Cambridge, Mass.: Harvard University Press, 1987), and Bruno Latour, "Drawing Things Together," in Michael Lynch, ed., *Representations in Scientific Practice* (Cambridge, Mass.: MIT Press, 1990).

[12] Edwin Black, *IBM and the Holocaust: The Strategic Alliance Between Nazi Germany and America's Most Powerful Corporation* (New York: Crown, 2001); John Dinges, *The Condor Years: How Pinochet and His Allies Brought Terrorism to Three Continents* (New York: New Press, 2004).

interdisciplinary fields of cybernetics, systems theory, and operations research.[13] Today, the rise in database, profiling, and encryption technologies represents the ideological tug between the national need to find terrorists and criminals, a corporate urge to increase customers and hence profits, and individuals' desire to protect their privacy.[14] Internationally, the emphasis on bureaucratic statecraft, with its numerous techniques of data collection, exchange, and representation, has been tied to ideas of modernity, development, and progress for most of modern history.[15]

However, there exists a fundamental difference in how these techniques, ideas, and practices are adopted in the developed and the developing worlds. The history of twentieth-century information technologies has been dominated by the U.S. success stories of invention and innovation and, to a lesser extent, such stories in European contexts. However, the majority of the world has a different history. Instead of leading innovation, most nations rely on trade and lending agreements that enable them to adopt foreign technologies, often with the caveat that they apply them much as the countries that developed them did, and then to adapt to the changes wrought by these systems.

The almost deterministic relationship, whereby less-industrialized nations find themselves following a technological trajectory blazed by their more

[13] Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, Mass.: MIT Press, 1996); National Research Council, *Funding a Revolution: Government Support for Computing Research* (Washington, D.C.: National Academy Press, 1999); Agatha C. Hughes and Thomas Parke Hughes, eds., *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After* (Cambridge, Mass.: MIT Press, 2000); Arthur L. Norberg, Judy E. O'Neill, and Kerry J. Freedman, *Transforming Computer Technology: Information Processing for the Pentagon, 1962-1986* (Baltimore: Johns Hopkins University Press, 1996); Janet Abbate, *Inventing the Internet* (Cambridge, Mass: MIT Press, 1999).
[14] See, for example, Simson Garfinkel, *Database Nation*, 2nd ed. (Cambridge, Mass. O'Reilly, 2001).
[15] One example is James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, Conn.: Yale University Press, 1998).

industrialized neighbors, runs counter to the body of scholarship within the history of technology that is dedicated to disproving the myth of technological determinism.[16] Certainly, it would be wrong to discount the role of human agency in technological development, and indeed governments and citizens in developing nations play a significant role in how technologies are purchased, applied, and altered to fit their national needs. However, it is also true that within the developing world, factors of economic and technological dependence restrict the options and confine the scope of human agency. The power of international economic and political relations can cause the technological tail to wag the dog. However, these relations may also generate a framework for developing nations to resist Western hegemony by using imported technologies in original, innovative ways that have symbolic significance. Chile, a tiny sliver of the South American continent framed by the Pacific Ocean and the Andean cordillera, provides an illustrative setting for exploring the relationship between technology and dependency.

The argument of Fernando Henrique Cardoso and Enzo Faletto's classic text, *Dependency and Development in Latin America,* is pertinent to this discussion, even though subsequent scholarship has shown the limitations of its approach.[17]

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[16] For an excellent collection of essays on the subject see Merritt Roe Smith and Leo Marx, eds., *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, Mass.: MIT Press, 1994).

[17] Fernando Henrique Cardoso and Enzo Faletto, *Dependency and Development in Latin America*, trans. Mariory Mattingly Urquidi (Berkeley: University of California Press, 1979). I cite this text because it is central to the ECLA dependency school, which evolved in Santiago during the 1960s. However, *Dependency and Development in Latin America*, and the ideas found within its pages, cannot be taken out of the wider history of structuralist and developmentalist economic thinking that shaped Cardoso and Faletto's argument. See Raúl Prebisch, *Towards a Dynamic Development Policy for Latin America* (New York: United Nations, 1963); United Nations, Economic Commission for Latin America, *The Economic Development of Latin America and Its Principal Problems* (Lake Success, N.Y.: United Nations Department of Economic Affairs, 1950); and in the original Spanish, Fernando Henrique Cardoso and Enzo Faletto, *Dependencia y desarrollo en América Latina* (Lima: Instituto de Estudios Peruanos, 1967). See also the response to these models in Andre Gunder Frank, *Capitalism and Underdevelopment in Latin America: Historical Studies of Chile and Brazil* (New York: Modern Reader Paperbacks, 1969), and Andre Gunder Frank, "The Development of Underdevelopment," in Peter F. Klaren and Thomas J. Bossert , eds.,

Originally published in 1971, the book describes how nations at the center of global capitalist markets exert economic power over those on the periphery, a collection of ideas collapsed under the heading of dependency theory.[18] According to Cardoso and Faletto, Latin American economies depend on the economies of the more industrially developed nations because "the accumulation and expansion of capital cannot find its essential dynamic component within the [Latin American] system." Less-developed economies must therefore look to other parts of the developed world to supply the new technologies and/or financial backing that allow for economic growth and capital accumulation.[19] Dependency theory frequently implies the study of how imperialist power relations have determined the historical economic trajectory of developing nations. Equally important, however, are relations at the domestic level, which frequently unite local party or class interests with those of foreign companies or lending agencies. This, in turn, opens the door to local social and political movements that can resist the effects of these economic relations and even challenge their structural underpinnings.

Promise of Development: Theories of Change in Latin America(Boulder, Colo.: Westview, 1986). In more recent years scholars have challenged dependency theory's framing of the Latin American condition in a manner that overlooks the role played by Latin American elites, emphasizes class and ignores gender and ethnic categories, demarcates the region into inflexible dichotomies of center and periphery, and overstates the influence of international actors and institutions while understating the role of developing world governments and citizens groups. Others have challenged dependency for its inability to account for variations among developing nations, particularly the successes of the Asian tigers. Economists have discarded dependency theory as a basis for economic policy, particularly calls for Latin American nations to remove themselves from the global capitalist system or to pursue the construction of a socialist state. Historians, however, continue to find value in dependency theory for its ability to describe the history of economic inequality among nations of the developed and developing worlds and the failures of developmentalism, modernization theory, and neoliberalism.

[18] However, as Cardoso and Faletto acknowledge, each nation on the periphery has a historically specific and varied experience with the growth of capitalist markets within its borders. This precludes the creation of a general "dependency theory" and begs for the study of specific "situations" or "categories" of dependency. In this light, studying the uniqueness of Chile's history with a "capital good" such as the computer furthers our understanding of the set of relations that characterized the Chilean experience.

[19] Cardoso and Faletto, *Dependency and Development in Latin America*, xx.

Understanding economic dependency is helpful to understanding the Chilean experience with computational technologies. Today Chile exports a considerable number of computer professionals and lines of software code, but the machines themselves have always been imported from other parts of the world. In the 1920s tabulating machines arrived from IBM in New York, and in the 1960s machines arrived from IBM in France and from National Cash Register and Burroughs in the United States. In the wake of the 1973 military coup and Chile's turn to neoliberal economic policy, imported computer machinery from DEC, Wang, and Honeywell (among others) began to enter the Chilean market with increasing ease. However, from the 1920s to the 1970s the purchase of computer equipment and the implementation of computer-related state modernization strategies hinged on securing trade agreements with other nations and financial backing from international lending agencies. Training a workforce capable of operating these machines also depended on the availability of foreign experts willing to travel to Chile or the opportunities offered by other nations for Chileans to study abroad.

It is difficult to overemphasize the role that international political events such as the Cold War or the Great Depression played in determining the availability of imported technologies and the nature of their application. These events fundamentally altered the structure of Chile's economic, political, and social relationships both domestically and abroad, influencing elections, the availability of foreign aid, and eventually helping to incite a military coup. The context created by these events similarly colored public perceptions of Chile's place in the world, the strategies available to incite or obstruct change, the causes of underdevelopment, and the solutions proposed to alter the economic and social status quo.

For all these reasons dependency theory provides a suggestive, if overly deterministic, framework for analysis. Thus Chile's computer history needs to include the actions of nations within the developed world, as well as their economic policies, political agendas, and technical assistance programs. Of the nations in the developed world, the United States, Britain, France, and Germany exerted the greatest influence in Chile during the period under study, the first three contributing significantly to the Chilean experience with computational technologies. Subsequent chapters will address how these nations contributed to the evolution of Chile's computer industry, workforce, and technological applications.

Dependency, however, has a flip side. During the nineteenth and twentieth centuries in particular, Chile provided a metaphorical laboratory for the experiments of those in other parts of the world. The experimental neoliberal shock treatment applied to the Chilean economy in the 1970s and 1980s by the University of Chicago economist Milton Friedman and his "Chicago Boys" constitutes one of the more famous examples, but it is far from being an isolated one. Chile's small size, wealth of natural resources, geographical isolation, relatively homogeneous and concentrated population, commitment to political order, and an elite linked to all sectors of public life (agriculture, mining, politics, and industry) made Chile, from the nineteenth century on, the ideal test bed for ideas that ranged from mining techniques to economic growth strategies. The nation's shifting ideological allegiances, which swung from the Right to the Left to the Center with each presidential election, increased Chile's desirability as a site for political and social analysis during the latter half of the twentieth century. The Chilean historian Alfredo Jocelyn-Holt has asserted that this history of nation as laboratory has shaped Chilean national identity. He argues that Chileans have always understood themselves as a test case or an experiment for the rest of the world. Even the brief recapture of national destiny that occurred in 1970 with Allende's election quickly transformed the struggling socialist nation into a Cold War laboratory for the conflicting political ideologies of the United States and the Soviet Union.

Today Chile continues to serve as a laboratory for interests that range from drug companies studying depression to political scientists documenting the return of democracy. This dissertation argues that changing relations of dependency have created many different Chilean "laboratories," several of which I will document and analyze in the pages that follow.

Historians of technology are still grappling with how relations of economic dependency affect technological development. Chilean history illustrates how international events, the decisions of lending organizations, and the presence of ideologically polarized superpowers affect processes of innovation, technology transfer, and modernization for nations on the geopolitical periphery. It also allows us to see how technologies became part of Chile's struggle for economic and political independence. Technological systems were not only something to be imitated, desired, or envied. If appropriated and altered, they provided a means for nations such as Chile to escape the hegemonic dominance of Western development.

Reading Technology, Reading Ideology

The increasing ubiquity of computer technology in our daily lives has spurred a change in the subdiscipline known as the history of computing. Rather than attempt to document the full history of these machines, their evolution, and their application, historians concerned with these technologies now must focus on how these machines entered the histories of a particular field, such as data processing or telecommunications, and changed technological processes and operations.[20] Aside from these technique-centered narratives, computer histories permit the study of institutional change, including changes in the methods, operations, and values that are embedded within the organization. "The State Machine" defines a crucial part of Chile's computing history. However, it does not focus on the machines themselves but rather on how they have helped construct and support differing ideas of modernity, development, and progress within the Chilean state apparatus. The history presented here extends beyond that of a particular technology and documents the interplay between these machines and the evolution of the Chilean state, as well as the changing approach to modernization and development pursued by the Chilean government over time.

Discussions of modernity and its pursuit through state modernization programs invariably become linked with ideology. The word *ideology* appears repeatedly throughout this work; given the number of definitions associated with the term, a short discussion of its use here is necessary.[21] I will not equate ideology with "false consciousness," as Engels suggested, or regard it as a means of unifying class interests for the purpose of changing socioeconomic structures, as Gramsci did.[22]

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[20] A sample of general computing histories includes Martin Campbell-Kelly and William Aspray, *Computer: A History of the Information Machine* (New York: Basic Books, 1996); Paul E. Ceruzzi, *A History of Modern Computing* (Cambridge, Mass.: MIT Press, 1998); and Edwards, *The Closed World.* General histories of early computing machines can be found in Herman Heine Goldstine, *The Computer from Pascal to von Neumann* (Princeton, N.J.: Princeton University Press, 1972); William Aspray, *Computing Before Computers* (Ames: Iowa State University Press, 1990); James W. Cortada, *Before the Computer: IBM, NCR, Burroughs, and Remington Rand and the Industry They Created, 1865-1956* (Princeton, N.J.: Princeton University Press, 2000); and William Aspray, *John von Neumann and the Origins of Modern Computing* (Cambridge, Mass: MIT Press, 1990). Overviews of computing and U.S. defense policy include National Research Council, *Funding a Revolution*; Norberg, O'Neill, and Freedman, *Transforming Computer Technology*; and Abbate, *Inventing the Internet.*

[21] Terry Eagleton, for example, lists sixteen definitions of *ideology,* ranging from an "action-oriented set of beliefs" to "semiotic closure." See Eagleton, *Ideology: An introduction* (New York: Verso, 1991), 1-2.

[22] Ibid.; Antonio Gramsci, Quintin Hoare, and Geoffrey Nowell-Smith, *Selections from the Prison Notebooks of Antonio Gramsci* (London: Lawrence & Wishart, 1971); David Forgacs, ed., *An Antonio Gramsci Reader: Selected Writings, 1916-1935,* (New York: New York University Press, 2000).

However, I do build upon Gramsci's articulation of ideologies "as real historical facts" that are capable of domination and the exertion of political power.[23] As historical forces, ideologies leave behind material traces, which can be documented using the methods and tools of historical analysis. In his treatment of economic ideology in Latin America, Joseph Love defines ideology as "a set of propositions which implicitly justifies social values or social configurations."[24] This framing allows us to place ideology within the process of history while acknowledging that ideologies exert very real forms of social power that shape our actions, beliefs, and relationships with those around us. Although many ideological framings have coexisted throughout Chilean history (e.g., capitalism, socialism, structuralism, fascism, etc.), I use as an analytical framework in each chapter only the dominant political ideology as determined by the political programs and publicly espoused beliefs of the acting Chilean president and his administration at the time.

Ideology is a notoriously slippery concept. From the perspective of a historian, accessing and successfully articulating the character of a dominant belief system is a much greater challenge than, for example, documenting the changing value of Chilean copper exports.[25] However, if we treat ideology as a historical phenomenon, meaning that we try to understand how historical actors understood

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[23] However, I do not restrict ideology to the context of class struggle or separate ideologies into categories of historical necessity and arbitrariness, as found in Gramsci's writings.

[24] Joseph L. Love, "Economic Ideas and Ideologies in Latin America Since 1930," in Leslie Bethell, ed., *Ideas and Ideologies in Twentieth Century Latin America* (New York: Cambridge University Press, 1996). It is worth noting that Love contrasted ideology with empirically verifiable beliefs or tenets, associating a degree of falsity with the term that I do not adopt here.

[25] Others argue that if ideology is invisible, it is impossible to step outside the bounds of one's own ideological framework and obtain "God's view" of objective reality. See Slavoj Zizek, *Mapping Ideology* (New York: Verso, 1994). Postmodern theory and science studies have both banished claims to objectivity, and I do not pretend to argue from this place of privilege. While it is impossible to rid a historical work of the subjective biases of the author, this does not prevent us from making claims about the events of the past. Here I argue that ideology, if viewed as part of a historical process, is a visible entity whose mechanisms and ramifications can be documented and interpreted.

and produced the world around them in accordance with a set of social, economic, and political beliefs during a particular time period, studies of technologies and technological systems can contribute greatly to this academic undertaking. Althusser argued for the material existence of ideology, stating that "an ideology always exists in an apparatus, and its practice, or practices."[26] According to Althusser, individuals act freely according to their own beliefs and ideas, but these actions stem from a set of practices and rituals that operate as part of an ideological apparatus. Actions, practices, and rituals constitute the materiality of ideology. Citing Pascal, Althusser inverts the perception that religious practice stems from religious belief. Instead, ritual and practice play a vital role in producing and maintaining the materiality of ideology, such that one could "kneel down, move your lips in prayer, and you will believe."[27] If actions and practices illustrate the material nature of ideology, it stands to reason that the act of technological creation may also illuminate the nature of ideology, especially technologies designed to enable or maintain certain configurations of state power. Machines, moreover, demand and reinforce certain behaviors, practices, rituals, and social configurations through the limited flexibility of their operation, thus cementing a particular material character of modernity that solidifies the influence of technical experts, lending agencies, or national governments, as well as the relations between workers and managers, bureaucrats, and the masses.[28]

If we credit ideology for a set of social values, configurations, and practices, we also need to recognize that ideology does not behave as a stable monolith but

[26] Althusser, "Ideology and Ideological State Apparatuses," 40.
[27] Ibid., 42.

must be continually produced, reproduced, and maintained. In this sense, ideology functions as a discourse as much as a belief system.[29] By analyzing the conversations, displays, and exchanges surrounding the production of Chilean computer systems, we begin to see shifting and conflicting ideas of modernity and development mobilized around groups of allies and artifacts that change with the passage of time. Drawing from the work of Foucault and Escobar, I use the idea of discourse but only as a complement to ideology rather than a conceptual replacement. In this way, we can view ideological production as a mobile and changing process while maintaining the ability to talk about institutional power and identify a particular discourse as dominant or more worthy of our attentions. Hegemony is a useful concept here, as it refers to a way of seeing the world and its relationships as commonsense political fact that is accepted equally by those who stand to profit from these relations and by those who are subordinated to them.[30] Western concepts of modernization, modernity, development, and progress exerted hegemonic power within Latin America during the nineteenth and twentieth centuries, shaped U.S. and European relations with Chile, and determined Chile's approach to economic policy and technological adoption.

Earlier scholarship has engaged the idea of reading computers as ideological texts. In Latin America, Emmanuel Adler has examined the histories of the Argentine and Brazilian computer industries and illustrated how nationalist ideology fueled ideas of antidependency in both countries and created unique

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[28] Althusser writes that ideology does "not have the same modality as the material existence of a paving-stone or gun." In contrast, I claim that the paving stone or gun can bear the material marks of ideological practice. Althusser, "Ideology and Ideological State Apparatuses," 40.

[29] Arturo Escobar, *Encountering Development: The Making and Unmaking of the Third World* (Princeton, N.J.: Princeton University Press, 1995). See also Michel Foucault, "Politics and the Study of Discourse," in Burchell, Gordon, and Miller, *The Foucault Effect.*

trajectories of domestic computer development that intentionally broke from those of U.S. computer companies. Adler's work argues for a historicized conceptualization of the state that not only examines the evolving raison d'être of its various institutions but also considers how ideologies and human choices have interacted with these institutional entities to define national goals and the preferred path to progress.[31] Adler also introduces the idea of the pragmatic antidependency guerilla, a term that he applied to groups of state *técnicos* (technical experts) and their acts of linking domestic scientific and technological development with increased national autonomy. Although the *técnicos* found in the Chilean story do not always marry national autonomy with technological autonomy, Adler's analysis brings to light how *técnicos* have historically gained power and exerted influence within the Brazilian and Argentine governments and succeeded in tying their technological projects to larger state ideological visions.

In *The Closed World* Paul Edwards illustrates how computers have historically served as rallying points for the Cold War discourse of control.[32] Writing against the histories of computing that delineate narratives of great men, revolutionary machines, and material progress, Edwards ties technological change to individual technological and political choices set against a backdrop of politics, culture, and technological capability. The techniques, practices, and language used to produce a Cold War "closed-world discourse" created particular fictions, fantasies, and ideologies that were tied to technological creation and global control and affected the nature and design of the technological systems produced by the

[30] Raymond Williams, *Keywords: A Vocabulary of Culture and Society*, rev. ed. (New York: Oxford University Press, 1985), 145.
[31] Emanuel Adler, *The Power of Ideology: The Quest for Technological Autonomy in Argentina and Brazil* (Berkeley: University of California Press, 1987), 28.

military-industrial-academic complex and the metaphors used to describe them. Computers thus emerged as tools for analysis, command, and control. Their form reflected the aspirations of national defense operatives, and their applications were intended to advance the geopolitical strategy of the United States. Edwards opted to frame his argument in terms of discourse rather than ideology. This allows him to include "the entire field of signifying or meaningful practices: those social interactions—material, institutional, and linguistic—through which reality is interpreted and constructed for us and with which human knowledge is produced and reproduced."[33] Rather than limit his analysis to the exercise of state power, Edwards is most concerned with how knowledge and subjectivity are produced and how computers historically served as "supports" for a "heterogeneous ensemble" of linguistic, technical, and institutional actors. Like Edwards, I link technical production to knowledge production. The Chilean state's generation of knowledge of its industries and its citizenry constituted a form of state power, making undisciplined bodies productive and imposing particular forms of order on Chilean economic and social practices. However, I am not concerned with all acts of signification and all forms of subjectivity; my central focus will remain the dominant discourse articulated and advanced by the Chilean state.

Modernity as Ideology

Computers have contributed to and reinforced state conceptualizations of modernity and state modernization programs. As concepts, both modernity and modernization have a long and contested history. The idea of modernity can be found as far back as

[32] Edwards, *The Closed World.*
[33] Ibid., 34.

the writings of Machiavelli, Bacon, and Descartes, but most modernity theorists identify the Enlightenment in eighteenth-century Europe as the moment when modernity became linked to ideas of freedom, tolerance, science, progress, and reason.[34] The philosopher of technology Philip Brey cites Marx and Weber as the "fathers of modernity theory" and credits them for developing social theories that describe the transition from premodern to modern societies.[35] For Marx the expansion of productive forces transformed feudal society into a capitalist society and made a socialist state possible. Weber wrote about rationalization and increased efficiency found in industrialized capitalist societies, a phenomenon necessary for the increased accumulation of wealth. Technology, and its uses, figures into both of these theoretical framings. As an instrument of industrialization and a tool for bureaucratization and greater efficiency, technology deterministically drives change. However, more recent scholarship by historians and social scientists of technology has placed technology and modernity in a symbiotic relationship, whereby modernity shapes technology and technology helps create modernity. Ideas of what it means to be modern contributed to the form and function of many technologies and technological systems, especially when combined with nationalism.[36] Yet, as the historian Thomas Misa writes, "culture changing technologies," such as railroads, electric lighting, atomic power, automotive travel, and computerization, among others, "have been at the core of modernity because their presence and their promoters' promises have seemingly offered proof of the modernist storyline that

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[34] A genealogy of modernity can be found in Jorge Larrain, *Identity and Modernity in Latin America* (Oxford: Polity, 2000).
[35] Philip Brey, "Modernity Theory and Technology Studies: Reflections on Bridging the Gap," in Thomas J Misa, Philip Brey, and Andrew Feenberg, eds., *Modernity and Technology* (Cambridge, Mass.: MIT Press, 2003).

society is incessantly changing, ever progressing, transcending frontiers without an end in sight."[37]

In all these instances modernity describes a process of change based on the experience of Western industrialized nations. To be "modern" requires an implicit comparison to a more traditional other. Less-industrialized regions, such as Latin America, are as much a part of what it means to be modern as the nations of the industrialized world. The Chilean scholar Jorge Larrain dates the birth of modernity to Europe's discovery of the New World, a moment that reaffirmed the technological superiority and conquering might of the colonizers.[38] Europe became modern only in comparison to the more "primitive" peoples of the Americas, Africa, and Asia. This observation also appears in the literature on technology and empire. By making machines "the measure of men," European colonizers and imperialists justified their dominance over the peoples in the non-Western world through the perceived superiority of European thought and material culture.[39] During the midtwentieth century, the structural classification of societies as traditional or modern, as found in the progressive stages of economic growth proposed by W. W. Rostow or the universal trajectories of traditional to modern espoused by modernization theorists, further illustrated the interconnectedness of "modern" societies and those of the non-Western world.[40]

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[36] Recent Chilean legislation requiring all primary and secondary schools to have Internet access, regardless of their other financial and material needs, is one such example.

[37] Thomas J. Misa, "The Compelling Tangle of Modernity and Technology," in Misa, Brey, and Feenberg, *Modernity and Technology*, 12.

[38] Larrain, *Identity and Modernity in Latin America.*

[39] Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca, N.Y.: Cornell University Press, 1989). An analysis of technology and nineteenth-century imperial power appears in Daniel R. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (New York: Oxford University Press, 1981).

[40] W. W. Rostow, *The Stages of Economic Growth, A Non-Communist Manifesto* (Cambridge: Cambridge University Press, 1960). The sociologist Talcott Parsons also tried to map the structure of modern societies,

Modernity functions as an ideology. Understandings of modernity guide national policies, contribute to the construction of national identity, and exert hegemonic power. Following World War II, the idea of changing the social and economic structure of less-industrialized nations to reflect those found in the Western world fell under a new, but equally problematic, heading of development. Initially, development referred to economic growth exclusively, meaning an increase in the per-capita production of material goods, but it gradually expanded to include programs for social, cultural, and economic change. The discourse of development shaped Chilean economic policies of import substitution (ISI) and attempts to re-create the industrial path pioneered by the developed nations to the north.[41] During the 1960s the escalation of the Cold War prompted the United States to expand its influence in the southern hemisphere in the form of $22.3 billion in aid to Latin America over a ten-year period. Through this "Alliance for Progress" the United States tried to help Latin American countries overcome the long-standing ills of poverty, inequality, and oppression through material progress and the spread of democracy, in effect linking development to the ideological struggle of the Cold War.[42] President Eduardo Frei encouraged economic policies of import substitution to push development, supported the entry of multinational corporations into Chile, and approved the introduction of foreign technology, policies that made him and Chile an Alliance for Progress favorite. However, U.S.-led development strategies focused primarily on economic growth and failed to make Chile's social revolution a

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tying modernity to U.S. conceptualizations of capitalism and democracy. Talcott Parsons, *Structure and Process in Modern Societies* (Glencoe, Ill.: Free Press, 1960).

[41] Love notes that many Latin American economists first implemented policies of ISI, then searched for a theoretical basis for this approach. He writes, "Industrialization in Latin America was fact before it was policy, and policy before it was theory." Love, "Economic Ideas and Ideologies," 209.

priority. While Chile strove to either emulate or import the fruits of Western development in hopes of constructing a modern nation, "progress" came at the price of social change.

The crisis of ISI and the failure of the Alliance for Progress bolstered support for the economic framings offered by dependency theory, which the United Nations Economic Commission for Latin America (ECLA) was working on at its headquarters in Santiago. By the end of the 1960s dependency theory had begun to exert a considerable degree of influence within Chilean intellectual and political circles, shaping Marxist economic critiques and the eventual socialist project of the Popular Unity Party. Dependency theory challenged existing ideas of development and critiqued the universality of modernization theory. It still posited "underdeveloped" nations in contrast to those in the "developed" world and championed modernization, industrialization, and self-sustained growth. However, it made their attainment more elusive within the existing structures of world economic power. Under Popular Unity the Chilean government rejected the developmentalism of the previous administration and linked modernity to nationalized domestic production, the redistribution of wealth and consumer goods, and programs for agricultural, industrial, and social reform. In place of the universal path toward modernization suggested by Rostow and the modernization theorists, or the developmentalism practiced by the Frei administration, Chile under Allende struggled to find a path that was uniquely its own, tailored to Chilean needs and Chilean resources. Following the overthrow of the Allende government, the national stance on modernization and development assumed a very different tone, grounded

[42] Tony Smith, "The Alliance for Progress: The 1960s," in Abraham F. Lowenthal, ed., *Exporting Democracy: The United States and Latin America* (Baltimore: Johns Hopkins University Press, 1991), 72.

in a universal discourse of free-market economics and with little concern for social costs or political freedoms.

Each of these different approaches to modernization reflected a particular historical context and dominant political ideology. However, modernity and its pursuit also functioned as an ideology in its own right. It influenced executive policies, election platforms, and the criteria for receiving international aid. Beliefs about modernity and modernization defined international relations and set the terms for Chile's integration into the world geopolitical system. Moreover, these beliefs guided economic decisions, defined points of political contention, and attached values to projects of state growth and the methodologies used to bring them to fruition. Chilean computer systems adhered to and embodied these perceptions of modernity. They also symbolized Chilean progress, supported state modernization programs, and provided a point of comparison that linked Chile to the United States and nations of Europe. Just as a multidirectional relationship existed between political ideologies and Chile's use of computer technology, Chile's early computing machines reflected and advanced Chilean ideas of modernity and the modernization programs promulgated by the Chilean government.

Outline of Dissertation

This dissertation is comprised of six chapters and an epilogue. Chapter 2 regards the opening of IBM Chile in the late 1920s as part of the state modernization and rationalization efforts that began during the presidency of Carlos Ibañez del Campo and continued through the 1940s and 1950s. These efforts contributed to the formation of a bureaucratic welfare state and offered new forms of legitimacy that differed from the divine right or elite right to rule that had characterized the preceding two centuries. In essence, chapter 2 provides the prehistory of Chilean computing as well as the early history of the Chilean administrative apparatus during the first part of the twentieth century.

Chapter 3 examines how ideas of directed state planning and rationalized order played into the state-led modernization programs of Christian Democratic president Eduardo Frei Montalva and encouraged the application and regulation of imported computer technologies by the Chilean state, feeding the growing Chilean bureaucracy with punch cards and reams of paper. These state planning efforts, in turn, reinforced the values advanced by the Alliance for Progress, U.S. firms that were doing business with Chile, and the foreign expertise and foreign capital that were flowing into Chile. The chapter also documents the origins of the Computer Service Enterprise (EMCO), a state-owned company charged with governing Chilean use of computing technology, and the emphasis placed on science and technology as one of the pillars for modernizing the nation.

The next three chapters trace how science and technology, particularly computer technology, supported the socialist transformation outlined by the Popular Unity government and President Salvador Allende. I pay particular attention to the experimental project known as Cybersyn, to which I alluded to at the beginning of this introduction. Cybersyn sought to facilitate the economic transition from private to public ownership of production and increase the degree of worker participation in the nationalized factories. Here we see a distinctively Chilean application of computer technology that differed from the systems developed in other regions of the capitalist and socialist world. Chapter 4 provides a brief overview of Chilean science, engineering, and industrial design during the early 1970s and identifies a shift toward multidisciplinary, politically oriented research, which later facilitated the creation of the Cybersyn Project. Chapter 5 outlines the construction of the Cybersyn system and the social and technical networks formed in the creation of this technological system. Chapter 6 considers the Cybersyn system within the context of the Allende government and illustrates how the ideological program of the Popular Unity, as well as the ambiguities and contradictions of its practice, can be read through the design of the system and its construction. Taken as a whole, chapters 3, 4, 5, and 6 demonstrate how the Frei and Allende administrations used computers as "state machines" that assisted state projects, furthered political goals, and created ideas of Chilean nationhood. However, the values associated with technical expertise and computing machinery changed dramatically from one administration to the next. The Chilean government used computer technology to construct different ideas of Chilean modernity during the 1960s and 1970s and to reposition itself politically and technologically with respect to the developed world.

"The State Machine" concludes with a discussion of the neoliberal reforms of the Pinochet dictatorship and the shift from state-controlled computing to the rise of Chile's private computer industry. This shift was most visible in the demise of the state computer agency, which was renamed ECOM during Allende's presidency. In its place, we see a new conceptualization of Chilean modernity, now driven by economic growth and the development of the private sector. Chapter 7 also discusses how the dictatorship used computers as technologies for intelligence sharing and social control.

Several actors and themes that play a central role in the history of computation in the United States will not receive the same degree of attention here. Although the military does play a part in this story, until 1973 the Chilean military acted as a largely independent entity, separated from university and state administrative bodies. Unlike U.S. history, where the story of computer development cannot be detached from defense funding and military applications, a distinction between civilian use and military use can be made in the Chilean example. The Chilean military lacked the financial resources to fund massive research efforts, and military engineers received their technical training at the military academies, not the public universities. As a result, the public universities labeled their engineering departments with the broad heading "civil engineering," a title that referred to "civilian engineering" and separated the university's brand of engineering from that studied at the military academies. Following the coup in 1973, the military government began to encourage computer science training at the university level as a way to supply expertise to the growing private sector. The majority of formal computer science programs took shape during this period. This dissertation does not address the history of computation within the Chilean military, although such a study would surely contribute to the themes examined here. The reader will also note that I have chosen not to address the evolution of computer science pedagogy and professionalization within the Chilean universities. This decision was made to preserve the focus on computer technologies and their importance to state administrative practices.

The research presented here represents a synthesis of sources and questions drawn from a wide array of disciplines and repositories. This work may be categorized as a history of technology, given its focus on computing machines and their application, but it also pertains to a larger body of literature that strives to understand historical processes within Latin America. By merging methods and frameworks from Latin American history and the history of technology, this dissertation illustrates how an interdisciplinary approach can enrich both subdisciplines and augment our knowledge of Latin America as well as our understanding of technological development.

A Note on Method

The legacy of the seventeen-year military dictatorship under General Pinochet has created numerous difficulties for scholars wishing to conduct contemporary historical research in Chile. Most noticeable are the absences--the gaps on library shelves that bear testimony to the wave of book burnings incited by military paranoia throughout the 1970s and 1980s. Less noticeable are the effects of poor archival maintenance that has resulted in the massive loss of documentation to flooding, mold, and office relocation. Much has been written about collective memory in Chile and Chileans' ongoing struggle with their past. Although some are still trying to uncover the details of what happened between 1973 and 1989, many prefer to live in the present or look toward the Chile of tomorrow.

In efforts to overcome these obstacles, I have relied upon a diverse range of source materials, including but not limited to, design drawings, newspaper articles, photographs, computer printouts, folksong lyrics, government publications, and technical reports amassed from repositories within the United States, Britain, and Chile. These written sources have been complemented with approximately forty oral history interviews conducted on three continents between 2001 and 2004. I have translated to English all the passages excerpted from Spanish-language interviews and written sources unless otherwise noted.

The merits and pitfalls of oral history continue to fuel debate among historians. Detractors point to the notorious fallibility of human memory, while supporters maintain that oral sources offer new levels of richness for historical narratives and help in understanding the meaning of historical events. Many scholars of Chilean history have embraced oral history as one of the only methods of recovering the lived experiences of the country and of incorporating in the historical record voices from marginalized sectors of the population, including those of factory workers, members of indigenous populations, women, and the poor.[43] Within the history of computing community, oral histories have significantly enriched historical narratives of computation when used carefully and in conjunction with more traditional archival sources.[44] Earlier scholarship in the history of technology also demonstrated the value of oral history in increasing our understanding of work practices, social relations, reactions to events, and motivating forces.

All source materials, including oral histories, have their ingrained subjectivity and must be read with a critical eye. The reader should bear in mind that the memories presented in the following pages have been shaped by the postcoup experiences of the interviewees, many of whom went into exile after 1973 and some of whom experienced torture, detention, or interrogation at the hands of their own government. Most found themselves coming to terms with one of the most contentious periods of the Chilean past during the period that I was conducting my research. Thus the memories that people related to me cannot be viewed as objective accounts of what happened but when juxtaposed with one another can represent a

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[43] See, for example, Gabriel Salazar V., "Ciudadanía e historia oral: vida, muerte y resurrección," *Proposiciones*, no. 29 (1999); Peter Winn, "Oral History and the Factory Study: New Approaches to Labor History," *Latin American Research Review* 14, no. 2 (1979); and Leopoldo Benavides, "La historia oral en Chile," paper presented at the Seminario Interdisciplinario Autobiografía, Testimonio, Literatura Documental, Santiago, Chile, December 1987.
[44] William Aspray, "The Problems and Virtues of Oral-History," *IEEE Annals of the History of Computing* 15, no. 1 (1993). The Charles Babbage Institute, the leading repository for materials related to the history of computing, has also devoted increasing attention to the collection of oral histories in recent years.

confluence of many histories, a diffraction of voices, some overlapping, some not.[45] I have tried to remain as faithful to my sources as possible; any errors outside our excerpted conversations are mine alone.

The research for this dissertation took place during a rather exciting moment in Chilean history. On September 11, 2003, Chile celebrated the thirtieth anniversary of the military coup, an event that invited a national process of remembrance and reexamination. The series of commemorative events tied to the anniversary spurred a new willingness for Chileans to talk about the events of the past and deeply affected the scope and depth of my research.

Although politicians and historians alike are still trying to understand why this particular anniversary opened the Pandora's Box of collective memory, most agree that the event has permanently changed the scope of Chilean history, allowing for a greater number of voices to be heard and the documentation of new objects of study, among them studies of *Chilean* science and *Chilean* technology. During this period I shared my research with a number of journalists from the United States, Britain, and Chile. Material from chapters 4 and 5 appeared in the international press, including the Chilean press, for the first time in nearly thirty years. Moreover, I had the privilege of presenting this work to a number of Chilean audiences. While many Chilean science and engineering students were well versed in the U.S. and European trajectory of computer development, from Charles Babbage to Bill Gates, they did not know their own national history with computing

[45] Haraway uses the metaphor of diffraction to describe how we can overcome the inabilities of reflexivity, which fails to position objects and subjects in the process of knowledge making. Diffraction accounts for a world where "interference patterns can make a difference in how meanings are made and lived." Although Haraway believes diffraction patterns result from different combinations of visible subjectivity on the part of the witness, I hope that *presenting* a series of subjective, juxtaposed voices will also result in a rich text that does not claim objectivity but rather acknowledges the multiple voices of the lived past. Donna J.

machines and the unique path of technological development that their government had once pursued. The addition of technological themes to studies of the Popular Unity government represented one of the many changes to Chile's historical landscape and the evolving historiography of this controversial period.

Computing histories can contribute to our academic understandings of information technologies, but they can also contribute to larger political discussions and heighten public awareness of a diverse set of national histories. I hope this work will not only enrich the history of computing literature by including the experience of this South American nation but that it will also help Chileans realize the wonder of their own technological history and their contributions to this pervasive technology.

Haraway, *Modest-Witness@Second-Millennium.FemaleMan-Meets-OncoMouse: Feminism and Technoscience* (New York: Routledge, 1997).

Chapter 2

The Making of the Masses

IN HIS memoir Thomas Watson Jr., former IBM president and son of IBM's first president, Thomas Watson Sr., recalled that when he first heard of his father's plan to create a world trade subsidiary of the data-processing giant, he dismissed it as simplistic and naive. "We had endless opportunity and little risk in the U.S.," he wrote, "while it was hard to imagine us getting anywhere abroad. Latin America, for example seemed like a bottomless pit."[1] The senior Watson, however, had a different impression of the potential for profit within the world market, believing that one day sales abroad would surpass IBM's growing domestic business. The younger Watson criticized his father's expansion plan in the mid-1940s, several years before IBM officially established its world trade subsidiary. By that time, however, the company had already established a substantial presence within Latin America.

IBM had begun investing in Latin America before 1914 under its original acronym, CTR (Computing Tabulating Recording Company), with operations in

[1] Thomas J. Watson Jr., *Father, Son, & Co.: My Life at IBM and Beyond* (New York: Bantam, 1990), 175.

Buenos Aires, Argentina, and soon after in Brazil and Uruguay.[2] The Chilean market, concentrated in the city of Santiago, constituted IBM's fourth office within the region. By the end of World War II, IBM had opened at least nineteen offices in no fewer than twelve Latin American countries, each facility dedicated to selling punch-card tabulating machinery to Latin American governments and businesses.[3] Historians of computer technology generally cite these early punch-card machines as among the predecessors of today's modern computing machines.[4] In this light, Chile's history with computing machines began long before the neoliberal economic reforms of the 1970s and 1980s that opened Chilean borders to a flood of foreign technologies and corporations and predated even the arrival of the first digital machines in Santiago during the 1960s.

Indeed, IBM began exporting punch-card tabulating machinery to Chile as early as 1921. In 1925 the Chilean State Railroad Company, seeking to mechanize its department of statistics and finance, ordered tabulating machines directly from IBM headquarters in New York, as did the Customs Office, which wanted to

[2] IBM Archives, *Frequently Asked Questions,* June 2004, http://www-1.ibm.com/ibm/history/documents/pdf/faq.pdf (July 15 2004); "Buenas Ideas, Pilares de IBM," *Diálogo IBM Chile*, September-October 1977.

[3] IBM Archives, *Frequently Asked Questions.* Although these are the official dates from the IBM Archives, it is worth noting that these documents record 1924 as the year IBM opened an office in Santiago, which does not coincide with the 1929 date found in corporate histories of IBM Chile, such as Fernando Villanueva's *Edición Especial de Aniversario, IBM 70 años en Chile* (Santiago: IBM Chile, 1999). The FAQ issued by IBM most likely contains other errors in reporting the years that IBM offices opened elsewhere in the world. The document, however, still provides a useful estimate for measuring the degree of IBM's penetration in Latin America within a general time frame.

[4] Cortada writes, "The important difference between this technology [punch-card machines] and others was that it dealt with a *system* that processed information quickly and in high volume." James W. Cortada, *Before the Computer: IBM, NCR, Burroughs, and Remington Rand and the Industry They Created, 1865-1956*, (Princeton, N.J.: Princeton University Press, 2000), 44. See also William Aspray, *Computing Before Computers* (Ames: Iowa State University Press, 1990); Martin Campbell-Kelly and William Aspray, *Computer: A History of the Information Machine* (New York: Basic Books, 1996); and Paul E. Ceruzzi, *A History of Modern Computing* (Cambridge, Mass.: MIT Press, 1998).

calculate statistics on import and export activity (see figure 2.1).[5] When the Chilean government decided to apply this new technology to processing the results of the 1930 population census, IBM Chile opened its first office in downtown Santiago in 1929 with only two employees, both of whom were charged with supporting the census effort. Although Chilean customers had imported machines directly from IBM headquarters in New York before 1929, the opening of the Chilean branch office signified the beginning of IBM's corporate infrastructure within Chile and the beginnings of a dedicated effort to increase the size of the Chilean market for punch-card tabulating machines.

As earlier works in the history of technology have shown, the creation or introduction of new technologies—their origin stories—rarely is a discrete event but rather must be situated as part of larger historical trajectory. The question remains, within which trajectory should we place the opening of IBM Chile? Earlier histories of computer and other office technologies reveal several dominant approaches. Yates's work on the adoption of office technologies during the nineteenth and early twentieth century suggests that the arrival of IBM tabulating machines could be viewed as another development in the history of office technologies such as typewriters, accounting equipment, and filing systems and their respective

[5] Villanueva, "Edición Especial de Aniversario, IBM 70 años en Chile." It is interesting to note the similarity between Chile's early customers for punch-card tabulating machines and those in the United States. The heavy data-processing needs of government agencies and railroad companies made them among the first purchasers of Herman Hollerinth's early tabulating machines. Hollerinth's background at the U.S. Census Bureau and his involvement with the U.S. censuses of 1890 and 1900 have been well documented. The importance of information technology to the railroad industry may appear less obvious. The economic historian Alfred Chandler cited the U.S. railroad industry as the prototype for modern business organization, which depended heavily on new innovations in information technology. Hollerinth, who founded the company that would one day become IBM, actively sought the railroad companies as his first clients. He also dedicated a number of years to reforming railway administration methods to incorporate the benefits of tabulating machines. In Chile the customs office was also an early adopter of foreign technologies because the agency was able to acquire imported goods.

applications in business management. [6] Such a study would undoubtedly prove worthwhile to our understanding of Chilean technological, business, and administrative history. Unfortunately, the lack of available resources on this topic prohibits an analysis of this form, although this should not detract from the overall merit of this approach.

Historians such as Beninger and Edwards have taken a somewhat different path by placing successive innovations in office and computer technologies within a framework of control.[7] This approach proves particularly useful when discussing the role of the military-industrial-academic complex in funding research and formulating the research questions that lead to specific technological developments. With that in mind, the argument presented in this dissertation does address how desires for development encouraged the adoption of state planning techniques, the use of technical experts, and the importation of computing technologies as a means of controlling of Chile's economic, social, and administrative processes. However, I do not frame control as a cultural metaphor or examine how ideas of control operated outside the realm of the state administration.

In *The Visible Hand* Alfred Chandler makes the case that modern business organization and its related techniques for information management evolved in response to the increasingly complex needs of private industry and corporate growth.[8] His thesis, while applicable in the context of U.S. business history, is not suitable for studies of Chile or perhaps any other country in the developing world.

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[6] JoAnne Yates, *Control Through Communication: The Rise of System in American Management* (Baltimore: Johns Hopkins University Press, 1989).
[7] James R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge, Mass.: Harvard University Press, 1986); Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, Mass.: MIT Press, 1996).

For most of the twentieth century, Chilean economic strategizing revolved around policies of state-led growth, whereas in the United States the growth and cultivation of the private sector dominated economic policies. Many management techniques that Chandler cites as arising from private sector need, such as technological innovations in transportation, communication, and administrative networks, arrived in South America through state-sanctioned imports and the state's contracting for expertise from foreign companies. In contrast to Chandler's reading of U.S. history, the early adoption of information technologies within the Chilean context did not stem from private sector needs or from domestic innovation.

Finally, many corporate histories of IBM have attributed its early penetration of foreign markets and international dominance to the aggressive business approaches used by IBM's first president, T.J. Watson. His philosophy of swiftly expanding the company's customer base abroad and thus entrenching the use of IBM products worldwide allowed the company to edge out its competition in the Chilean market from the outset. The opening of IBM's Chilean branch office, therefore, could be viewed as another example of Watson's effective business strategy. The emphasis on IBM sales tactics found in histories written by former IBM employees, as well as in other histories of the company, has merit. [9] However, this analytical framework also has the potential of creating a one-sided, U.S.-centric narrative, which homogenizes IBM's efforts to create new markets in dramatically different political and cultural settings throughout the world. With regard to the Chilean context, IBM corporate histories can tell only part of the story. IBM strategies for international expansion may explain how these machines arrived in

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[8] Alfred Chandler, *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, Mass.: Harvard University Press, 1977).

Chile during the 1920s, but they do not explain why the Chilean government readily accepted them and applied them to key government tasks.

Rather, this dissertation frames the beginnings of IBM Chile and its application of punch-card tabulating machines to the Chilean census effort as part of a larger history of state modernization. When IBM's Chilean branch office began operations in 1929, the Chilean government was in the midst of restructuring its administrative practices, bringing them in line with positivist conceptions of national progress through rationalized order.[10] Increasing the efficiency and scope of the state apparatus reflected this ideological commitment to state organization and political control that the authoritarian Chilean president Carlos Ibañez del Campo (1927-31) promoted. A strong executive, who at times bore a closer resemblance to a dictator than an elected leader, Ibañez advanced a program of "state socialism" as a means of preventing a revolt among the Chilean working classes, who bore the brunt of economic dislocations from nineteenth-century industrialization. The state, he argued, could provide for the Chilean masses and create programs of social protection in order to prevent genuine socialist revolution. The administrative growth that ensued gave rise to the Chilean welfare state and entailed the widespread adoption of scientific techniques and expertise to modernize state operations and manage poverty, among other social ills.

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[9] Watson Jr., *Father, Son, & Co.*; Cortada, *Before the Computer.*

[10] Of the frameworks listed, the argument presented here bears the closest resemblance to that of Jon Agar, *The Government Machine: A Revolutionary History of the Computer* (Cambridge, Mass: MIT Press, 2003). Although there are important differences between the British case as described by Agar and the Chilean case, which stem from historical disparities in political events, economic resources, the degree of industrialization, and the level of integration in the world marketplace, this work, like Agar's, studies how the introduction of computer and information technologies changed the scope of government administration, supported differing ideological visions of governance, and altered the relationship between citizens and the state.

This chapter illustrates how the conceptualization of a socially protective state arose in response to the negative economic and social effects of nineteenth-century industrialization and the failure of previous governments to address those effects, known in Chile as "the social question." By directing Chilean citizens from all social backgrounds to look to the state as a source of protection and well-being, the Ibañez administration managed to stall the effects of class antagonisms and create a new ideological framework that legitimized his administration.

From the perspective of Chilean history, the government contract with IBM Chile represents one aspect of a multisited push to create an ordered state, which also included promoting engineers to high-ranking positions, undertaking ambitious public works projects, and applying scientific methods to the collection of official statistics and to record keeping. Within the overall scope of state modernization efforts, tabulating and calculating machines played a small but significant role. While it is important not to overstate the importance of these technologies, detailing how these machines permitted the state to visualize complex economic and social interactions, and expand the scope of state operations by increasing the wealth of data available to it, complements our knowledge of these other modernization initiatives. In this chapter I argue that the adoption of scientific methods and imported technologies during the latter part of the 1920s played a vital role in Ibañez's program to create a nation free from political chaos, with the potential to progress and develop along the same path as nations in the modern industrialized world. The emphasis, therefore, is not on IBM per se but rather on the state's coordinated efforts to rationalize, order, classify, and control Chile's economic and social activities through scientific and technological interventions, including the early use of tabulating machines. These early efforts to rationalize, classify, and produce detailed scientific knowledge of the Chilean economy and population furthered a conceptualization of development that was grounded in policies of state-led economic growth, programs for social welfare, and the techniques of directed planning. Subsequent chapters will address how the naturalization of this development discourse transcended political ideology and guided the creation of Chilean economic policy during the latter half of the twentieth century.

Ordering a Nation

The Chilean elite's desire to bring order to chaos began shortly after Chile declared its independence from Spain in 1810. Early drafts of the Constitution tried to mimic the liberal values of the French Revolution and transform Chile into a republic of equal citizens, each endowed with the same rights, duties, and abilities to elect government officials.[11] However, conflicts among liberal leaders, as well as between the liberals and their conservative opponents, threatened to destabilize the Chilean government and provoke the ire of both the Chilean elites and segments of the military. In 1830 members of the military, backed by the upper class, succeeded in overthrowing the government, unseating the president, and establishing a new system of rule. The earlier commitments to liberalism gave way to the even stronger appeals for authoritarian order posed by the new government of Diego Portales. As a Latin American *caudillo,* or strongman, Portales quickly expanded the authority of the central government, especially the unchecked power of the executive branch. These changes appeared in the 1833 Constitution, which governed Chile for the next fifty-eight years.

[11] Equality, that is, among propertied and educated men of Spanish descent.

Political uprisings and the establishment of a provisional authoritarian "democracy" constituted one of many changes that dramatically altered the Chilean way of life during the middle part of the nineteenth century. Wars and heated negotiations with neighboring countries to the north and south, as well as with Chile's own indigenous Mapuche population, had demarcated national boundaries, proved the effectiveness of the Chilean military in combat, and, toward the end of the century, augmented Chile's wealth in natural resources with the nitrate mines in the Atacama Desert, which previously were held by Peru and Bolivia. With British investment Chilean copper mines grew to become the leading world exporters of the metal until the 1870s. The wealth and foreign investment flowing into the northern mining towns trickled down to the workers through higher, though still dismal, salaries, higher costs of living, large concentrations of salaried workers, and the beginnings of class consciousness. It also created a powerful economic tie between Chile and the global marketplace, making the country vulnerable to the effects of world economic cycles.

Increased mining activities in the northern regions fueled economic growth in the south. The northern copper and silver mines generated business for the coal mines of Lota, Coronel, and Lebu in the southern region of Concepción. Agricultural expansion in central Chile paralleled the growth of the Chilean mining industry and created a need for seasonal rural wage laborers to help with the increased production but could not offer permanent employment opportunities. Families from the countryside traveled in waves toward the cities in search of work. These waves of migration amplified the size and density of Chilean urban areas and eventually transformed a population once dominated by rural peasants *(campesinos)* and large plantations (*haciendas*) to one primarily made up of salaried urban dwellers.

The technical marvels of the nineteenth century, such as the railroad, steamship, and improved road system, opened new opportunities for employment in massive public works projects and further encouraged urban migration.[12] Once completed, these projects contributed significantly to boosting Chile's economic activity and advancing the process of national unification. Chile boasted one of the first railways in Latin America, which was planned in the 1840s. The first line was completed on Christmas Day 1851, stretched fifty miles, and connected the northern mining town of Copiapó to the port of Caldera. On September 14, 1863, work was finished on the challenging 116-mile line that linked the principal urban centers of Santiago and the port of Valparaíso. Government estimates claimed that in 1861 alone the railway between Santiago and Valparaíso transported more than 600,000 people and 130,000 tons of goods.[13]

The Pacific Steam Company, headed by the North American William Wheelwright, was the first and primary investor in the construction of Chilean railways. The company, with the backing of British investors, had already introduced a system of steam navigation to the region and had established a shipping line that crossed the Pacific Ocean and the Magellan Straits.[14] The Civil Engineering Corps, founded in 1842, played an important role in expanding and improving road, canals, and ports from the 1840s to the 1860s, constructing a more complete network that connected Chile's urban centers, outlying provinces, and the

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[12] For a condensed history of Chilean railway and telegraph construction, see Sergio Villalobos R., *Historia de la ingeniería en Chile* (Santiago: Hachette, 1990) ; Ernesto Greve, *Historía de la ingeniería en Chile*, vols. 1 and 2 (Santiago: Imprenta Universitaria, 1938); Ernesto Greve, *Historía de la ingeniería en Chile*, vol. 3 (Santiago: Imprenta Universitaria, 1944); Guillermo Guajardo, "Burocracía Técnica y cambios socio-economicos en Chile: El caso de los Ferrocarriles del Estado, 1852-1914," Universidad de Chile, Santiago, 1988; and Rafael Sagredo Baeza, "Política y Ferrocarril en el Chile del siglo XIX," *Patrimonio Cultural*, Autumn 2001.

[13] Villalobos R, *Historia de la ingeniería en Chile*, 133.

[14] Sergio Villalobos R, *A Short History of Chile* (Santiago: Editorial Universitaria, 1996).

Pacific Ocean. The Civil Engineering Corps was in such great demand that the government decided to form the controversial Ministry of Public Works in the 1870s to keep up with Chile's rapid pace of development. Work on roads south of Concepción advanced as a result of the personal efforts of the local inhabitants, who built many of the roads themselves.

By the 1880s the transportation networks formed by the interconnecting systems of railways, roads, and steamships had succeeded in dramatically transforming Chile from a loosely linked territory of scattered urban and rural dwellers to an organized, traversable space that could be navigated without great difficulty. These technologies offered new levels of mobility to the growing working class, which migrated regularly between the northern and southern regions of the country, depending on the work opportunities available. Because of their capacity to mobilize and connect people and goods, these technologies played a significant role in converting what was an "imagined community" under Spanish rule into a cohesive nation.[15] Loveman argues that these technologies played a primary role in constructing Chilean nationhood. He writes, "More important even than the advancing urbanization of the population, Chilean society and the economy became truly national with the extension of the rail lines, telegraph networks, and steamship service and the evolution of a national labor market."[16] The introduction of these transportation systems, moreover, played a formative role in the creation of an integrated workforce, which would later evolve into a self-conscious proletariat,

[15] Benedict R. O'G. Anderson, *Imagined Communities: Reflections on the Origin and Spread of Nationalism* (New York: Verso, 1991).
[16] Brian Loveman, *Chile: The Legacy of Hispanic Capitalism*, 3rd ed. (New York: Oxford University Press, 2001), 175.

or working class, that would push the social question and reshape Chile's political landscape in the next century.

As the nineteenth century advanced, the strength of the authoritarian state created by Diego Portales began to erode, and facets of liberal doctrine reemerged among the Chilean elite. Conservatives felt that liberal ideals posed a significant threat to the tight-fisted Portalian state that had dominated the Chilean public sphere. The conservatives accused the liberals of removing the state's moral foundation because they rejected Catholicism and had reintroduced social pluralism and civil liberties. In 1871 Chile elected its first liberal president since the drafting of the 1833 Constitution, and liberal candidates continued to win the presidential office for the next twenty years. Even before 1871, the liberals had managed to build a significant stronghold within Congress. Upon securing the presidency, they were able to bring about constitutional reforms that expanded the role of the legislature and reined in the power of the executive branch. They also implemented a number of reforms that weakened the influence exerted by the Catholic Church, which the liberals viewed as a reactionary institution. For the purposes of this study, one of the more interesting administrative changes involved the creation of a civil registry service responsible for recording all births, deaths, and marriages, a responsibility previously assumed by local parishes.

This political convergence, however, did not guarantee a harmonious relationship between the president and the parliament. In 1891 most of the Chilean Congress backed a coup against President José Manuel Balmeceda, citing his authoritarian claims to executive power, which they felt did not respect the rights and wishes of Congress. When it became apparent that the troops backed by

Congress were besting those of the president, Balmaceda committed suicide, and liberal ideology returned to a position of dominance.

According to the historian Mario Góngora, 1891 marked a watershed in Chilean history, signifying the end of the Portalian era and concluding a century of waging war. Chile entered an era of "fantasmal" politics, characterized by oligarchic parliamentary rule that was incapable of confronting the social and economic realities of nineteenth-century modernization. During the late nineteenth century, the growing numbers of Chilean workers employed in the nitrate and copper mines had intensified the struggle between labor and capital. No legislation protected workers from abuse and economic uncertainty; workers throughout Chile began pressing for changes that would ameliorate the wretched conditions of poverty that they and their families were forced to endure. The liberal philosophies voiced by Chilean political leaders echoed the egalitarian and individualistic principles of British libertarian thought but failed to address the daily realities endured by the majority of the Chilean population. Living conditions further declined in the first two decades of the twentieth century, a situation exacerbated by the First World War and its aftermath. Disrupted trade routes between Chile and its two major European markets, Britain and Germany, combined with a drop in demand for Chilean nitrates with the introduction of a cheaper synthetic at the war's conclusion, created shortages of consumer goods, inflated prices, lower wages, and massive unemployment.[17] Members of Chilean urban working classes lived in squalid conditions, marked by disease, filth, and crime. The misery of poverty, abusive

[17] The entrance of the United States in World War I created a short-lived boom in the export of Chilean raw materials and fueled growth in selected Chilean industries such as cement, textiles, and sugar refineries. However, the positive effects of this brief boom paled in comparison to the economic devastation brought

working conditions, economic instability, and a lack of legislative provisions for worker protection fueled worker unrest and gave rise to the first organized labor movements. At the same time, greater access to secondary education and an expanding state contributed to the creation of a new middle class, consisting of small shop owners, government workers, and career military. This new class voiced its opinions and interests concerning the leadership of the nation; especially vocal were middle-class reformers in the military who felt it was their duty to save the country from the threat of anarchy they perceived and to encourage progress.[18]

Legislators openly condemned organized labor, collective bargaining between workers and management, and legislative protections for the industrial classes as going against liberal conceptualizations of liberty and the right to work, but these same legislators regularly protected the rights of the aristocracy in practice. Rhetorical appeals to liberty and equality met the needs of the Chilean elite ideologically but failed to address the many harmful effects of nineteenth-century industrialization and the social question. The liberal principles professed by the Chilean government afforded middle and working classes greater freedom of expression, but in general the democratic reforms put in place after 1891 created a democracy for the powerful, a "democracia caudillesca," or democracy controlled by a strong man.[19] The military disapproved of the working-class mobilization permitted

by the introduction of synthetic nitrates in the world market, which created a Chilean nitrate crisis with trickle-down effects. By 1920 the social question had become a central force in Chilean politics.

[18] Military unrest increased during the "parliamentary period" and resulted in several failed military efforts to overthrow the government. Although the military disliked the increasing economic and social chaos of the parliamentary period, as well as the government's interference in military affairs, the military did not support the growing labor movement and massacred large numbers of striking workers in Valparaíso, Santiago, and Iquique.

[19] Mario Góngora, *Ensayo histórico sobre la noción de estado en Chile en los siglos XIX y XX*, 2nd ed. (Santiago: Editorial Universitaria, S.A., 1986).

under liberal doctrine, fearing it would incite political chaos and deepen the possibilities for the spread of communism.

The power struggle among the executive branch, legislative branch, and military, exacerbated by the growing social unrest from below, quickly reached a breaking point. In 1924 a military junta forced the resignation of President Arturo Alessandri, a reformer, who temporarily fled to Europe. Following a second coup by military reformers led by Col. Carlos Ibañez, Alessandri returned to the Chilean presidency in 1925. With newfound support among the military and a pacified Congress, the Alessandri government drafted a new Constitution, which was approved by plebiscite in 1925. The Constitution shifted power back to the executive branch, restricted the authority of Congress, separated church and state, and included provisions for the protection of labor through housing and social security programs. Ideological problems, however, continued to persist between the president and the military. In 1927 Alessandri resigned from the presidency for a second time, under pressure from his minister of the interior, Gen. Carlos Ibañez de Campo, who took over the presidential office after a controlled election that gave him approximately 96% of the popular vote.[20] Ibañez initially appeared committed to the 1925 Constitution but broke quickly from its legal and philosophical provisions and returned Chile to a personalist dictatorship not seen since the days of Diego Portales.

Ibañez became the symbol of a new, strong Chile, a new kind of *caudillo* who strengthened the state through bureaucracy rather than by force. He dealt aggressively with his political opponents and oppressed dissenting voices, but he also subscribed to Alessandri's philosophy that programs of state "socialism," or welfare from above, could prevent genuine socialist revolution from below. Ibañez promoted the idea that the state had a moral obligation to protect all social sectors of the population, a commitment realized by expanding the state administration, implementing a labor code that both legalized and controlled labor organization, and applying new techniques and technologies to manage this rate of growth. Although Chile had experienced the effects of modernization during the nineteenth century, as judged by the introduction of new transportation, industrial, and agriculture technologies, most historians of Chile cite Ibañez's presidency as the moment when science, technology, and appeals to rationalization intersected with state administrative practices.[21]

In this context the application of IBM tabulating machinery to Chile's 1930 census effort is but one manifestation of a larger government effort to create a modern nation-state grounded in technical expertise rather than parliamentary politics. The next section will place the introduction of these early tabulating machines within the context of other initiatives to rationalize state operations, which included the promotion of engineers to high positions of power, the new attention paid to generating accurate statistics, and the creation of government agencies dedicated to state coordination and planning.

Moreover, Ibañez identified industrial growth as the necessary precursor to social well-being. This resulted in a new set of criteria for modernization that began during his presidency and solidified during the next two decades. This definition of

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[20] Loveman, *Chile*, 183.

[21] Ibid.; Góngora, *Ensayo histórico sobre la noción de estado*; Sofia Correa et al., *Historia del siglo XX chileno* (Santiago: Editorial Sudamericana, 2001); Aldolfo Ibañez Santa Maria, "Los 'ismos' y la redefinición del Estado: tecnicismo, planificación y estatismo en Chile, 1920-1940," *Atenea*, no. 474 (1996); Aldolfo Ibañez Santa Maria, *Los ingenieros, el estado y la política en Chile: del Ministerio de Fomento a la Corporación de Fomento, 1927-1939*, vol. 7 (Santiago: Instituto de Historia, Pontificia

modernity, first articulated within Chile and later combined with the development discourse that emerged in the wake of World War II, dominated Chilean economic policies, encouraged the use of advanced imported technologies, and remained unchallenged until the 1970s.[22]

Carlos Ibañez del Campo

The military junta and subsequent "election" that brought Carlos Ibañez to power signified a mounting distaste for politics, particularly among members of the armed forces, and the failure of the elite to confront Chile's political and economic challenges. Ibañez's presidency, moreover, signified an intellectual as well as a political shift toward nationalism, order, progress, and state protectionism. Likewise, his articulation of the state stood in deliberate contrast to the British liberal values and elite rule of the past; instead, Ibañez drew from the positivist modernization strategies of the Porfiriato in Mexico and a belief that authoritarian rule would augment the pace of industrialization, as demonstrated by Otto von Bismarck in Germany. This approach reflected a mind-set shared by members of the Chilean army, who felt it was their duty to "save the Republic" and place Chile on the correct path toward national growth, regeneration, and public well-being, even

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Universidad Catolica de Chile, 1985); Aldolfo Ibañez Santa Maria, *Herido en el ala: estado, oligarquías y subdesarrollo* (Santiago: Universidad de Andres Bello, 2003).

[22] Here I am referring to Arturo Escobar's definition of *development discourse,* which he defines as "how certain representations [of the Third World] become dominant and shape indelibly the ways in which reality is imagined and acted upon" and create a "space in which only certain things could be said and even imagined." Arturo Escobar, *Encountering Development: The Making and Unmaking of the Third World* (Princeton, N.J.: Princeton University Press, 1995), 5, 39. This discourse was produced and applied through international bodies such as the United Nations and its filial organizations, the World Bank, and government leaders within the United States, Europe, and so-called underdeveloped nations, as well as by groups of experts representing various disciplines and interests.

at the expense of Chile's legal framework. [23] The self-perceived importance of the armed forces in national modernization efforts reflected the Prussian influence in their education and training and succeeded in expanding their role in public life. Mandatory military service further increased the popular adoption of military views on patriotism and historical development and widened Ibañez's base of popular support during the early years of his presidency.

While in office, Ibañez made it a priority to expand Chile's network of roads and railroads. He used foreign credit to build schools, hospitals, and administrative offices. Raúl Simon, director of the Budget Office under Ibañez, eloquently linked these ambitious undertakings as fundamental to the regime's constructive philosophy, observing that:

> Doctrines change and initiatives are not eternal. Only the railroads, the universities, the roads, the ports, the schools, and the works for public health remain. These are the only things that political passion cannot destroy and the only things that history cannot refrain from mentioning.[24]

In addition to showing an explicit disdain for "political passion," this passage reveals an implicit conviction that the state infrastructure could best provide for the long-term health of the nation. This included the public works projects championed by both Ibañez and Simon, as well as the creation of new administrative bodies capable of managing and coordinating the myriad of economic and social welfare projects originating during this period. Through this administrative growth a protectionist

[23] In his first message to Congress as Chile's acting executive, Ibañez wrote, "I will not omit my own sacrifices or those of others in order to guide the country toward the right path, maintaining order, although at the end of my time in office, instead of being able to declare that I have closely followed the law, I would only be able to affirm, repeating the historic phrase: 'I swear that I have saved the Republic.'" *Mensaje leido por S.E. el Vicepresidente de la República en la apertura del Congreso Nacional el 21 de mayo de 1927* (Santiago: Imprenta Nacional, 1927), 46.
[24] Raúl Simon, *Anales del Instituto de Ingenieros*, December 1927. Quoted in Ibañez Santa Maria, *Los ingenieros, el estado y la política en Chile.*

state emerged in place of its parliamentary predecessor. Ibañez argued that extending state involvement into Chilean economic and social spheres enabled the government to protect and improve the living conditions of most Chilean citizens. The government justified this growth as the best means for stimulating the Chilean economy while protecting the working and middle classes from the abuses of the elite. These changes, moreover, served the deeper purpose of curtailing a nascent labor movement and preventing a genuine revolution from below that might implement radical structural changes. Therefore, the growth of the state apparatus that occurred during Ibañez's presidency must be viewed as both the beginning of a protectionist welfare state and the introduction of new techniques for social control. In the end, these administrative techniques, rather than the public works endeavors, would constitute the legacy of Ibañez's first presidency. As Góngora writes, "The great value of Ibañez was in his administration."[25]

The Rise of the Técnicos

While still minister of war under President Alessandri, Ibañez gave a speech to the House of Representatives that set the stage for the next five years of his presidency:

> It is necessary to establish clearly and frankly that the country cries out for expanding the principle of authority; that it wishes to end anarchy, enemy of all progress, that it desires, once and for all, to introduce the social justice that our laws establish . . . ; it also asks, in accordance with our resources, that we reorganize our public administration, modernizing it and reducing it to the benefit of its efficiency.[26]

Unbeknown to Ibañez at the time, modernizing the state administration would entail its growth rather than its reduction in size. The creationist spirit of the

[25] Góngora, *Ensayo histórico sobre la noción de estado*, 178.

administration's public works programs also applied to the structure and scope of the Chilean ministries and their subordinate agencies. Ibañez formed the new Ministry of Development (Ministerio de Fomento) in 1927, one of his more important contributions, given that it served as a precursor for the independent State Development Agency (CORFO), which spearheaded Chilean policies for state-led growth from 1939 on. Moreover, the Ministry of Development provided an example of the perceived necessity for state intervention in order to industrialize the public and the private sectors. The Ministry of Development and later the State Development Agency both depended upon the advice of technical experts in drafting economic policies while trying to outwardly eschew the influence of partisan politics.

The Ministry of Development was one of several key changes to administrative organization and practice. In 1927 the Ministry of Justice and Instruction split into two separate ministries, Education and Justice. The Directorate of Public Works also increased its importance under Ibañez and secured many of the same powers as the cabinet-level ministries, much to the pleasure of the Chilean engineering and technocrat communities. In fact, the number of ministries was limited only by the scarcity of adequately trained *técnicos* (university-trained technical experts) required to fill their ranks.[27] The increasing complexity of the state led to the creation of the General Comptrollers Office, also in 1927, which initially housed the Statistics Bureau until it became an independent agency in 1930. Later, Ibañez created Chile's first National Economic Council, a body charged with providing expert economic advice to the executive but one that regularly bowed to the wishes of the president in practice, frustrating industry leaders. Even local

[26] Cited in Ibañez Santa Maria, *Los ingenieros, el estado y la política en Chile*, 5.

governments felt the effects of administrative reform, as local elected representatives were replaced by appointed juntas de vecinos (neighborhood governing bodies). In this manner Ibañez constructed a vast network of supporters that reached into the very infrastructure of local community governments. The juntas de vecinos assisted members of various social groups within their communities and promoted government goals at the local level through the elimination of political dissidence and the repression of social movements. Political goals were thus realized through changes in administration, an approach that contrasted sharply with the political mechanisms of the past. As Chileans began to look to the state as a new source of economic and social protection, members of the Ibañez government further entrenched their claim to legitimate rule and strengthened their vision of the Chilean nation.

This "*tecnificación*" of the state demanded a new workforce fueled by young, middle-class men who could renovate existing administrative practices without a political commitment to the status quo. Within this new labor force engineers gained considerable respect and influence and ascended to key posts in the administration. The treasury minister, Pablo Ramirez, assembled a group of talented engineers from the State Railroad Company (Ferrocarriles del Estado) and placed them in a number of high-ranking positions throughout the government, including director of the Budget Office, director of the General Accounting Office, superintendent of customs, director of the Internal Revenue Service, as well as in several crucial positions within the Ministry of Development. Ibañez supported the replacement of politicians with *técnicos* throughout his presidency, believing they had a closer connection with

[27] Decreto Supremo 7.912, 12 November 1927, Santiago. Cited in Ibañez Santa Maria, *Herido en el ala*, 126.

the challenges of the day and the training to meet those challenges successfully. Along the same lines he emphasized industrial education over the traditional liberal education of the past, a preference that carried over into the military schools. Young Chilean soldiers received lessons in machining, telegraph operation, and public works in addition to the requisite combat training.

The historian Ibañez Santa Maria has written at great length on the rise of the engineering profession in Chile during the 1920s and 1930s. His studies illustrate how the values of the Ibañez government created an environment that not only employed *técnicos* but also laid the foundations for training future generations of engineers and technocrats, who were inspired by the new range of opportunities available to them. These *técnicos*, in turn, spread the positivist doctrine characteristic of the era and played a crucial role in separating state modernization strategies from the practice of politics as usual. The visibility and prestige of Chilean engineers within the government led to an increased sense of self-worth within the profession. In 1927 Chilean engineers lobbied to restrict the title of "engineer" to include only those who had graduated with an engineering degree from a university, a codification of professional identity that would resurface again in the 1960s. Four years later, in 1931, the Chilean Engineering Institute began its practice of awarding a gold medal to the individual its members felt had most honored the profession. In 1938 the organizing committee of the First South American Engineering Conference commissioned a two-volume history documenting the contributions of Chilean engineers to the progress of the nation, later supplemented by a third volume commissioned by the institute in 1944.[28]

[28] Greve, *Historía de la Ingeniería en Chile.*

By the end of the 1920s engineers had come to be seen as modernizers and instruments of economic growth and progress. Their new prestige within the state administration coincided with the introduction of new technological wonders, such as electrification networks, the automobile, refrigeration, and the telephone, a confluence that reinforced the engineers' sense of self-worth and importance in Chilean modernization efforts. Perhaps the prominent engineer Ramón Salas Edwards said it best as he concluded his inauguration speech for one of the new buildings on the University of Chile's science and engineering campus: "If this is a century of electricity, antennas, radios, and airplanes," Edwards announced, "then engineers have the right to stand up from their crouched positions before the blackboard and look toward the sun."[29]

International Business Machines

Although Chile celebrated the arrival of its many imported technologies with full-page newspaper articles and elaborate inauguration ceremonies, IBM Chile opened its first office in downtown Santiago on April 10, 1929, not with a shout, but a whisper. The new branch office began operations with only two U.S. employees—General Director Sydney Wharin and Daniel Toriello—both of whom were North Americans charged with assisting the newly formed Chilean Statistics Bureau and the 1930 census effort.[30] Because of the small scale of the operation, Wharin and Toriello took turns watching the office while the other left to attend to clients.[31]

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[29] Ramón Salas Edwards, "La misión integral del ingeniero," *Annales del Instituto de Ingenieros de Chile,* July 1929, pp. 321-27. Quoted in Ibañez Santa Maria, "Los 'ismos' y la redefinición del Estado," 37.
[30] "Mensaje de Nuestro Gerente General," *IBM Diálogo*, July 1987, 3.
[31] "Hablan los precursores," *IBM Diálogo*, July 1987, 4.

The nascent Chilean market failed to make much of an impact on the multinational company, whose international list of clients focused primarily on those within European countries. However, there are several interesting parallels between the documented history of IBM's origins and the early operations of the Chilean branch office, beginning with their shared roots in tabulating national census data. Hollerinth had worked as a clerk for the U.S. Census Bureau in 1880 and developed the prototype punch-card tabulating machine with the explicit intention of saving clerks from the labor-intensive process of hand calculations. The success of his invention in accelerating the tabulation process of the 1890 U.S. census subsequently encouraged governments in Europe, Russia, and Canada to apply Hollerinth's tabulating machinery to their census calculations before World War I. Hollerinth also spent a number of years applying his machines to the reorganization of railroad administrative practices. The Chilean State Railroad Company also was one of the first clients for IBM Chile and would later be used as an administrative model for state operations.[32]

Hollerinth believed in the potential of the international market and pushed for sales at home and abroad almost from the outset. In 1889 he traveled to Paris, hoping to generate enthusiasm for his invention by participating in the Paris Universal Exhibition. Even before the company adopted the name International Business Machines, such a trip clearly demonstrated a desire to cultivate international demand. Early attempts to build a client list outside the United States created a market overseas for tabulating machines, which in turn fueled domestic production. When T. J. Watson Sr. took over as general manager of CTR in 1914,

[32] Ibañez Santa Maria, *Herido en el ala.*

and later as president of IBM, he continued to push IBM's international activities and in 1949 spun off IBM World Trade as an independent subsidiary.

Tabulating machinery was not the only office machinery being shipped to Chile in 1930. Judging from the advertisements of the period, Burroughs calculating machines, National Cash Register's cash registers, and Remington typewriters all managed to secure a client base within Chile. Burroughs, for example, claimed that with forty-two years of experience, it could offer a "Burroughs machine for any business" (see figure 2.2).[33] In 1929 alone Chile imported 282 calculating machines, 786 adding machines, 390 cash registers, and 4,368 typewriters from the United States, sales totaling approximately $560,000 (see tables 2.1 and 2.2).[34]

German companies also tried to penetrate the Chilean office machinery market, building on their previous successes in exporting telegraph machines, among other technological goods. However, World War I had dramatically changed the landscape of Chile's international relationships and frustrated these efforts. The outbreak of the war had interrupted Chile's long-standing ties with Germany and Britain and enabled the United States to dominate Chilean trade markets. In 1918 U.S. trade comprised more than 50% of all Chilean foreign commerce. By 1930 the United States accounted for 70% of all Chilean foreign investment and dominated the largest copper mines, which produced Chile's biggest export.[35] Historians of Latin America have referred to this shift from European to U.S. economic dominance in the region as a process of "Americanization" that opened the door to U.S. technical expertise, capital, machinery, and cultural influence. In this context German office

[33] "Hay una maquina Burroughs para cualquier negocio," *El Mercurio*, 12 October 1930.
[34] U.S. Department of Commerce, *Foreign Commerce and Navigation of the United States* (Washington, D.C.: U.S. Government Printing Office, 1923-46).
[35] Loveman, *Chile*, 178.

machine companies could not build the same client base as their U.S. counterparts. By the 1950s Chilean firms had incorporated IBM in their cultures, as evidenced by the regular creation of "Hollerinth departments." Cortada reports that German firms eventually abandoned the office machine industry in favor of developing their expertise in areas such as automobile manufacture.

In the 1920s, however, it was hard to foresee the role that these office machines would eventually play in changing administrative practices and creating the modern bureaucratic state that Ibañez sought to establish. They certainly failed to capture the public imagination. The oldest Chilean newspaper, *El Mercurio,* mentioned the application of tabulating machinery to the 1930 census effort in a tiny article hidden on page 7, nearly one year after IBM Chile open its doors.[36] Tabulating machines and other office machinery may not have generated the same degree of enthusiasm in Chile as the electric light or automobile, but their adoption by the Chilean government warrants our attention.

The introduction of such office technologies as tabulating and calculating machines to state administrative practices allowed the Chilean government to adopt the same techniques of administrative growth as those found in the industrial nations of North America and western Europe. In the eighteenth century these developed nations had already confronted the negative effects of industrialization, such as poverty, economic insecurity, disease, and unconstrained urban growth, obstacles that now threatened to stall Chile's modernization process and provoke social unrest.

When faced with such problems, Chile decided to mirror the approach of the industrialized nations and begin creating state sponsored social programs. Chile's economic integration in the world economy during the nineteenth and twentieth centuries paralleled its domestic efforts to industrialize and create a mobile, salaried workforce. These changes brought to Chile the ills that characterized urbanization and industrialization elsewhere during the nineteenth century. Just as the plight of the British textile workers captured Marx's attention and spurred a number of state-sponsored welfare programs in the second half of the nineteenth century, Chile's expanding cities and impoverished workforce demanded a change in the very nature of state governance.[37] By the end of the 1920s, the Chilean state had begun to emerge as a protectorate for all social strata of the Chilean population. The creation of government programs for the scientific understanding and administrative management of poverty, health, education, and economic growth that Ibañez initiated would continue to grow and expand during the Popular Front governments of the 1930s.[38]

The importation and application of office machinery from another industrialized nation, the United States, can be read as a concurrent attempt to address the problems of industrialized nations through imported techniques and technologies. If detailed knowledge of the Chilean population could advance projects of social ordering, combat social ills, and spur economic growth, as the *técnicos* believed, then tabulating and calculating machines contributed to these goals. Speaking of office machinery in the U.S. context, Cortada writes that "technology was clearly a basic driver of business actions."[39] In Chile we see that office technology provided a particular articulation of business and government actions, a

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[36] "Máquinas especiales se emplearán en el escrutinio del censo general," *El Mercurio*, 6 March 1930.
[37] See Agar, *The Government Machine.*
[38] See Karin Alejandra Rosemblatt, *Gendered Compromises: Political Cultures and the State in Chile, 1920-1950* (Chapel Hill: University of North Carolina Press, 2000).

means for imagining their execution, and a normalization of a new set of techniques for modern administrative management. In the next section I explore how the changing role of statistical data also illustrated a particular vision of state modernity, which achieved new levels of prominence during the Ibañez period. This vision both normalized the path toward modernity previously laid down by the United States and Europe and promoted the administrative techniques and technologies used in these countries as tools for surmounting Chilean underdevelopment and advancing the modernization process.

Visualizing a Nation

The Chilean government began collecting statistical information on a national scale a mere three years after independence, conducting its first census in 1813. Thirty years later, in March1843, President Manuel Bulnes established the Statistics Office within the Ministry of the Interior and charged it with collecting "exact knowledge of the current condition of the country in general and each one of the provinces and sectors that compose them in particular."[40] This office became a permanent state agency in 1847, a formality that allowed its workforce to increase to eight. In 1853 the census law took effect, requiring a regular census of the Chilean population every ten years.[41]

According to Jaramillo, these early census efforts required the formation of vast complex social networks capable of disciplining a heterogeneous geography and population to yield accurate information that adhered to a set of state-determined

[39] Cortada, *Before the Computer,* 87.
[40] Máximo Aguilera Reyes, *Estadísticas de Chile en el Siglo XX* (Santiago: Empresa Periodista La Nación, 1999), 12.
[41] Ibid.

classifications.[42] As was often the case, Chileans viewed the census effort as a government tool for determining levels of income tax and counting the number of young men eligible for military service. The Chilean government and citizenry alike viewed the collection of census information as inherently political and therefore suspect. However, the image of the nation proved to be a powerful rhetorical device for overcoming this resistance. Censuses conducted in the nineteenth century permitted the fledgling state to sketch the dimensions of the territory and population it governed and played a key role in shaping the national imagination. By connecting people from different regions of Chile's diverse territory and imposing categories of nationality, the census helped create a unified national identity.[43] "Nationality" appeared as a fixed category for the first time in the 1843 census, alongside other categories for local identification such as birthplace. By the 1854 census the space reserved for the *"patria chica,"* or home town, had completely disappeared in favor of the broader national category, even though many Chileans still identified more with their local communities. As Jaramillo writes:

> The complex web of social loyalties that [the census] operation needed to establish demonstrates that a mere administrative practice can have implications for the social construction process of the [Chilean] nation. Its simultaneous action, territorial scope, and the need to motivate the population to overcome their fears served as the primary motors of machinery that marginalized no individual or institution.[44]

These census efforts helped consolidate the territorial scope of the Chilean government and provided the legal base for the organization of congressional and

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[42] Andrés Estefane Jaramillo, "'Un alto en el camino para saber cuántos somos.' Los censos de población y la construcción de lealtades nacionales. Chile, Siglo XIX.," Pontificia Universidad Católica de Chile, Santiago, 2001.

[43] For an analysis of how census efforts deepened the imagined national community in the East Asian and U.S. contexts, see Anderson, *Imagined Communities,* and Theodore Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton, N.J.: Princeton University Press, 1995).

local elections. However, in the first decades of the twentieth century the significance of this statistical collection process changed considerably. The success of social welfare and economic planning programs placed greater emphasis on these statistically generated maps of Chilean industries and populations, which in turn demanded increased attention to accuracy.

Census takers hoped to apply western scientific methods to statistical studies in the early part of the twentieth century but were unable to do so, blaming their failures on a lack of resources, an underdeveloped administrative structure, and an uncultured population. The introduction to the 1907 population census begins with a rather lengthy apology for the quality of the work accomplished:

> The insufficient nature of our statistical services has poorly prepared our public administration, principally in the provinces, to direct work of this nature, which not only requires patriotism and enthusiasm, but also a staff and elements that can only be formed with practice and time.
>
> These reasons have obliged the Commission to undertake all operations in the least complicated manner possible. . . . We have always thought that it is better to stigmatize the Census as incomplete and unscientific in its methods rather than seeing it fail because we had asked for more from the country than it was capable of giving.
>
> In operations of this nature, it is not always possible to achieve the level of admirable perfection that prevails in the more advanced nations of old Europe; we cannot overlook the state of public administration in Chile, or the general level of culture of its inhabitants.[45]

Despite expressed desires to achieve the "perfection" found in other "advanced" parts of the world, Chilean census takers resigned themselves to their administrative limits as well as the general lack of sophistication they felt was exhibited by the majority of the population.

[44] Jaramillo, "'Un alto en el camino para saber cuántos somos'," 21.
[45] Comisión Central del Censo, "Censo de la República de Chile levantado el 28 de noviembre de 1907," Sociedad Imprenta y Litografia Universo, Santiago, 1908, v.

After the 1907 census the government again decided to increase its statistical resources and established the Central Statistics Office in 1912 with fifty-six employees and a director appointed by the president. The degree to which the Chilean government applied statistical data in its policy making, however, remains unclear. For example, the 1916 edition of the annual publication "A Statistical Synopsis of the Chilean Republic," a report compiled by the Central Statistics Office, contains a very simple amalgamation of statistical data with no advice about how to interpret or apply its findings. This publication included figures on population increases since the last census, the number of cities with more than ten thousand inhabitants, the recorded high and low temperatures, the amount of rainfall recorded in seven selected cities, the number of urban and rural schools, and the basic revenues and expenses of the government recorded during the previous five years.[46] Written in a purely descriptive tone, the text leaves the reader lacking an analytical perspective on the significance of the data collected and does not appear particularly useful for guiding government decisions. The text also appears in both Spanish and English, suggesting an equally important foreign audience for the publication, perhaps among British and North American merchants and investors.

This format changed during the latter part of the 1920s. From the early days of Ibañez's presidency, the Central Statistics Office occupied a new level of importance within the Chilean state and used its platform to tout the importance of scientific methods in the collection and generation of statistical data. On December 23, 1927, the Chilean government again reorganized the Central Statistics Office, placing it within the federal comptroller's office and granting it exclusive control

[46] Oficina Central de Estadística, "Sinopsis estadística de la República de Chile," Sociedad de Imprenta y Litografía Universo, Santiago, 1916.

over all official statistical matters, ensuring the proper application of scientific methods to the statistical studies conducted in all branches of government. Desires expressed by Chilean *técnicos* to emulate the rigorous statistical methods found in the industrialized nations created a deeper awareness of Chile's shortcomings in this area. A 1928 conference paper on Chilean statistical organization lamented that:

> Chile still is not ready for complete statistical service. In just one year, it is not possible to create a definitive office that functions well in all aspects, especially in a country that has not developed a comprehension of the importance of effective and well-understood cooperation in statistical matters.[47]

In illustration of this point, the author (the General Director of Statistics, Dr. Walter Gräwell) pointed to the current deficiencies in the statistical technique employed by the government. For example, the country lacked laws to standardize the recording of foreign commerce activities. Customs agents regularly noted the value of imports as determined at their point of embarkation instead of recalculating their value upon arrival in Chile. Gräwell also called for the creation of standardized weight tables for various imported goods to prevent the personal biases of individual shippers from skewing the numbers reported. Other difficulties included calculating the cost of living for an abstract Chilean citizen. Questions arose about which social class should provide the basis for calculations and how to determine food costs (based on caloric intake or the presence of certain basic food items). In short, the creation of this statistical category required both knowledge and standardization of the domestic lives of the Chilean citizenry. Gräwell reported that the government, acting through workers' associations, had given special notebooks to groups of working-class families and asked that they record their expenses for a period of several months. From these samples government *técnicos* could peer into working-class lives, gain a better understanding of their daily activities, and subsequently determine the criteria for cost-of-living calculations.

Gräwell's text illustrates the difficulties that *técnicos* faced when trying to measure and record phenomena that did not yet exist. Standardizing the weight of a can or determining the expenses of an abstract Chilean citizen necessitated the creation of categories designed to erase difference, ambiguity, and subjectivity. Through the application of these scientific techniques, the government sought to replace the messiness of an observed reality with one of clean abstraction that was easier to document, visualize, understand, and thus manage. Processes of classification, quantification, and abstraction permitted the government to generate increasingly sophisticated and comprehensive maps of national activities that it used to direct state planning efforts. Statistics collection disciplined the indescribable complexity of Chilean life into distinct, knowable categories.[48] From this knowledge, the government could draft new policies for boosting the productivity of Chilean industries and the workforce, overcoming the deleterious effects of industrialization, and furthering the process of development. As Gräwell writes:

> In my opinion, statistics are a service that must be responsible for *the systematic observation of the sizeable social masses*, in a form that their results, based on a great number of facts or events, *give an idea of the nation's position and state of development*. This opinion corresponds with the experiences in other countries to develop and improve official statistics services.[49]

[47] W. Gräwell, "Conferencia sobre la organización de la estadística," *Anales del Instituto de Ingenieros de Chile* (1928): 744.
[48] Here I am referring to Foucault's discussion of discipline and economic productivity found in part 3 of Michel Foucault, *Discipline and Punish: The Birth of the Prison*, 2nd ed. (New York: Vintage, 1995).

Here we see that the systematic observation of the masses constituted a necessary and desirable precursor for gauging the current state of development and the direction of future policy. These techniques of knowledge production, moreover, exercised authority among *técnicos,* given the successful application of these techniques in other industrialized nations. The capability of the state to better "see" the Chilean masses, moreover, complemented the authoritarian practices of the Ibañez government, which opposed political dissent and organized labor but still needed the approval of an increasingly independent voter base.

The application of scientific techniques to the collection of statistical information amplified the quantity and organization of data recorded from 1927 to 1930. In order to keep up with the myriad economic planning and administrative initiatives, the General Statistics Office expanded to become the General Statistics Bureau in August 1930 and welcomed additional labor and technical resources to complete the population census in a timely fashion.[50] The appearance of the formal magazine, *Chilean Statistics,* in January 1928 replaced the monthly statistical overview *Statistics Bulletin* that had previously been circulated by the Statistics Office (figure 2.3). This lengthy publication included an impressive array of economic and population data, as well as figures on specialized topics ranging from meat consumption to meteorology to the degree of telegraph penetration.[51] The appearance of graphs and figures integrated with the printed text constituted one of the most notable improvements and facilitated the reader's understanding of observed trends or events of significance. Moreover, the written text did not simply

[49] Gräwell, "Conferencia sobre la organización de la estadística," 735. Emphasis added.
[50] Instituto Nacional de Estadísticas, "Reseña histórica del Instituto Nacional de Estadísticas, centésimo cuadragésimo aniversario 1843-1983," INE, Santiago, 1983.

summarize the data but included an analysis of the numbers collected. Readers, for example, were asked to compare the shape of temperature curves from different cities, then received an explanation for these phenomena. The publication sandwiched its reporting between advertisements for such modern luxuries as imported automobiles and stylish liquors, items that invited the Chilean reader to enter a world enjoyed by inhabitants of more industrialized nations.

Despite the statistical complexity found in *Chilean Statistics,* an opposite trend toward simplification emerged with respect to the agricultural, industrial, and population censes. Chilean *técnicos* reasoned that complicated census forms invited ambiguity and caused the failure of statistical studies. The application of techniques that emphasized simplicity and clarity increased the number of industrial establishments reported from 7,600 in 1926 to 9,100 in 1927. A similar increase was observed in the number of commercial firms reported, which rose from 34,000 in 1926 to 60,000 in 1927.[52] This quantitative increase was attributed to the imprecision of previous census efforts, which had failed to include these additional establishments. However, the report failed to mention how these classifications had been simplified or whether the process of clarification had changed the definition for industrial establishments or commercial firms.

The 1930 population census continued this trend toward simplification. The census questionnaire used in 1920, for example, required the census taker to manually separate neighborhoods and households by drawing a line between entries. Given that the majority of census takers were untrained volunteers, many forgot to mark these divisions on their completed questionnaires, causing problems

[51] Dirección General de Estadística, "Estadística chilena," Dirección General de Estadística, Santiago, 1928.

for subsequent calculations. The 1930 census questionnaire used one form per household. It avoided controversial questions such as those pertaining to legitimate birth, military service, and race.[53] The form also provided strict definitions for an individual's primary occupation, a potentially ambiguous category that in the past had been left to the judgment of the census taker, and eliminated the space for a secondary occupation.[54]

As I mentioned earlier, the application of Hollerinth tabulating technology to census calculations first occurred in 1930. Census clerks recorded the data for every Chilean citizen on a punch card, not just the data for every household, thereby permitting the machines to calculate and classify statistics relating to age, civil status, physical defects, nationality, literacy, and occupation (figure 2.4). The Hollerinth machines helped census clerks achieve better speed and precision and significantly augmented the sheer quantity of data published. The results of the 1920 census were published in one volume five years after the census was conducted. In contrast, the results of the 1930 census occupied three volumes, published in 1931, 1933, and 1935, respectively.[55] Hollerinth machines generated

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[52] Gräwell, "Conferencia sobre la organización de la Estadística," 742.
[53] Chilean statistics takers viewed the country as racially homogeneous, a feature they viewed as beneficial. It allowed them to avoid the ambiguities found in countries with more diverse populations, such as theUnited States. The 1930 census report reads, "We do not consider it necessary to note the race or color of the population because almost everyone is of European descent. The inhabitants of indigenous origin in the country are few and have already been incorporated in mainstream life. Only the araucanos, who continue to conserve their primitive customs and live in reduced numbers in regions south of the Bío-Bío, were counted using colored census questionnaires in order to determine the size of the indigenous population." Dirección General de Estadística, "Resultados del X Censos de la República de Chile 1930 efectuado el 27 de noviembre de 1930 y estadísticas comparativas con censos anteriores" Impresa Universo, Santiago, 1931, 8.
[54] Ibid., 9.
[55] Ibid.; Dirección General de Estadística, "X Censos de la República de Chile 1930 efectuado el 27 de noviembre de 1930 edad, estado civil, nacionalidad, religión e instrucción," Impresa Universo, Santiago, 1933; Dirección General de Estadística, "X Censos de la República de Chile 1930 efectuado el 27 de noviembre de 1930 ocupaciones," Impresa Universo, Santiago, 1935); Dirección General de Estadística, "Censo de población de la República de Chile levantado el 15 de diciembre de 1920," Soc. Imp. y Litografía Universo, Santiago, 1925.

the various configurations of data that comprised the second and third volumes. In the end, these machines enabled the state to draw an unprecedented connection between population characteristics—such as education, occupation, standard of living, social class, and family size—and their respective geographical locations. The classification, quantification, and geolocation techniques applied by census clerks and Hollerinth machines resulted in maps of greater precision and sophistication that increased the visibility of the Chilean population and made it more susceptible to state policies of economic and social management. Yet, despite efforts to increase the accuracy of the 1930 census, members of the statistics bureau again faulted the quantity and ambiguity of the questions found on the census form for the unreliable data collected on the number of property owners, rates of female fertility, physical defects, and the number of nationalized citizens. Arguing once more in favor of increasing categorical simplicity and homogenization, the bureau observed that "perhaps . . . it would be better to simplify [the census form] a little" before undertaking the next census in 1940.[56]

The Rise of the State Machine

Ibañez's professed commitment to order, progress, and the expansion of state administration gave rise to new techniques of state control, but not even he could control the devastating effects of the worst economic crisis in Chilean history. According to the League of Nations, the Great Depression of 1929 hit Chile harder than any other country in the world. From 1929 to 1932 imports dropped by 80%, and copper and nitrate exports dropped from more than 200 million pesos to 18.1

[56] Dirección General de Estadística, "X censos de la República de Chile 1930 efectuado el 27 de noviembre de 1930 edad, estado civil, nacionalidad, religión e instrucción," v.

million pesos. More than fifty thousand workers lost their jobs in the nitrate fields.[57] The government's inability to ameliorate the worsening conditions of poverty and unemployment fed civilian and military opposition to Ibañez's presidency. He resigned on July 26, 1931, and temporarily sought exile in Argentina.

In the aftermath of Ibañez's resignation Chile slid into political disarray. For all the dictator's attempts to create an administration that imposed order and abhorred chaos, six different governments came to power in 1932, including Chile's first "Socialist Republic," headed by Marmaduque Grove. It lasted for only twelve days. By the end of 1932 members of the military were calling for civilian elections, which reinstated Arturo Alessandri in the presidential palace for the second time, this time as an establishment conservative.

Alessandri's second presidency initiated a period of uninterrupted democratic rule that lasted until 1973, but Chile had changed dramatically during the six years since he had left office in 1926. In the aftermath of the depression early attempts to develop national industries and increase the volume of exports took on new levels of importance as Chilean leaders realized the dangers of economic integration and the need for greater independence. The Chilean government turned to policies of import substitution and channeled their attentions toward spurring local production and domestic industrial growth. Ironically, these policies of inward development increased Chile's economic sensitivities to international geopolitics and related trade disruptions.

In the post-1932 period a cleavage emerged in Chilean politics that separated the ideological Right, Left, and Center into three distinct groupings, a division that continues today. After 1952 consecutive administrations often represented parties

[57] Loveman, *Chile*, 188, 98.

from the opposite ends of the ideological spectrum, a phenomenon some viewed as a testament to Chilean democracy and others as symptomatic of popular dissatisfaction with elected representatives.[58] Vocal proponents of Marxism, liberalism, communism, social Catholicism, fascism, and Nazism all found a willing audience among factions of the Chilean citizenry. Despite this ideological pluralism, only a single articulation of modernity appeared in Chilean policy making and remained unchallenged through the victory of the Popular Unity government in 1970. Achieving modernity, a concept predefined by the historical trajectories of industrialized nations, came to be equated with policies of state-led economic growth and, to a lesser extent, the creation of state-directed social welfare programs. The heightened role of this interventionist state in turn grew the national bureaucracy and expanded the employment opportunities for educated Chileans. No longer a government composed primarily of a wealthy elite, as was the case in the late nineteenth and early twentieth centuries, the public administration of the 1930s and 1940s played a significant role in forming a bureaucratic middle class of white-collar professionals. Between 1930 and 1949 employment in the public sector more than doubled, outpacing the growth in the mining, agricultural, and industrial sectors of the Chilean economy.[59] In the forty-year span between 1925 and 1965, the number of employees in the Chilean public administration tripled, whereas the national population only doubled.[60]

The expansion of the Chilean bureaucracy during the 1930s and 1940s paralleled the growth of IBM's Chilean operations. From the perspective of IBM the

[58] Many historians have noted this phenomenon. See, for example, Paul W. Drake, *Socialism and Populism in Chile, 1932-52* (Urbana: University of Illinois Press, 1978).
[59] Loveman, *Chile*, 199-200.
[60] Ibid., 200.

depression created a new motivation for expanding its market share overseas, increasing sales coverage, and converting independent dealers of IBM products into company-owned operations. To encourage international growth and market penetration, profits from overseas branch offices remained within their host countries and were reinvested locally. While Chile struggled to recover from the devastating effects of the Great Depression, Wharin and Toriello, IBM's team in Chile, decided to hire their first Chilean employee. Mena Verdaguer took over sales. Despite an initial drop in sales, IBM Chile continued to expand its operations throughout the economic recovery process. In the early 1930s the company added a training school. The number of employees had swelled to twenty by 1933. By 1939 seventy employee names appeared on the company payroll.[61] Wharin directed the operations of IBM's Chilean branch until 1938, establishing separate departments for unit record machines, scales, and clocks, each with their own technical service department. His coworker, Toriello, took over as general director after Wharin left and remained in the post from 1938 to 1950, when he was replaced by the Chilean Hernán Elizade. The early expansion and Chileanization of IBM's Santiago operations no doubt pleased the elder Watson as a businessman, a believer in Pan Americanism, and a proponent of "world peace through world trade."[62]

Given the limited data available, it is impossible to determine what percentage of IBM Chile's sales from 1930 to 1950 were comprised of government clients. However, given the early integration of these machines in public administration and the Chilean government's well-documented commitment to

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[61] "Hablan los precursors."

[62] T. J. Watson Sr. wrote editorials about Theodore Roosevelt's Good Neighbor policy (1940) and Watson's theory of "world peace through world trade" (1953), which were later reprinted in volume Thomas J.

expanding the state apparatus during the period in question, it seems reasonable to believe that these machines continued to hold a place of importance within the larger government machine.

In terms of bureaucratic growth and national planning, the creation of the State Development Agency (CORFO) in 1939 constituted one of the most important developments of the decade; its history has been well documented.[63] Ibañez Santa Maria argues that "the creation of CORFO finalized a long trajectory of institutional searching to show a new concept of the State that . . . would require the technical-administrative channeling of political activities in order to respond to the requirements of the age."[64] Ideas for a state development agency had been circulating since 1910, yet it was a natural disaster that finally brought the institution into being. Toward the beginning of 1939, an earthquake whose epicenter was located in the southern areas of Concepción and Chillán caused considerable destruction in the region and required immediate plans for state assistance and reconstruction. The Finance Ministry responded by proposing two distinct agencies: the Relief and Reconstruction Corporation, which would rebuild the areas most affected by the earthquake, and the State Development Corporation, charged with directing national economic activities. The latter agency would draft long-term plans to improve national standards of living through the better use of Chilean natural resources and through reducing the costs of production; expanding the nation's mining, agricultural, commercial, and industrial activities; promoting policies of

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Watson Sr., *"As a Man Thinks": Thomas J. Watson, the Man and His Philosophy of Life as Expressed in His Editorials* (New York: International Business Machines, 1954).

[63] Interested readers may consult Luis Ortega Martínez, *Corporación de Fomento de la Producción: 50 años de realizaciones, 1939-1989* (Santiago: Universidad de Santiago Facultad de Humanidades Departamento de Historia, 1989) for a detailed look at CORFO's origins and subsequent projects.

[64] Ibañez Santa Maria, *Los ingenieros, el estado y la política en Chile*, 57.

import substitution and the national consumption of domestic goods; and undertaking studies on themes relevant to increasing levels of national production. Industrial development within ("*hacia adentro*"), it was argued, could further Chilean economic independence—a hypothesis that later proved false. The majority of the financial backing secured for CORFO projects originated from the U.S. Export-Import Bank. Rather than freeing itself of the relations of dependency that had caused the nation's economic downfall during the depression years, the Chilean government gave the United States a new venue for exerting influence and power.

The proposed legislation for the State Development Corporation generated considerable controversy. Members of the political right feared that the newly elected president, Aguirre Cerda, would use the agency as a mechanism for exercising the political whims of the Socialists and Communists within his Popular Front coalition.[65] Moreover, the sums of money cited by Aguirre Cerda as necessary for implementing Popular Front programs scared many members of Congress, especially when added to the funds requested for earthquake relief. The agency's detractors pointed to the mounting national debt as a source of concern, but CORFO's supporters countered that if the government could not look beyond the size of the national debt, then earthquake relief efforts must be tied to strategies for future economic planning and development.

The economic arguments dominating the CORFO debate had merit, but they were not the only objections to the development agency. The first signs of rural unionization and what some landowners viewed as "militant activities" among the

[65] In fact, Pedro Aguirre Cerda acquired the presidency through an unlikely coalition of Communists, Socialists, and Radicals and with the votes of Nazi supporters of Carlos Ibañez—a coalition that was impossible to maintain and quickly spun off into splintered parliamentary factions whose inability to agree

Chilean peasantry spread fears of communism and peasant uprisings. Landowners appealed for government assistance in restoring order to the countryside on the ground that rural unrest could slow or stall levels of production. Building on this logic, the vice president of the National Manufacturers' Association (SOFOFA), Walter Müller, argued that a plan for economic development would be wasted if the state continued to permit the "unhinging of individual and collective discipline."[66]

Despite these reservations, the legislation for both the development and the reconstruction agencies passed--barely--in April 1939. With the founding of the State Development Corporation, Chilean public administrators significantly increased their ability to intervene and control the development process.[67] However, the right's distrust of Aguirre Cerda and the politics of the Popular Front resulted in a push to make the agency independent of the executive branch and to limit its duties to technical analyses of production activities. Claims of scientific neutrality provided one response to the political and social conflicts of the moment and continued the trend of placing *técnicos* in positions of power within the public administration. Many engineers who had occupied important posts during the Ibañez government had since reassumed positions of power within the administration of Aguirre Cerda. Appeals to scientific objectivity, and therefore political neutrality, veiled the inequalities built into the agency's underlying structure. For example, sitting on the CORFO oversight board were several representatives from the private sector and

stalled most legislative proposals. CORFO's founding constituted one of only two significant pieces of legislation passed in 1939.

[66] Walter H. Müller, "Industria: órgano oficial de la Sociedad de Fomento de Fabril" June Dirección General de Estadística, "Resultados del X censos de la República de Chile 1930 efectuado el 27 de noviembre de 1930 y estadísticas comparativas con censos anteriores" Impresa Universo, Santiago, 1931, 8. 1939, 379-80. Cited in Ibañez Santa Maria, *Los ingenieros, el estado y la política en Chile*, 53.

[67] That the legislation passed at all provides a clear illustration of Chile's widespread commitment to long-term economic planning and development.

government but only one representative from the Chilean Workers Confederation (CTCH), who alone was charged with presenting the position of labor.

CORFO provides another example of how appeals to technocracy and scientific objectivity served to advance a particular conceptualization of industrial progress that blocked legitimate social change. CORFO embodied the widely held conviction that only mechanisms of state intervention could propel Chile closer to a state of modernity. The agency's core responsibilities, in fact its very raison d'être, reflected this shared faith. Despite this expressed national commitment to mapping Chile's financial resources and coordinating them with projects that advanced the economic health of the country, Chile would not be able to draft a comprehensive economic plan until 1961. This plan, however, bore fruit almost immediately. As I show in chapter 3, Chile's first ten-year economic plan served as a vital political tool for securing U.S. foreign aid and elevating the country's status as the model nation of the Alliance for Progress.

The Making of "the Masses"

A fundamental shift occurred in the organization of the Chilean state during the 1920s. In place of the oligarchic state of the late nineteenth century, a new administrative apparatus emerged, one committed to solving the ills of industrialization by using the tools and expertise imported from industrialized "modern" nations. Like those nations, Chile chose to respond to the social question through a welfare state, outwardly committed to identifying and managing the negative effects of industrialization by using programs of directed economic development. It was believed that this approach would improve the standard of living for all social strata of the Chilean population without slowing the pace of industrial growth. The mounting social unrest among Chile's displaced poor, confirmed by the first signs of organized labor movements and the formation of a Chilean socialist party in 1933, motivated the government to take up the philosophy of evolution to prevent revolution. Evolution, however, did not imply solving the social question or the myriad social ills associated with the industrialization process. Instead it entailed the creation of new state agencies dedicated to applying "scientific" techniques for the advancement of industrial and social welfare. As state operations increased in size and complexity, the application of science, technology, and expertise emerged as tools vital for defining, understanding, and eventually overcoming obstacles to progress.

The timing here is important. Scholars of development etiology have often placed the origins of this discursive framework within the recognition of the Third World in the aftermath of World War II and the escalating Cold War.[68] In Chile, however, we see a concerted state-initiated effort for development as early as the mid-1920s, using many techniques and mechanisms later ascribed to the development discourse. This included the employment of scientific experts, or *técnicos*, public intervention in the economy, the importation of foreign technologies, and the application of statistical methods to generate knowledge of national economic and social resources. These approaches had strong precedence in both western Europe and the United States during the nineteenth and early twentieth century; their appearance in pre-World War II Chilean modernization efforts should thus come as no surprise. Public economic intervention, moreover, assumed new levels of importance in the years after the depression, as seen in both the New Deal

[68] See, for example, Escobar, *Encountering Development*; Wolfgang Sachs, *The Development Dictionary: A Guide to Knowledge as Power* (Atlantic Highlands, N.J.: Zed Books, 1992).

programs in the United States and in the formation of the Chilean State Development Corporation (CORFO). Technologically speaking, however, the Chilean modernization process attested to the growing "Americanization" of the region as European economic and hegemonic influences gave way to those of the United States. From 1912 to 1932 the United States pursued a strategy of commercial and ideological dominance, rather than physical domination, in Latin America and wrapped it in the rhetoric of "Good Neighbor" policies.[69] This included the growing presence of U.S. companies in Chile and the broader application of U.S. technologies.

This chapter has situated Chile's early history of computing machinery within the historical trajectories of administrative growth, state rationalization, and directed economic planning, core facets of Chilean modernization efforts until the early 1970s. From the evidence, IBM tabulating machinery appears to have played a relatively small role in state practices during the 1920s and 1930s. The Chilean market likewise constituted a small percentage of IBM's international sales. However, these machines both epitomized and furthered government attempts to classify, homogenize, standardize, and discipline Chilean commercial and social spheres, augmenting the influence of foreign experts and *tecnicos* within the Chilean public administration.

Finally, the adoption of these technologies further illustrates that Chilean modernization processes extended beyond simply increasing industrial output and raising the standard of living. The path to modernity also entailed growing the powers of state management and the ability to map and manage the population with greater accuracy, detail, and sophistication. Achieving this goal depended on the

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[69] Paul W. Drake, "From Good Men to Good Neighbors: 1912-1932," in Abraham F. Lowenthal, ed., *Exporting Democracy: The United States and Latin America* (Baltimore: Johns Hopkins University Press,

government's ability to collect, quantify, tabulate, combine, and recombine information on a national scale, reinforcing the unification and naturalization of the Chilean nation state. Hollerinth machines enabled the government to achieve these goals through the collection of census data and the managing of customs and railway accounts. As I noted earlier, the use of these machines increased considerably during the 1930s and paved the way for the eventual application of electronic mainframe computers to state planning efforts in the 1960s and 1970s.

The import of the bureaucratic shift that occurred during the 1920s extended beyond marking the conclusion of nineteenth-century liberalism and the adoption of western administrative practices. Góngora writes that the first part of the twentieth century gave birth not only to the modern administrative state but also to the idea of "the masses" as both a political identity and a descriptive category. The construction of the masses, he asserts, evolved in tandem with the classification, rationalization, and management techniques characteristic of modern administration. "The techniques and the masses," he writes, "have reciprocally generated themselves. . . . The apparatus that serves the masses is grounded in technical inventions." The abstract conceptualization of the masses legitimized the expansion of the Chilean state administration by creating an entity that it serves--and controls.[70] The statistical and ordering techniques discussed in the preceding pages did not emerge as the by-products of a state in transition; they helped solidify a particular articulation of the state that was supported by new claims to legitimate power.

If we take Góngora's observation as our starting point, then knowledge of the Chilean population, gathered through the quantification, categorization, and

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1991).

[70] Góngora, *Ensayo histórico sobre la noción de estado*, 245.

homogenization of complex social and economic processes, made this new abstraction a visible entity. Thus the state played a complicit role in shaping Chilean national identity.[71] Góngora, moreover, notes that state programs to "civilize the masses" gave the state an even greater justification for intervening in the lives of its citizenry, as measured by the creation of welfare institutions and changes to production processes.

During the 1920s and 1930s the Chilean state defined the characteristics of its citizenry with greater exactitude and delineated with more precision the procedures necessary for Chileans to interact with their government. In addition to creating stricter definitions of normality and deviance, classification imposed order on Chilean society while erasing old ways of being.[72] Just as the idea of "Chileanness" replaced the identification that Chileans felt with their *patria chica* during the nineteenth century, the process of "massification" sought to transcend the complexities of migration, work, community, and fluctuating economic markets.[73] New categories emerged to determine the cost of living, levels of employment, or even race, categories that simultaneously homogenized and differentiated. Through this process certain aspects of Chilean life became visible while others faded from view.

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[71] The central thesis of Góngora's essay rests on the claim that the state formed Chilean national identity. Góngora, however, does not elaborate on the techniques used by the state or describe the nature of the identity created. Chilean historians have traditionally linked the state to processes of national identity formation with regard to state support for cultural institutions, such as public universities and museums, which provide sectors of the population with a cultural education. It is clear, however, that this class-centric argument is not the thesis advanced by Góngora. Here, I provide an alternative reading.

[72] See Foucault's writings on classification, discipline, and governmentality. Foucault, *Discipline and Punish*; Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (New York: Vintage, 1973); Foucault, *The Foucault Effect: Studies in Governmentality: With Two Lectures by and an Interview with Michel Foucault,* ed. Graham Burchell, Colin Gordon, and Peter Miller (Chicago: University of Chicago Press, 1991).

[73] Jaramillo, "'Un alto en el camino para saber cuántos somos.'"

According to Foucault, disciplinary power operates through distributive networks rather than extending from a powerful state apparatus. The all-seeing guard tower located in the center of Bentham's Panoptican functions democratically; anyone can enter, anyone can exercise disciplinary power. In the Chilean case, however, we see that the centralized power of the Ibañez dictatorship played a crucial role in making the modernization of state operations possible.[74] The limited forms of popular participation in the construction of statistical categories served more to exploit than to create cooperative relationships among equals. The expense journals kept by working-class Chileans, to which I alluded earlier, are one example. The state transformed these chronicles from snapshots of lived experiences to data sets that later allowed groups of *técnicos* to extract and generalize facets of the working-class experience. The power exerted by Chilean *técnicos* to make populations, territories, economies, and resources visible, and thus knowable, served to increase the centrality of the *técnicos* to the Chilean government and granted them the freedom to further develop these techniques for seeing. Classification, rationalization, and directed planning would occupy a central role in the development discourse that emerged after World War II, particularly during the Alliance for Progress and the presidency of Eduardo Frei Montalva. However, it is evident that by 1930 the state apparatus constructed by the Ibañez government enabled new forms of control, permitting greater levels of growth and coordination among the different branches of the Chilean government. As the government became more organized and held together by these administrative techniques, so was the

[74] The importance of centralized state power in large-scale modernization efforts described by James Scott more closely resembles the experience described in this chapter. See James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, Conn.: Yale University Press, 1998).

Chilean population, quantified as it was into data sets of unprecedented completion that were easily read by the growing state machine.[75]

Bureaucratic growth rearticulated the claims for a legitimate right to rule. Ibañez could not claim legitimacy through divine rule, as in the days of the Spanish colonizers, or through wealth and elite class status, as with the oligarchs of the nineteenth century. Rather, he had to convince Chilean citizens that his right to rule grew out of his ability to serve the people, regardless of social class or status. As I have shown, this led to the creation of social categories that demarcated new differences and erased those of the past. Rearticulating the Chilean population in terms of the masses served to homogenize and reconfigure the relationships among *pobladores* (poor), *campesinos* (peasants), individuals from distinct *patrias chicas* (homelands), indigenous populations, and descendants of Spanish blood, all of which were situated beyond the protective reach of the Chilean state. This claim to legitimacy holds only when the administration in power remains successful at bettering the conditions of the population it serves. The Great Depression made this impossible; even the iron rule of the dictator could not surmount the myriad of problems that enveloped Chile in 1929. By 1932 the rational, ordered government created by Ibañez had disintegrated into chaos.

The era also saw the creation of a different form of political legitimacy tied to plans for economic growth and industrialization. In the post-Depression period, the protections afforded by state programs appeared to offer the only possibility for Chile to recover from economic devastation and assume its place among the industrialized nations of the world. In contrast to the "antiquated concept of the

[75] The administrative machine to which I allude here draws a parallel with the government machine described by Agar in *The Government Machine.*

political-state," which reflected the views of the dominant class or ruling party, the modern nation-state recognized the danger of partisan interests and prioritized the needs of the entire country. Jaime Larraín García-Moreno, then the conservative president of both the Chilean National Agricultural Society and the Confederation of Production and Trade, wrote in 1937 that the modern nation-state had moved beyond the partisan ways of the past and tried to recognize the "totality of national interests" and "integrate within the State all of the useful 'functions' and activities for the material and social progress of the collective whole."[76] This new *tecnico-*administrative state contrasted sharply with the parliamentary state of the past and further cemented the relationship between modernity and the powers of objectivity that came with the application of scientific methods. This early conceptualization of modernity, articulated through policies of directed economic planning and social management, withstood the ideological shifts in Chilean politics and emerged as a widely accepted framework for economic growth and development in the coming decades.[77]

The creation of CORFO in 1939 further illustrates that the Chilean government equated modernization with economic growth well before the United States, the United Nations, and international lending bodies began encouraging this approach to development. Industrial growth promised to increase export capacities, generate employment and income, raise the standard of living, and decrease economic dependency, factors that would accelerate the economic recovery process. Industrialization thus became the primary motivation for state economic activity, as did assuring the basic conditions for production. CORFO's founding, moreover,

[76] Quoted in Ibañez Santa Maria, *Los ingenieros, el estado y la política en Chile*, 42.
[77] Escobar, *Encountering Development*.

continued the trend of employing engineers and other *técnicos* in public service positions.

The 1920s and 1930s witnessed a fundamental shift in administrative organization, national prioritizing, and state claims to legitimate power. These changes served to further solidify a definition of modernity cast in terms of state-led economic growth, industrialization, and new infrastructures for social management and public well-being. The government did not succeed in solving the social question; however, it did succeed in rearticulating the underlying causes in terms of identifiable and manageable phenomena, such as education, nutrition, poverty, and employment, problems the government could resolve if armed with the correct political agenda. Implementing the infrastructure necessary to overcome these social ills and increase economic productivity required collecting information that captured the key qualities of the Chilean citizenry and the Chilean nation with new levels of rigor and completeness, as well as the capacity to map and make sense of these increasingly complex data sets. Early tabulating machines, in combination with other factors, such the increased hiring of *técnicos* and the refinement of statistical methods, contributed to this process and served to expand the reach of the Chilean interventionist state. Having accepted the application of scientific techniques and technological innovations in administrative organization as necessary for achieving modernity, Chile then struggled to find the political program that would allow the country to assume its rightful place among the modern nations of the developed world.

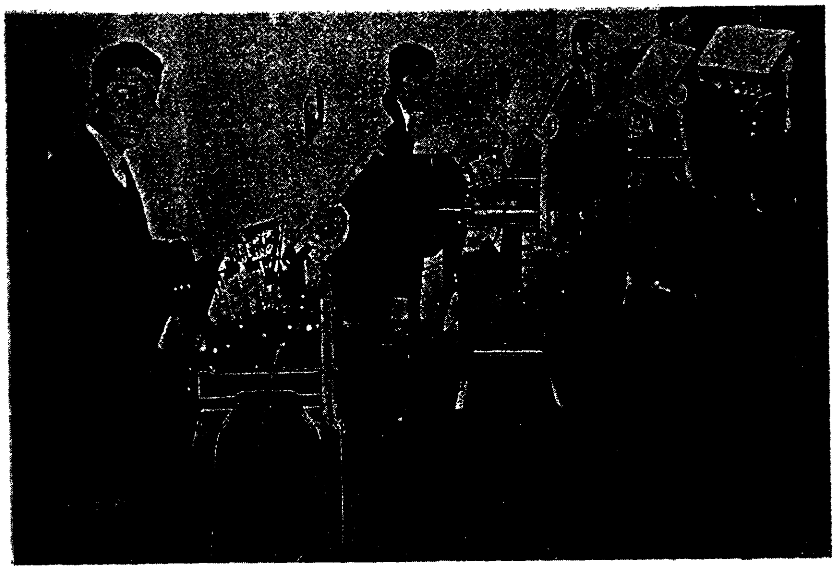
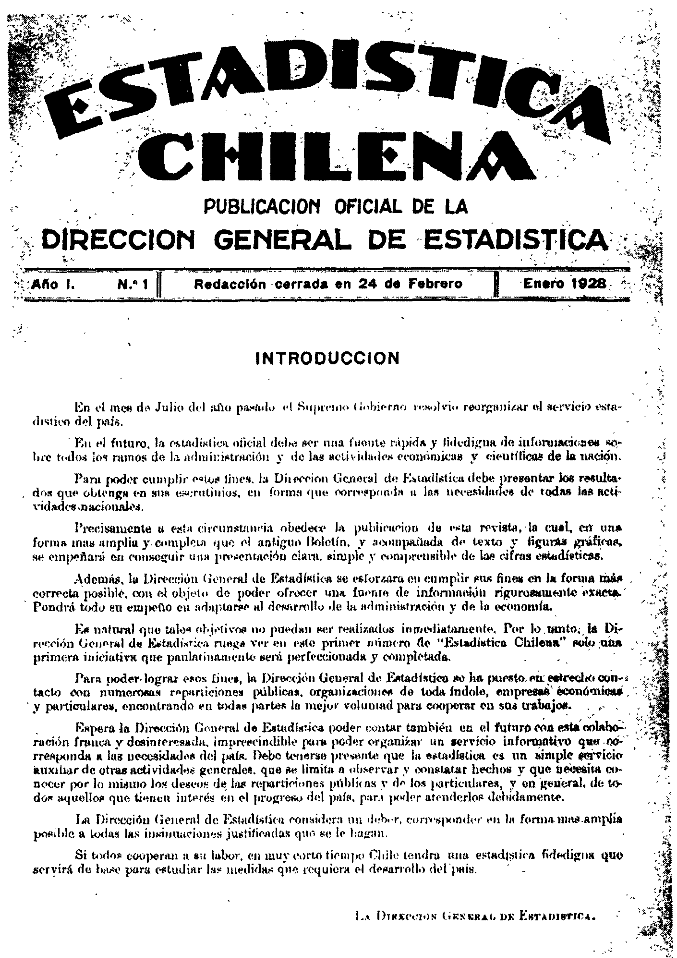


Figure 2.1: Employees at the Chilean Customs Office in the 1930s use IBM tabulating machines to collect statistical information on imports and exports. (Image reproduced with permission from the National Library, Santiago.)

Figure 2.2: A newspaper advertisement from 1930 claims that Burroughs accounting machines offer a solution for any business. (Image reproduced with permission from the National Library, Santiago.)



ESTADISTICA CHILENA

PUBLICACION OFICIAL DE LA

DIRECCION GENERAL DE ESTADISTICA

Año I. N.° 1 | Redacción cerrada en 24 de Febrero | Enero 1928

INTRODUCCION

En el mes de Julio del año pasado el Supremo Gobierno resolvio reorganizar el servicio estadistico del país.

En el futuro, la estadística oficial debe ser una fuente rápida y fidedigna de informaciones sobre todos los ramos de la administración y de las actividades económicas y cientificas de la nación.

Para poder cumplir estos fines, la Direccion General de Estadistica debe presentar los resultados que obtenga en sus escrutinios, en forma que corresponda a las necesidades de todas las actividades nacionales.

Precisamente a esta circunstancia obedece la publicacion de esta revista, la cual, en una forma mas amplia y completa que el antiguo Boletín, y acompañada de texto y figuras gráficas, se empeñará en conseguir una presentación clara, simple y comprensible de las cifras estadísticas.

Además, la Dirección General de Estadística se esforzara en cumplir sus fines en la forma más correcta posible, con el objeto de poder ofrecer una fuente de información rigurosamente exacta. Pondrá todo su empeño en adaptarse al desarrollo de la administración y de la economía.

Es natural que tales objetivos no puedan ser realizados inmediatamente. Por lo tanto, la Dirección General de Estadistica ruega ver en este primer número de "Estadística Chilena" solo una primera iniciativa que paulatinamente será perfeccionada y completada.

Para poder lograr esos fines, la Dirección General de Estadística se ha puesto en estrecho contacto con numerosas reparticiones públicas, organizaciones de toda índole, empresas económicas y particulares, encontrando en todas partes la mejor voluntad para cooperar en sus trabajos.

Espera la Dirección General de Estadistica poder contar también en el futuro con esta colaboración franca y desinteresada, imprescindible para poder organizar un servicio informativo que corresponda a las necesidades del país. Debe tenerse presente que la estadística es un simple servicio auxiliar de otras actividades generales, que se limita a observar y constatar hechos y que necesita conocer por lo mismo los deseos de las reparticiones públicas y de los particulares, y en general, de todos aquellos que tienen interés en el progreso del país, para poder atenderlos debidamente.

La Dirección General de Estadística considera un deber, corresponder en la forma mas amplia posible a todas las insinuaciones justificadas que se le hagan.

Si todos cooperan a su labor, en muy corto tiempo Chile tendra una estadística fidedigna que servirá de base para estudiar las medidas que requiera el desarrollo del país.

La Direccion General de Estadistica.

Figure 2.3: The first edition of *Estadística Chilena* (Chilean Statistics), 1928. (Image reproduced with permission from the National Statistics Institute, Santiago.)

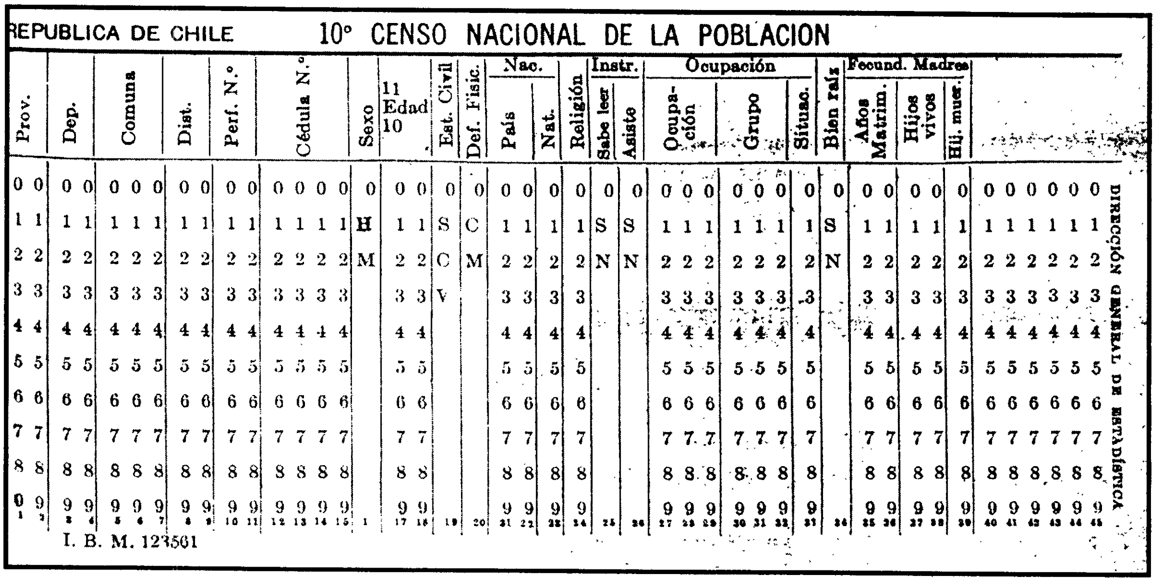


Figure 2.4: A punch card used in the 1930 Chilean population census. (Image reproduced with permission from the National Statistics Institute, Santiago.)

Table 2.1: Calculating and Adding Machines Exported from the U.S. to Chile (1923-46)

Year	Number of calculating machines	Value (U.S. Dollars)	Number of listing adding machines	Value (U.S. Dollars)
1923*	166	29,008	-	-
1924*	200	36,510	-	-
1925*	492	90,654	-	-
1926	165	28,340	181	22,704
1927	167	28,282	219	21,700
1928	187	36,411	612	52,780
1929	282	57,379	786	83,599
1930	338	74,175	1,128	103,649
1931	60	10,168	73	8,948
1932**	-	-	-	-
1933**	-	-	-	-
1934	1	50	54	6,972
1935	78	12,707	140	8,950
1936	100	16,064	153	13,590
1937	100	24,540	478	39,183
1938	88	20,444	416	39,453
1939	112	31,056	488	39,495
1940	188	29,966	605	56,878
1941	253	53,112	853	91,971
1942	318	39,656	149	14,112
1943	62	17,033	141	11,946
1944	246	57,968	187	23,165
1945	289	77,469	340	45,571
1946	122	35,379	1,035	142,070

Source: Bureau of Foreign and Domestic Commerce, U.S. Department of Commerce, "Foreign Commerce and Navigation of the United States," compiled by the Division of Foreign Statistics, 1923-1946, Washington, D.C.

* Listed as "Adding and calculating machines" for these years.
** No data reported for these years.

Table 2.2: Cash Registers and Typewriters Exported from the U.S. to Chile (1923-45)

Year	Number of new cash registers	Value (U.S. Dollars)	Number of new standard typewriters	Value (U.S. Dollars)
1923*	214	54,382	2,444	154,214
1924*	325	73,334	3,354	194,970
1925*	348	66,340	2,548	180,141
1926	277	67,264	2,582	179,665
1927	417	99,781	2,378	170,729
1928	362	86,324	3,047	211,956
1929	390	95,696	4,368	324,481
1930	356	101,223	3,132	226,614
1931	15	4,160	273	20,389
1932**	-	-	146	9,937
1933**	-	-	8	637
1934	9	198	127	8,756
1935	13	3,324	753	50,171
1936	28	8,793	954	68,050
1937	48	17,249	1,164	78,642
1938	165	25,075	1,266	92,169
1939	48	33,579	1,858	131,997
1940	165	53,806	2,079	156,756
1941	870	116,310	3,549	259,375
1942	545	73,809	660	55,104
1943***	7 (used)	1,575	333	24,989
1944***	21	9,143	974	70,009
1945***	3	2,700	951	89,589

Source: Bureau of Foreign and Domestic Commerce, U.S. Department of Commerce, "Foreign Commerce and Navigation of the United States," compiled by the Division of Foreign Statistics, 1923-45, Washington, D.C.

* Figures listed are for all typewriters, new and used.
** No data reported for these years.
***A trend toward exporting used machines began during World War II.

Table 2.3: Card-Punching Machines Exported from the U.S. to Chile (1926-46)

Year	Number of card punching, sorting, and other tabulating machines	Value (U.S. Dollars)
1926 *	3	2,550
1927	29	11,750
1928 **	-	-
1929	8	3,869
1930	24	31,559
1931	17	5,994
1932	9	1,754
1933	24	7,349
1934	16	23,034
1935	30	14,187
1936	7	11,588
1937	3	287
1938	4	9,853
1939	4	9,828
1940	14	11,539
1941	15	15,399
1942	32	20,679
1943	1	1,381
1944	23	15,142
1945	82	49,614
1946	18	28,268

Source: Bureau of Foreign and Domestic Commerce, U.S. Department of Commerce, "Foreign Commerce and Navigation of the United States," compiled by the Division of Foreign Statistics, 1926-46, Washington, D.C.

* Reported as "Accounting and Tabulating Machines" for this year. Although tabulating machines arrived in Chile before 1926, the U.S. Department of Commerce had not created a category for tracking their exportation before this date.
** No data reported for this year.

Chapter 3

Bringing an Authentic Order

ON JANUARY 16, 1969, the newly created State Computer Service Enterprise, known as EMCO (Empresa de Servicio de Computación Limitada), unveiled its first computing machine in an elaborate inauguration ceremony. The government had bought the mainframe computer, an IBM 360-40H, using French credit for the hefty $2 million purchase price. The Chilean press described the computer as "an immense machine" consisting of "thirty specialized apparatuses," including fifteen magnetic disks, nine magnetic tape readers, a punch-card reader, and a printer capable of writing eleven hundred lines per minute. The general director of EMCO, Efrain Friedmann, told the newspaper *El Mercurio* that the new computer would need only eight hours to process the paychecks for fifty thousand people. With a separate set of instructions, Friedmann continued, it could also play music, write mysteries, compose Christmas cards, or even play chess or roulette.[1] Chilean President Eduardo Frei Montalva attended the inauguration ceremony (see figure 3.1), as did the president of EMCO, Alvaro Marfán; the French ambassador Raoul Duval; and Frei's ministers of agriculture, mining, finance, labor, public works, and health. Also in attendance were the rectors of Chile's top universities, the University of Chile and the Catholic University of Chile, and officials from the Chilean public and private sectors. Both Frei and Friedmann delivered eloquent speeches, quoting Shakespeare and Dickens and heralding the new machine as another step in Chile's road toward progress and modernity. Leading national newspapers *La Nación* and *El Mercurio* reprinted both speeches in their entirety the following day. *La Nación* declared the computer to be of the "highest productivity" in Latin America.[2]

Frei began his inauguration speech by saying, "At the beginning of my period of government, I promised to concern myself with the study and solution of one of the most acute and least studied problems in the country. I am referring to the functioning of the public administration and its technological aspects."[3] The modern state, the president declared, was responsible not only for the economy and social development of the country but also for "orienting, advancing, and coordinating all of its national activities." The most "critical difference" between a developed nation and underdeveloped one was in "management."[4] Since his 1964 inauguration, Frei's administration had emphasized state planning in all economic, social, and administrative activities, but the organization of the state apparatus itself "practically did not differentiate itself from that of the previous century," Frei said.[5] The sophistication of Chile's civil service and the tools it had to work with paled in

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[1] "Computadora procesará desarrollo del país," *El Mercurio*, 6 January 1969, 57.

[2] "Frei inauguro computador de mas alta productividad en América Latina," *La Nación*, 17 January 1969; "Inaugurado computador para el sector público," *El Mercurio*, 17 January 1969; "Chile se coloca a la cabeza del progreso computacional y tecnológico de América Latina," *La Nación*, 18 January 1969.

[3] Eduardo Frei Montalva, "Discurso del Presidente Frei en inauguración computador electrónico," (Santiago de Chile: Oficina de Difusión y Cultura de la Presidencia de la República, 1969).

[4] He used the English word "management," yet another indication of where the criteria for development originated.

[5] Given the tremendous increase in the Chilean state administration from the 1930s to the 1950s and the rationalization techniques supported by the *técnicos* and adopted by the government, Frei's comment is more rhetoric than historic fact.

comparison to the "highest powers of the State in all of the developed countries." The president later noted with pride that several European nations were creating centralized state computer agencies similar to the one that the Chilean government had established only a year before, in 1968. "This fact," he announced, "must make us proud. . . . Our far-away country is developing this modern centralized system for public administration at the same time as the most advanced countries in the world." The president recalled the changes that industrialization had brought to Chilean life during the nineteenth century and said, "In this way [installing a computer system] we are returning to the situations that garnered admiration during the last century for their spirit of scientific and technological progress." The inauguration of the "great computer" also provided an incentive for the nation's scientific and technological experts to continue working in Chile, slowing the brain drain that alarmed Chilean engineering societies, universities, and government agencies during this period. The president ended his speech dramatically, citing the famous opening lines from *A Tale of Two Cities*:

> It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair.

Drawing a parallel between Dickens' s text and the potential offered by science and technology for tremendous benefit or, if managed poorly, for great harm, Frei concluded, "I have full confidence that the dramatic alternatives of these times will resolve themselves positively with the help of science and technology, bringing an authentic order and the prosperity that our people require."

The inauguration ceremony was designed to emphasize the prominent role that the Frei administration was giving to science and technology and, in particular, the mainframe computers that the administration was purchasing. However, the views that Frei expressed in his speech also reflected the developmentalist (*desarrollista*) strategy he and his party had decided to pursue, which emphasized sustained economic growth and the marshalling of foreign credit, technical expertise, and advanced technology to progress the nation and escape the condition of underdevelopment. Import substitution industrialization (ISI) played a key role in his developmentalist policies and called for the state to intervene in Chilean economic activities in order to protect domestic industries through higher tariffs and import restrictions. This approach also demanded higher levels of state rationalization to coordinate the allocation of Chile's limited resources and best direct the Chilean path toward economic growth and industrialization.

External factors also influenced the early computerization of Chile's public administration and Frei's call for better administrative management. U.S. and international lending agencies demanded that Latin American governments draft global economic plans as a prerequisite for receiving foreign aid. These plans included how the funds would be utilized and the economic benchmarks for gauging success. Moreover, the Christian Democrats drew from the administrative structure of foreign governments and used them as a model for reforming the operation of the Chilean state. For example, Frei and the Christian Democrats decided to emulate the state planning techniques of French *dirigisme*, whereby the state encouraged and directed economic development in the context of a mixed economy. In this vein, the Christian Democrats pushed to create a series of state-owned enterprises and state planning agencies, including a central planning agency, ODEPLAN, for the executive branch, with a function similar to that of the French Commissariat au plan (Commisary for the Plan). This same logic also played into the founding of EMCO in 1968.

Frei's ISI and developmentalist policies largely equated modernization with the drafting fiscal policies, the owning of machines, and the ability to manufacture and purchase high-tech consumer goods. His presidency was marked by the domestic assembly of capital-intensive consumer goods, such as televisions, which were quickly coveted by members of the Chilean upper and middle classes. This vision of a technologically mediated road to progress made possible by a coordinated, interventionist state, made the purchase and application of mainframe computers even more appealing to the Chilean government. But this only constituted part of Frei's modernization program, which also included social restructuring through an agrarian reform and the formation of grassroots organizations to broaden the base of political participation. However, the government's early pursuit of modern technology and economic growth later forced to president to put the interests of foreign investors over those of the Chilean people and stalled the programs proposed by the Christian Democrats for social change.

This was particularly true in the case of Chile's relations with the United States. U.S. foreign aid through the Alliance for Progress was often linked to favorable trade agreements and benefits for U.S. multinational companies operating in Chile. Therefore, developmentalism continued past relations of economic inequality between Chile and the United States and placed a substantial portion of the profits made from Chile's industrialization in foreign hands rather than in the pockets of Chile's popular classes. As Chile struggled to find its own political and economic path, technologies such as computers and foreign companies such as IBM became contested sites of desire and resentment, feelings that echoed the nation's conflicted relationship with the developed world, especially the United States.

A "Revolution in Liberty"

Eduardo Frei Montalva had secured the Chilean presidency in 1964 on a platform that called for a "revolution in liberty." His program reflected a sincere desire to improve Chile's economic, social, and political conditions without the violence typically associated with socialism or the abuses of capitalism.[6] With 56% of the vote Frei and his Christian Democratic Party (PDC) believed that they had a mandate for their program of social and economic reform, overlooking the fact that their electoral victory resulted from the support Frei had received from the Right and from the U.S. government. Christian Democracy was Chile's largest political party from 1963 to 2001. The rapidity of its growth was impressive--it was established only in 1957 and had scored Frei's electoral victory only seven years later.

The PDC was an offshoot the National Falange, a party related to the Spanish Falange of José Antonio Primo Rivera but that emphasized the teachings of

[6] For an overview of the Christian Democrats and the presidency of Eduardo Frei Montalva, see Paul E. Sigmund, *The Overthrow of Allende and the Politics of Chile, 1964-1976* (Pittsburgh: University of Pittsburgh Press, 1977); Michael Fleet, *The Rise and Fall of Chilean Christian Democracy* (Princeton, N.J.: Princeton University Press, 1985); Albert L. Michaels, "The Alliance for Progress and Chile's 'Revolution in Liberty,' 1964-1970," *Journal of Interamerican Studies and World Affairs* 18, no. 1 (1976); Thomas L. Edwards, *Economic Development and Reform in Chile: Progress Under Frei, 1964-1970* (East Lansing: Latin American Studies Center, Michigan State University, 1972); James F. Petras, *Chilean Christian Democracy: Politics and Social Forces* (Berkeley: Institute of International Studies, University of California, 1967); Barbara Stallings, *Class Conflict and Economic Development in Chile, 1958-1973* (Stanford: Stanford University Press, 1978); Arturo Valenzuela, *The Breakdown of Democratic Regimes: Chile* (Baltimore: Johns Hopkins University Press, 1978); Leslie Bethell, *Chile Since Independence* (New York: Cambridge University Press, 1993); Simon Collier and William F. Sater, *A History of Chile, 1808-1994*, Cambridge Latin American Studies (New York: Cambridge University Press, 1996); Brian Loveman *Chile: The Legacy of Hispanic Capitalism*, 3rd ed. (New York: Oxford University Press, 2001); Brian H. Smith, *The Church and Politics in Chile: Challenges to Modern Catholicism* (Princeton, N.J.: Princeton University Press, 1982); Eduardo Frei Montalva, "The Aims of the Christian Democracy," *Commonwealth*, 9 October 1964; Sergio Molina Silva, *El proceso de cambio en Chile: la experiencia 1965-1970, Textos del*

the Catholic Church and the humanism found in the writings of the French Thomist philosopher Jacques Maritain.[7] The Falange began as a faction of the Conservative Party in the 1930s and was led by progressive members of Catholic youth organizations. In 1938, when the Conservative Party could no longer tolerate the progressive politics of the young people, the National Falange declared its independence. The National Falange continued to maintain its elite orientation and anticommunist position but searched for a means to implement social reform within a capitalist framework.

As a party, the National Falange had a slow start. Its leader, Eduardo Frei Montalva, lost congressional races for a seat in the Chamber of Deputies three times. In 1949 he secured a seat in the Senate representing the smallest region of the country. However, the Falangists managed to gain attention for their political integrity. The Nobel laureate and famed Chilean poet Gabriela Mistral described Frei as a man of "concrete ideas, unsentimental, but noble nature."[8] In 1957 the Falange decided to merge with another splinter faction of the Conservative Party, the Social Christian Conservatives, and together they formed the Christian

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Instituto Latinoamericano de Planificación Económica y Social (Santiago, Chile: Editorial Universitaria, 1972).

[7] Jacques Maritain is credited with giving Catholic thought a political framework. His book *Integral Humanism,* a volume based on lectures he gave in Spain before 1936, argued that the modern democratic state best represented human nature and Christian values. He later drafted a Thomist theory of human rights that influenced the UN Declaration of Human Rights, which Maritain helped write.
After World War II, Maritain's philosophy, which linked democracy, pluralism, and religious freedom, shaped the ideological positioning of Christian Democratic parties throughout Europe and Latin America. In 1934 a young Eduardo Frei heard Maritain speak at the Institut Catholique in Paris. The philosopher's words later inspired the future president to break with the youth movement of the Conservative Party and establish the National Falange in Chile. Paul E. Sigmund, "The Transformation of Christian Democratic Ideology: Transcending Left and Right, or Whatever Happened to the Third Way?" in *Christian Democracy in Latin America*, ed. Scott Mainwaring and Timothy Scully (Stanford: Stanford University Press, 2003).

[8] Eduardo Frei Montalva, *Memorias: (1911-1934) y correspondencias con Gabriela Mistral y Jacques Maritain* (Santiago de Chile: Planeta, 1989), 158. Cited in Collier and Sater, *A History of Chile, 1808-1994*, 307. A detailed description of Frei's life can be found in the two-volume biography by Cristián Gazmuri,

Democratic Party. Later that year Frei won election as a senator representing Santiago. He received more votes than any other candidate that year. The following year Frei ran for president and came in third, displacing the Radical Party candidate as the dominant representative of Chile's political center.

The Rightist candidate, Jorge Alessandri, won the presidency in 1958, but as Huneeus has pointed out, the Right did not have new ideas or a powerful political figure like Frei. During the next six years the PDC cultivated a platform of communitarian reform that would benefit a greater number of Chile's citizens without the class conflict of Marxism. This included gains in education, healthcare, housing and employment. As the Left continued to gain power, the PDC grew its base of support to include the Right, which decided that it was better to back the PDC than allow the Left to win the presidency.

The United States also embraced the third way offered by the PDC as the best means of addressing the call for social reform without inspiring another Marxist revolution, such as that of Cuba. Sources vary on the amount of U.S. dollars that flowed into Chile in support of Frei's election, but in 1975 the U.S. Senate Committee on Intelligence Activities put the level of CIA support for Frei's campaign at \$2.6 million.[9] The committee report also claimed that the United States had funded more than half of the Christian Democrats' campaign--without Frei's knowledge--and that the local CIA station had "furnished support to an array of pro-Christian Democratic student, women's, professional and peasant groups." Most

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Patricia Arancibia, and Álvaro Góngora, *Eduardo Frei Montalva y su época* (Santiago de Chile: Aguilar, 2000).

[9] U.S. *Covert Action in Chile, 1964-1973: Staff Report of the Select Committee to Study Governmental Operation with Respect to Intelligence Activities* (Washington, D.C.: U.S. Government Printing Office, 1975), 9. In addition, the PDC received monies from the German Christian Democratic Party, among others.

notable among the CIA's efforts was the financing of a slick media scare campaign that equated a Leftist victory with totalitarianism, the loss of Chilean traditions, and the destruction of the Chilean family. The CIA also paid for reproductions of an anticommunist pastoral letter written by Pope Pius XI that was distributed by PDC organizations. These tactics proved remarkably effective with Chile's largely Catholic population. On election day only 10% of Chileans who regularly attended mass voted for Allende.[10]

This combined base of support gave the PDC a landslide victory. Despite the Left's accusations that the PDC was nothing more than the new face of the Right, the party continued to receive strong support through 1965, electing 82 of their 142 candidates to the Chamber of Deputies and all twelve PDC candidates to the Senate. Confident in its electoral returns, the PDC decided to pursue its "revolution in liberty" without building alliances or striking compromises with Chile's other political parties, including those on the Right that had supported Frei. The Christian Democrats felt they could find a new balance between the often-conflicting goals of social reform and economic growth without playing the political game of coalition building and compromise. The idealistic position of the PDC is apparent in a statement Frei made shortly after his election, in which he summarized the ideological stance of the Chilean PDC as follows:

> The central tenet of the Christian Democracy is the belief that we are witness to the crisis of a world exhausted, to the death of paternalism, and to the birth of a civilization of work and solidarity *with man as its center*, rather than the pursuit of monetary gain that has pervaded the bourgeois society. And its inspiration is that this new era in history and the new social condition will be based on Christian values and concepts of Christianity. The strength of this movement lies, in consequence, in its positive character, and not a negative or anti-communist position."[11]

[10] Smith, *Church and Politics in Chile*, 107.
[11] Frei Montalva, "The Aims of the Christian Democracy."

Or, more succinctly, "Christian Democracy is founded on faith and on the ability to believe that it represents and better interprets the nature of man, and can inspire a new and more perfect social order."[12]

The PDC program led to significant improvements in education and welfare, aggressive pursuit of a program of agrarian reform, majority ownership of the nation's copper mines (a process known as "Chileanization"), and major strides in creating local self-help organizations for women and the poor (*promoción popular*). During Frei's tenure the state housing corporation, CORVI, built nearly seventeen thousand new houses. The government established three thousand new schools, and 95% of Chilean children received a primary school education by 1970, Frei's last year in office.[13] Valenzuela has written that during Frei's presidency public expenditures on health increased by 136%; on housing by 130%; and education by 167%.[14] In addition, Frei secured the majority ownership of the El Teniente, Chiquicamata, and El Salvador copper mines, which were owned by the U.S. companies Anaconda and Kennecott. In 1966 the Chilean government bought 51% of El Teniente, Chile's largest copper mine, and 25% of the newer mines Río Blanco and Exótica. After much negotiation the government convinced Anaconda to permit the "Chileanization" of its mines in 1969. As part of the deal the government retained the option to purchase the remaining stock between 1973 and 1982 and complete the process of nationalization.[15]

In the countryside the government began a process of agrarian reform and played a central role in the organization of rural peasants, a demographic group

[12] Ibid.
[13] Collier and Sater, *A History of Chile, 1808-1994*, 312.
[14] Valenzuela, *The Breakdown of Democratic Regimes,* 25.

previously ignored by the Chilean Left. Drawing on the idea of the social function of property espoused by St. Thomas Aquinas, the agrarian reform program created cooperatives of rural peasants and compensated Chilean landholders with government bonds. The government permitted two hundred rural unions to form before they were legalized in 1967. By 1970, 136,984 rural workers were organized, a dramatic increase over the 1965 figure of 2,118.[16] In the final two years of Frei's presidency, rural peasants seized two hundred private estates, actions that put the government in the difficult position of choosing between upholding the law or the stated goals of the revolution in liberty.

The PDC succeeded in incorporating marginal sectors of the population into the political sphere, an accomplishment that worried members of both the Right and the Left.[17] The party increased the number of local grassroots organizations such as the Mother's Centers (*Centros de Madres*) and legalized local governing bodies such as the *Juntas de Vecinos*. While these organizations succeeded in mobilizing women, slum dwellers, young people, and rural farmworkers, sectors of the population previously ignored by the Right, historians are quick to point out that these organizations excluded more than they were able to benefit. The government's tolerance for rural and urban unionization resulted in a dramatic increase in strike activity and unleashed uncontrolled levels of mobilization that would continue to plague the Chilean government during Allende's presidency. The Popular Unity program for socialist change through democracy often receives credit for initiating Chile's "peaceful road" to revolution. However, as we see here, the peaceful revolution began well before the presidential election of 1970.

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[15] Michaels, "The Alliance for Progress and Chile's 'Revolution in Liberty,'" 92.
[16] Valenzuela, *The Breakdown of Democratic Regimes,* 29.

Apart from these programs for social reform, Frei's presidency oversaw an increase in foreign investment, particularly from U.S. multinationals. By 1970 foreign interests controlled forty of the top one hundred Chilean companies. Twenty-four of the thirty leading U.S. multinationals had branches in Chile.[18] As Chilean private investment declined, foreign firms came to control one-quarter of all Chilean industrial capital. Government attempts to increase foreign investment deepened Chile's economic dependence, failed to alleviate unemployment, and gave priority to the needs of foreign companies and international lending agencies, not domestic policies. For this reason Loveman opined that the PDC was a "dismal failure" in its attempts to modernize by increasing the flow of foreign capital into Chile.[19]

The Kennedy administration's Alliance for Progress further exacerbated Chile's dependence on U.S. capital. From 1961 to 1970 the U.S. government gave $22.3 billion to Latin America, $720 million of which went to Chile. It was the largest per-capita sum awarded to any Latin American country. Only Vietnam ranked higher in terms of per-capita U.S. aid during the 1960s.[20] The Alliance for Progress was announced in a speech that Kennedy gave in March 1961, and it reflected the priorities of the United States during the Cold War: containing communism and preventing another revolution like the one in Cuba. The Kennedy administration believed that building democratic institutions and encouraging

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[17] The Left worried they would loose constituents to the PDC.
[18] Collier and Sater, *A History of Chile,* 318.
[19] Loveman, *Chile: The Legacy of Hispanic Capitalism*, 239.
[20] Miles D. Wolpin, *Cuban Foreign Policy and Chilean Politics* (Lexington, Mass.: Heath Lexington Books, 1972), 71. Cited in Michaels, "The Alliance for Progress and Chile's 'Revolution in Liberty,'" 77.

economic growth would instigate a wave of peaceful, non-Marxist revolution throughout Latin America.[21] In his address Kennedy had announced:

> I have called on all people of the hemisphere to join in a new Alliance for Progress – *Alianza para Progreso* – a vast cooperative effort unparalleled in magnitude and nobility of purpose to satisfy the basic needs of the American people for home, work and land, health and schools – *techo, trabajo y tierra, salud y escuela.*[22]

The president described an ambitious ten-point program that called for democratic institution building, economic integration, better nutrition and education for the poor, technical training programs, collective defense programs, and cultural exchange between the northern and southern hemispheres. In August 1961 representatives of the Inter-American Economic Council convened in Punta del Este, Uruguay, to further develop the objectives of the alliance, which included the redistribution of income, trade diversification, higher agricultural production, improved education, inexpensive housing, improved tax collection, and raised levels of foreign investment.

The Alliance for Progress tried to formulate a program that would bolster Latin American support for the United States. After Kennedy's assassination President Lyndon Johnson (1963-1969) continued to support the alliance, but its focus shifted away from the ideological goals of the past, such as social reform and democratic development, and moved toward programs for fostering economic growth.[23] However, the Christian Democrats had the potential to institute both while offering an ideological framework for change that the Alliance for Progress

[21] Michael E. Latham, *Modernization as Ideology: American Social Science and "Nation Building" in the Kennedy Era* (Chapel Hill: University of North Carolina Press, 2000).
[22] John F. Kennedy, "Address at a White House Reception for Members of Congress and the Diplomatic Corps of the Latin American Republics," March 1961, John Fitzgerald Kennedy Library, Boston.

lacked. Frei noted the compatibility of the stated goals of the Alliance for Progress and the reforms that he thought Latin America needed, including the elimination of the elite, redistribution of the land, equal access to education and wealth, and secure economic development. "These," he concluded, "are precisely the same objectives of the Alliance."[24]

Chile provided an ideal test site for the Alliance for Progress. Apart from the political platform advanced by the Christian Democracy, the country had the longest history of constitutional democracy in the region, uninterrupted since 1932. Moreover, Chile had finished drafting a ten-year plan for economic growth that was known as the National Plan for Economic Development and could be used as a benchmark for determining the effectiveness of U.S. monies. Although CORFO, the state development agency, had finished the plan in 1958, the government did not call for its implementation until 1961. Frei's minister of finance, Sergio Molina, explained that the four-year delay resulted from a lack of government support for economic planning during the Alessandri administration. Moreover, the decision to implement the plan aligned perfectly with Kennedy's announcement of the Alliance for Progress. According to Molina, the Chilean government "saw the opportunity to obtain an immediate advantage from the ten-year plan," as it provided a "means of gaining external credit" from the Kennedy administration.[25] In 1964 both Frei and Allende stressed the importance of planning and wanted to increase the number of technically trained employees within the Chilean government so that they could further develop the scope and utility of these plans for national benefit. In a 2004

[23] Michaels argues that under Johnson the Alliance for Progress adopted a stance of political neutrality except in the case of stopping communism.
[24] Eduardo Frei Montalva, "The Alliance That Lost Its Way," *Foreign Affairs* 45, no. 3 (1967): 438.
[25] Molina Silva, *El proceso de cambio en Chile,* 159.

interview Molina added that planning also "gave [the United States] a vision of an ordered country, that knew where it was going, what it wanted to do. This was very important for Chile's relationship with the Alliance for Progress."[26] Critics of the Alliance for Progress would point to the clarity with which U.S. officials articulated the methods, aims, and benchmarks of success for programs of economic growth, the vagueness of their definitions of democracy, and their failure to explain the relationship between democracy and social reform.

Organization is Power

In 1965, in his first State of the Union speech, Frei declared, "The road to power is organization."[27] His comment was directed at the need for labor to organize, but the remark also expressed Frei's stance on administrative order, rationalization, and control. In that same speech he also stated, "The people voted to reform the administrative organization of the State so that the country has at its command an effective instrument for realizing the changes it desires."[28] From the beginning of his presidency, Frei devoted considerable attention to improving the rationalization and coordination of state activities, which later included computerizing facets of public administration. In 1965 he created the Special Commission on Rationalization of State Civil Administration, presided over by the general comptroller, who reported directly to the president. Frei also submitted to Congress a proposal to create an executive office of national planning. This agency, which became ODEPLAN, was located within the executive branch; advised the Ministry of Finance; promoted

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[26] Sergio Molina Silva, interview by author, 15 January 2004.

[27] *Primer mensaje del Presidente de la Republica de Chile don Eduardo Frei Montalva al inaugurar el periodo de sesiones ordinarias del Congreso Nacional, 21 de Mayo de 1965*, (Santiago, Chile: Departamento de Publicaciones de la Presidencia de la Republica - Chile, 1965), 6.

national, sector, and regional planning across the various government ministries; and contributed to the creation of short-term and long-term plans for economic development. Through ODEPLAN the government acknowledged the importance of economic and social planning and took responsibility for its execution. In addition to establishing budgets for spending the various sums flowing into the Chilean treasury and setting priorities for economic activities, ODEPLAN sought to rationalize the Chilean government workforce by defining the skills required to hold various administrative positions and directing investment toward the training of these future employees.[29] Congress debated the program for two years before enacting the law that granted ODEPLAN its charter in 1967. The agency began operation that August under the direction of Fernando Aguirre Tupper, formerly an engineer employed by CORFO.[30]

The Central Office for Organization and Methods (OCOM), an organization created during the Alessandri administration (1958-1964), also concentrated its efforts on making government agencies better organized and more efficient. It established the National Center for Electro-Mechanical Data Processing in 1966 and helped organize the data-processing centers of other government agencies, such as the National Statistics Institute (INE). OCOM drafted detailed job descriptions that were used to define pay scales for all public sector workers.[31] In an independent effort, tthe government also established a system for tallying the total number of state employees on the payroll of Chile's many state agencies, enterprises, and

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[28] Ibid., 9.
[29] *Segundo mensaje del Presidente de la Republica de Chile don Eduardo Frei Montalva al inaugurar el periodo de sesiones ordinarias del Congreso Nacional, 21 de Mayo de 1966*, (Santiago, Chile: Departamento de Publicaciones de la Presidencia de la Republica - Chile, 1966).
[30] "Senado aprobó creación de la Oficina de Planificación," *La Nación*, 27 April 1967; "Primer director del "ODEPLAN"," *La Nación*, 12 July 1967.

organizations. “It seems hard to believe,” the president remarked, “but before 1965 there was never a system to know the exact number of administrative functionaries [in government].”[32]

The Christian Democrats also established smaller offices and committees charged with reforming state administrative practices. The Office of Rationalization and Administrative Control opened in 1967. In April 1968 the government created the National Commission on Computation to advise the government on computing and to draft reports about how the public sector could make the best use of modern electronic data-processing technology. At the same time, the government also proposed creating a national training school for public administration that would educate state employees on “the most modern techniques of organization and in the use of computing.”[33]

In addition, the Frei government founded a number of other state agencies and enterprises dedicated to Chilean technological development. These new state agencies linked the state to the management of Chilean technical resources and their role in the Chilean economy. The Empresa Nacional de Telecomunicaciones (ENTEL), established on December 30, 1964, facilitated communication within Chile by building new telephone, telegraph, and telex lines. However, the true utility of these communications lines is debatable. Most Chileans could place a telephone call only from the limited number of call centers that ENTEL was constructing in Chile's urban centers. It often took forty-five minutes to call Santiago from Valparaíso, a

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[31] See, for example, Ministerio de Hacienda, "Nomina única de cargos administración civil del estado, indice," Ministerio de Hacienda, OCOM, Santiago de Chile, 1967.
[32] Frei Montalva, "Discurso del Presidente Frei en inauguración computador electrónico."
[33] Ibid. See also Ministerio de Hacienda, "Programa de adiestramiento en la administración pública y creación de la escuela nacional de adiestramiento," Ministerio de Hacienda, Dirección de Presupuestos, OCOM, Santiago de Chile, 1968.

distance easily traversed by a two-hour bus ride.[34] ENTEL also improved radio and television transmissions, which increased the influence of the media and, as the CIA and Chilean political parties quickly learned, its potential for manipulating public opinion. In 1967 the government established the Comisión Nacional de Investigación Científica y Tecnológica (CONICYT), similar to the National Science Foundation in the United States, and charged it with directing and developing Chilean science and technology to meet national needs. On January 19, 1968, the Frei administration established Chile's first National Science Prize and made CONICYT an independent organization. CONICYT significantly increased the government's support for scientific research. During its first year the science agency funded 154 projects involving 263 scientists and purchased scientific equipment for common use. Its formation also reflected the importance of scientific and technological activities to the Chilean government and its developmentalist policies. At the 1967 Conference of Science and Technology for Latin America, Frei declared:

> No one can ignore that the development of contemporary civilization depends on science and technology and that those countries that are on the margin of this process of investigation or that are not capable of perceiving and adapting this process to their own reality, find themselves unpardonably condemned.[35]

Through CONICYT the government hoped to save Chile from this unpardonable fate.

The government's determination to promote science and technology was further reflected in the creation of technology offices within Chile's traditional government agencies. For example, the state development agency, CORFO, carved

[34] For an overview of Chilean telecommunications see "Las telecommunicaciones en Chile," *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, May-June 1966.
[35] Eduardo Frei Montalva, *América Latina tiene un destino* (Santiago de Chile: Zig Zag, 1967).

out a technology subdivision in 1968 that was known as the Comité de Investigaciones Technológicas de Chile (INTEC). This new committee advised CORFO on ways to "promote technological research in the country" and encourage "studies for the development of new industrial products." The committee's charter also contained plans to establish a "Center or Institute for technological research" that would further assist the application of technology to Chilean industries.[36]

Frei's desire to modernize the Chilean state and the Chilean economy by using new techniques and advanced technologies depended on the financial assistance and expertise of international organizations such as the United Nations, International Development Bank, and European Economic Commission; the United States; Western European nations such as France, Britain, Italy, Holland, and Switzerland; and other nations such as Yugoslavia, Romania, Israel, the Soviet Union, India, Argentina, and Brazil.[37] Except for the U.S. funded Alliance for Progress, many of these reflected Chile's political ties, such as those to the European Christian Democratic parties. The Chilean program for state growth and Latin American integration resembled the program advanced by the European Christian Democrats for the creation of a European welfare state after World War II, postwar

[36] CORFO, Resolution No 834, 1968, INTEC Archives, Santiago de Chile.
[37] In its report on international technical assistance, ODEPLAN listed various sources of aid. Multilateral sources included the United Nations and its specialized agencies such as the International Labor Organization, the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the World Health Organization. Regional sources included the Organization of American States, the International Development Bank, the European Economic Commission, and the Organization for Cooperation and Economic Development. Finally, the report listed the governments of "friend" nations, including Germany, Belgium, Denmark, the United States, France, Great Britain, Holland, Israel, Italy, Japan, Switzerland, Austria, Argentina, Brazil, Bulgaria, Canada, Czechoslovakia, Spain, India, Norway, Poland, Romania, Sweden, the Soviet Union, and Yugoslavia. Departamento de Asistencia Técnica Internacional, "La asistencia técnica internacional recibida por Chile, 1965-1968: un intento de evaluación," 1970, ODEPLAN, Santiago, 10.

reconstruction, and European integration.[38] At the beginning of his presidency, Frei broke off relations with the Soviet Union to increase Chile's standing with the United States; however, he gradually reinstated relations with the Soviet bloc as his presidency continued.

Between 1965 and 1968 the Chilean government received $46.4 million in technical assistance from industrialized nations and earmarked $9 million for scholarships abroad or at Chilean universities.[39] France, in particular, provided both technical assistance and the foreign credit that Chile needed to buy computers, upgrade the national telecommunications system, and introduce new techniques for civil administration. An ODEPLAN report on technical assistance acknowledged, "The help of France in the areas of civil Administration has been of great importance, especially through OCOM." The report also thanked the United Nations and Britain for their assistance to the Chilean Budget Office and EMCO.[40] The $46.4 million in foreign aid also included $1.6 million for 715 scholarships for civil servants and economists and $4.3 million (1966-68) for state projects and the bringing foreign experts to Chile. Chile spent more of its foreign aid on improvements to Chilean government administration than on industry, energy, transportation, mining, and health, construction, and social development.[41] Most of this money came from the United States and France.

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[38] Sigmund, "The Transformation of Christian Democratic Ideology: Transcending Left and Right, or Whatever Happened to the Third Way?" 68. In the spirit of Simón Bolívar, Frei repeatedly called for Latin American integration. Without integration, Frei believed, "Our markets will be reduced and we will not be able to reach new forms of economic life and the widespread adoption of modern technology." *Segundo mensaje del Presidente de la Republica de Chile don Eduardo Frei Montalva al inaugurar el periodo de Sesiones Ordinarias del Congreso Nacional, 21 de Mayo de 1966*, 57.

[39] Departamento de Asistencia Técnica Internacional, "La asistencia técnica internacional recibida por Chile, 1965-1968: un intento de evaluación," 8. The $9 million figure included the period from 1964 to 1968.

[40] Ibid., 37.

[41] Ibid., 41-42.

Taken together, these administrative initiatives and the influx of foreign aid demonstrated the Christian Democrats' commitment to cultivating of Chilean technological capabilities, as well as the application of new techniques and technologies to achieve better administrative and economic management. Science and technology occupied a crucial role in the economic development model promoted by international organizations and the United States, which emphasized industrialization, capitalism, and technocracy. Frei employed a similar framing for his development program and expressed faith in the power of science and technology to positively change Chilean society. The larger role of the state in Chile's modernization and development efforts, as well as the emphasis on state planning, also reflected the influence of the French *dirigiste* model and its interventionist and technocratic state.[42] Chilean industries and administrative bodies both felt the effects of state growth and heightened intervention. By 1970 the state was responsible for more than half of all Chilean industrial investment.[43]

Government projects for rationalization and organization extended beyond the formation of national state agencies and entered the daily life of Chilean communities. In addition to setting up local and regional offices of ODEPLAN, Frei

[42] In the French context *dirigisme* refers to a capitalist economy with a high level of state intervention and control. French dirigisme emphasized the formation of state enterprises, such as the national railway, telecommunications company, and energy company and coincided with the creation of the administrative training school, the École Nationale d'Administration, as well as the promotion of engineers to civil service leadership positions. *Dirigisme* flourished during the Center-Right presidencies of Charles de Gaulle (1958-69) and Georges Pompidou (1969-74). According to Sergio Molina, Chile "felt a stronger identification with [*dirigisme*] than with a liberal or classical system where the private sector [makes] decisions. Private sector decisions were few and less important, they were to a large extent induced by the public sector. The State fixed prices . . . the State authorized importations, so it was a dominant State." This made state planning seem logical "because a good part of the influential policy measures [being made] were State decisions." Molina interview. For an in-depth study of French bureaucracy see Michel Crozier, *The Bureaucratic Phenomenon* (Chicago: University of Chicago Press, 1964). For a comparative study of Chilean bureaucratic structures, see Peter S. Cleaves, *Bureaucratic Politics and Administration in Chile* (Berkeley: University of California Press, 1974), and German Urzua Valenzuela and Anamaria Garcia Barzelatto, *Diagnostico de la burocracia chilena (1818-1969)* (Santiago de Chile: Editorial Juridica de Chile, 1971).

fought to legalize the Juntas de Vecinos, connect them to other hierarchical governing bodies, and use them to build democracy and instigate local development efforts. The formation of grassroots community organizations constituted a vital part of his National Council for Popular Promotion (*Consejería Nacional de Promoción Popular*), charged with identifying local needs, coordinating development efforts between the state and local levels, and facilitating the flow of information between the governing center and the Chilean people. According to Molina, *promoción popular* constituted a key part of the Christian Democratic ideology:

> Organization was a form of power . . . to better defend your interests and therefore increase your potential in all levels of society, in the Juntas de Vecinos, in the Centros de Madres, in the urban centers, because they pressure the local authorities and the national authorities regarding their interests. Social organization was an essential question.[44]

He added that the government's attention to increasing participation was "attacked by other parties because they considered it a political instrument of the Christian Democrats. The truth is that there was a degree of political proselytizing." He maintained that this was not the intention but that "people felt a certain relationship with what the Christian Democracy had done."[45]

To return to the remark Frei made in his 1965 State of the Union Address, which was echoed by Molina, organization is power. Through efforts that ranged from coordinating the activities of a growing public administration to coordinating the activities of Chile's working and poor classes so that they might improve their situation, the Frei government increased its scope of influence and tried to fortify its position. Collier and Sater argued, "The entire PDC program can be seen as an extension and intensification of the state-interventionist tradition that had built up

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[43] Collier and Sater, *A History of Chile,* 318.
[44] Molina interview.

since the Ibañez regime of the 1920s," an observation that would hold true were it not for the aforementioned attempts by the Christian Democrats to simultaneously broaden the base of organized political participation.[46] In contrast to the Ibañez government of the 1920s, where organization and rationalization became synonymous with tools of dictatorial control, Frei continued to uphold democracy and succeeded in increasing levels of popular participation.[47] However, Frei did appeal to scientific methods and techniques in order to avoid the compromises and coalition building that had characterized Chile's democratic process in the past. He strengthened his position by appointing economists or engineers, rather than politicians, to high government offices, including those in his cabinet. From this perspective, it would be accurate to say that Frei continued the "*tecnificación*" that began under Ibañez and the Popular Front government. But it was a strategy members of the opposition had learned to recognize. Members of the Right especially did not view the president's attention to planning as apolitical but rather as a means of extending executive power. For example, senators from the Right objected to ODEPLAN, not because they disagreed with the value of centralized economic planning but because they believed that the agency's location within the executive branch would advance the presidential agenda and not the national interest.[48] There was probably some truth in the critique, particularly given the unwillingness of the PDC to compromise or recognize competing voices. On the surface, PDC calls for the rational allocation of resources and long-term economic planning appeared to be

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[45] Ibid.
[46] Collier and Sater, *A History of Chile,* 318.
[47] Aldolfo Ibañez Santa Maria, "Los 'ismos' y la redefinición del Estado: tecnicismo, planificación y estatismo en Chile, 1920-1940," *Atenea*, no. 474 (1996); Molina Silva, *El proceso de cambio en Chile;* Richard Bourne, *Political Leaders of Latin America* (Baltimore: Penguin, 1969).
[48] "Senado aprobó creación de la Oficina de Planificación."

above clientelist politics, offering a scientifically determined path for development. However, this framing also represented a party strategy to place expertise over corporatism and justified the PDC's practice of ruling as a single party.

When asked to define the idea of modernity that prevailed during the presidency of Frei Montalva, Sergio Molina responded, "I believe that modernity was in the institutional changes [Frei] made, being aware of the need to rationalize decisions, being aware of the significant waste in state actions due to unjustified bureaucracy, being aware that decisions must be made with a degree of knowledge about their effects." Rationalization and order, and the techniques for their achievement, therefore constituted central facets of Frei's modernization program. He added, "I would say that modernity was more in the search for a different way of doing things." If the administration of Jorge Alessandri had been the "government of managers," Molina reasoned that the Frei administration was a "government of advisers," with professional academics assuming a role of greater influence.[49] Molina himself was a prime example of this phenomenon, having worked as a professor of economics at the University of Chile and as the director of the budget office from 1954 to 1964. His successor as minister of finance, Raúl Saez, was one of the most respected engineers in Chile.[50] This predominance and privileging of technocratic expertise also characterized the ideological program of the PDC. Molina concluded, "Modernization, the change in the structure of the country, this was the focus, this was what we were looking for, but in the sense of social change, equality, different organization." Rationalization, organization, coordination, and, at bottom, *tecnificación* not only played a crucial role in Frei's economic policies for

[49] Molina interview.

development, but also the social changes outlined in the "revolution in liberty" and the president's dream for modernizing the state so that he might create a better society. As instruments of organization, computers thus played a role in shaping Chile's economic, political, and social history.[51]

Centers of Computation

The presidency of Frei Montalva marks an important moment in the history of Chilean computing. The Christian Democrats imported Chile's first mainframe computers for government use, established a government agency dedicated to managing the application of these new machines (EMCO), and instituted the first publicly funded training programs for computer programmers and systems analysts that predated university computer science curriculums. Granted, the PDC cannot claim sole credit for these accomplishments as they built upon past efforts to bring order to the bureaucracy and adopt electromechanical data processing technologies in state activities. However, the PDC played a vital role in supporting Chile's early adoption of mainframe computer technology and its initial training of computer operators.

Electronic computers, as opposed to the mechanical tabulating machines discussed in chapter 2, had begun to arrive in Latin America during the late 1950s. Venezuela purchased an IBM 650 in 1957.[52] The University of Chile installed a Standard Electric-Lorenz ER-56 in 1959, a machine later derided as an "elephant

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[50] For more on Raúl Sáez, consult the two-volume collection of his writings, Raúl Sáez, *Raúl Sáez hombre del siglo XX* (Santiago de Chile: Dolmen, 1994).
[51] In Spanish computers are even called *ordenadores* or "orderers."
[52] Ramón C. Barquín, "Some Political Effects of Computation in Latin America," in *M.I.T. Alfred P. Sloan School of Management Working Paper no. 655-73* (Cambridge, Mass.: M.I.T. Alfred P. Sloan School of Management, 1973).

without a trunk or feet," given its limited capabilities (see figure 3.2).[53] In 1965 the State Technical University of Chile acquired an electronic computer donated by the Californian Research Corporation and the Californian Chemical Pan American Company.[54] The University of Concepción approved the creation of a computer center in 1964 and purchased an IBM 1620-II in 1965 with help from the United Nations Educational, Scientific and Cultural Organization (UNESCO) and an education discount from IBM.[55] The Catholic University also purchased an IBM 1620 for its computer center, and then replaced it in 1969 with a Burroughs B3500 mainframe for academic research and the training of programmers and systems analysts.[56]

On April 4, 1964, IBM had announced that it would be selling a new family of computers with interchangeable software and peripheral components known as the System/360. It was, in the words of *Fortune* magazine, "IBM's $5 billion dollar gamble." The IBM 360 mainframe quickly became the most sought-after computer in the Chilean market. According to the United Nations, the first IBM 360 arrived in Chile in 1966 and was most likely destined for the private sector (see table 3.1). The University of Chile welcomed the arrival of an IBM 360/40 in 1967 with an elaborate inauguration ceremony attended by President Frei. For its first official duty the new machine printed a likeness of the president in less than thirty seconds (see figure

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[53] Patricio Léniz, interview by author, 23 December 2003. A firsthand description of the Lorenz ER-56 and its early operation appears in Julieta Melo, *La Escuela de Ingeniería: quién y qué es la Facultad de Ciencias Físicas y Matemáticas de la Universidad de Chile* (Santiago, Chile: Eds. Mil Hojas, 1997).
[54] "Computador electrónico recibe a las 11.30 Horas la U. Técnica," *El Mercurio*, 13 January 1965; "Computador electrónico recibió Universidad Técnica del Estado," *El Mercurio*, 14 January 1965. As the story goes, the Californian Research Corporation was looking for a place to send its outdated hardware. An employee who had ties to the State Technical University recommended sending the machine to Chile. It was heralded as the largest computer in Chile and one of the biggest on the continent, with the ability to perform five hundred operations per second.
[55] Carlos Muñoz Labraña, *Historia de la Facultad de Ingeniería Universidad de Concepción* (Santiago de Chile: Ediciones Universidad de Concepción, 1992).

3.3).[57] The then-director of the Department of Mathematics at the University of Chile, Efrain Friedmann, stated that the computer would support government agencies such as CORFO and the National Health Service as well as provide a tool for scientific research and engineering education within the university. In this way, the university could help lessen Chilean dependency on foreign computer companies.

Chile's treasury and internal revenue service were among the first government agencies to use rented computer technology, although the state banks, the National Statistics Institute (INE), and the Civil Registry (*Registro Civil)* were not far behind. Computer technology helped the government to restructure the national tax system and enforce payment. In 1967 the state treasury began a pilot program to record daily economic statistics and transactions, an effort purported to "eliminate a series of routine jobs for treasury personnel."[58]

Rented computer technology entered the census office in time for the agriculture and fishing census of 1967; the creation of EMCO and the government's acquisition of mainframe technology enabled the complete computerization of census data by the time of the population census in 1970. The new methods of data processing received a mixed reaction from employees at the National Statistics Institute. "In Chile we have a particular way of thinking, we are not friends of change," remarked Jorge Morales, an employee of the National Statistics Institute for more than forty years. He began his career processing the data for the national censuses in the 1960s and 1970s. "There was a lot of fear, primarily surrounding

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[56] "Nuevo computador adquirirá la UC.," *La Nación*, 22 July 1969.

[57] "Asombroso computador inaugura la universidad," *El Mercurio*, 17 January 1967; "Centro electrónico fue inaugurado por S.E. en la Universidad de Chile," *El Mercurio*, 18 January 1967; "Cerebro electrónico comenzó a funcionar," *La Nación*, 18 January 1967.

unemployment, particularly when a machine arrives that works much quicker and can perform many tasks on its own."[59] In the end, however, the process of tabulating the census data did not change dramatically with the introduction of mainframe technology. Employees of INE still needed to collect the data and prepare the series of punch cards as they had in the past. However, they then delivered the stacks of cards to EMCO instead of performing the calculations themselves on electromechanical tabulators or taking the cards to an IBM service bureau.

Other government projects made use of the new computing machines. The Servicio Nacional del Empleo (National Employment Service) drew up plans for a computerized database that would match unemployed "maestros" (e.g., carpenters, plumbers, electricians) with potential employers.[60] The Ministry of Justice began a program to assign a national identification number and civil identification card (Cédula de Identidad) to every citizen, efforts that paralleled activities in the treasury to prevent tax evasion and tax fraud. This rationalization of the Chilean population later enabled the Ministry of Justice, Internal Revenue Service, and Civil Registry to develop a common national identification number (RUT) that facilitated the collection, organization, and exchange of information on the Chilean population.[61] The National Mining Enterprise (ENAMI) established a regional computing center in September 1968 that was charged with processing the administrative and production data from the various smelting plants and refineries

[58] *Tercer mensaje del Presidente de la República de Chile don Eduardo Frei Montalva al inaugurar el periodo de Sesiones Ordinarias del Congreso Nacional, 21 de Mayo de 1967*, (Santiago, Chile: Departamento de Publicaciones de la Presidencia de la Republica - Chile, 1967), 188.
[59] Jorge Morales, interview by author, 9 August 2002.
[60] "Cerebro electrónico para obtener empleo," *La Nación*, 19 June 1967.
[61] Isaquino Benadof, interview by author, 10 April 2002; *Sexto mensaje del Presidente de la República de Chile don Eduardo Frei Montalva al inaugurar el periodo de Sesiones Ordinarias del Congreso Nacional, 21 de Mayo de 1970*, (Santiago, Chile: Departamento de Publicaciones de la Presidencia de la Republica -

as well as all ENAMI offices.[62] According to *La Nación,* the ENAMI computer could process 30,000 multiplications per second, punch as many as 14,000 cards per hour, and read as many as 15,000 cards per hour.

OCOM was an important institutional precursor to the government's computerization of administrative tasks and its formation of a state computer agency. The Chilean government formed OCOM within the Ministry of Finance during Jorge Alessandri's presidency, but the office increased its influence considerably during Frei's administration as part of the multisited effort to promote economic growth and administration reform.[63] The management approach known as "organization and methods," or O&M, began in the British Treasury during the 1940s as a means of applying scientific methods to administrative management.[64] The increase in O&M's appeal during the 1940s paralleled the directed economic policies put in place by the British Labour Party in the aftermath of World War II and reflected the increases in state spending demanded by reconstruction. Toward the end of the 1940s other sectors of the government, British nationalized industries, and the British private sector adopted O&M techniques. O&M always emphasized the development and application of methods to improve the efficiency of clerical work. However, it evolved considerably from the 1940s to the 1960s, changing from a human-centered approach to collecting, organizing, and recording information

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Chile, 1970). See also Ministerio de Hacienda, "Registro único nacional" 1969, Ministerio de Hacienda, Dirección de Registro Civil e Identificación, OCOM, Santiago de Chile.

[62] "Inaugurada computadora que realiza treinta mil operaciones por segundo," 1968.

[63] Legal decree 106 (Decreto de Fuerza de Ley), passed in 1960, charged the Budget Office of the Ministry of Finance to "dictate norms and establish general procedures of organization and the operation of Organization and Methods units that exist or that are created in the different Services." *Ministerio de Hacienda*, DFL-106, 25 Feburary 1960.

[64] Agar writes that Treasury O&M was "at last, a British administrative science espoused by an expert movement which can be compared in relative size, influence, and theoretical sophistication to the management sciences found in early-twentieth century America that have been described by Yates." Jon

during the 1940s to one that emphasized mechanized data processing, using punch-card machinery and, later, electronic computation during the 1950s and 1960s. As Agar writes, these technologies became "the unproblematic tool and symbol of postwar O&M."[65] The computer, in particular, became a machine that embodied the management goals of O&M technocrats. As O&M spread, Britain became an administrative model for other nations, such as Chile.

OCOM oversaw the introduction of Organization and Methods techniques in public administration and trained government workers in these new practices and the use of tabulating machines. The office also controlled the tariffs on the IBM Unit Record machines imported by the private sector and assisted the government in applying these punch-card machines to the administration of the public sector. Following Frei's election, OCOM was able to expand its presence in the public administration through Frei's efforts to modernize the state. They also trained systems analysts and programmers for employment as functionaries in state accounting and offices such as social security. OCOM served as the organizational hub for the government's data processing activities prior to 1968. In 1967, the President formed a National Commission for Data Processing placed under the direction of OCOM and charged it with laying the groundwork for creating a national center for data processing. This resulted one year later in the formation of EMCO.

Agar, *The Government Machine: A Revolutionary History of the Computer* (Cambridge, Mass: MIT Press, 2003), 258.

[65] O&M technocrats did not embrace these technologies overnight but gradually became convinced over a five-year period that computers could feasibly replace clerks. The technocrats also succumbed to external pressure from computer manufacturers and the British press, as well as internal pressures from the British government for more complete industrial statistics and increased computing power. Ibid., 256, 305-07.

EMCO represented the culmination of Chile's gradual acquisition of computing machinery and expertise throughout the 1960s, its longer history of using punch-card tabulating machines, and the government's desire to centrally control the application of data processing technologies. Part of the government's rationale for EMCO was simple. Computers were extremely expensive machines, and each branch of government could not afford to purchase a mainframe for its exclusive use. Former IBM employee Fernando Villanueva recalled that if a Chilean company wanted to purchase an IBM 1401, a machine known as the "Model T of business computers" that was hardly top of the line, it needed to pay the $200,000 purchase price plus a government required $2.5 million deposit in the Central Bank as proof of funds, money that would be returned to the purchaser when the machine arrived.[66] The company also paid 200% of the purchase price in tariffs, raising the total cost of the IBM machine to $600,000.[67] Chilean law excused government agencies from paying tariffs, making the government one of the few early adopters of the technology, but the price of these machines and the limited availability of the foreign credit required to make their purchase possible presented a strong argument in favor of centralizing Chilean computer resources. Establishing EMCO permitted the government to import more advanced, costlier technologies, assured their full utilization, and helped smaller government offices enjoy the benefits of computers. The agency was placed under the joint direction of CORFO, ENDESA, and ENTEL

[66] The 1401 was the first mass-produced, digital, transistor-based model offered by IBM. It was more limited but more affordable model than the 360 mainframes that the Chilean government later imported toward the end of the 1960s.
[67] Villanueva interview.

and given status superior to that of OCOM, which continued as an office within the Ministry of Finance.[68]

In addition to purchasing and maintaining the government's computer machinery, EMCO provided advice, services, and educational training. According to EMCO's first general director, Friedmann, the agency's initial tasks included creating an economic system of computation that linked the machines to telecommunication lines to form a "giant nervous system"; setting up compatible computer systems in every government agency so that the same data archive could be used in the future; and establishing an "emergency" training program to produce the specialists needed to carry out the first two goals. Within six months the computer agency was servicing twenty-two government institutions.[69] EMCO inaugurated its first mainframe in January 1969 and welcomed its second and third machines exactly one year later.[70] In addition, both the national bank (Banco del Estado) and the state electric company, Chilectra, installed new mainframe machines in September 1969.[71] These new acquisitions represented considerable gains in Chile's computing power. According to the United Nations, by 1969 Chile possessed thirty-three computers, eighteen in the public sector and fifteen in the private sector.[72]

EMCO played a vital role in training the first generation of computer-literate professionals employed by the government. Isaquino Benadof began working for

[68] Barquín, "Some Political Effects of Computation in Latin America," 25.
[69] EMCO, "Seminario sobre sistemas de información en el gobierno," 1969.
[70] "Nuevo computador se instala en el país," *La Nación*, 7 January 1970.
[71] "El más grande computador de Sud América inaugura mañana el Banco del Estado," *La Nación*, 31 August 1969; "El Presidente Frei Inauguro Computador Electronico del Banco del Estado de Chile," *El Mercurio*, 5 September 1969; "Inaugurado computador electrónico de Chilectra," *La Nación*, 2 September 1969; "Un computador en el Banco del Estado," *La Nación*, 3 September 1969; "Moderno computador inauguró B. del Estado," *La Nación*, 2 September 1969.

EMCO in 1969 when he was recruited by Freidmann to start a state computer-training program with another Chilean, Mario Pardo. After exploring options in Europe and the United States, Benadof and Pardo decided to model the Chilean computer-training programs after those offered at the British National Computing Centre, an organization sponsored by the British government to train computer professionals and help improve the national use of computer technologies. With United Nations funding and the help of British advisers, the EMCO training program began operation in 1969 and, according to Benadof, trained three hundred programmers and one hundred systems analysts in its first year. "It was massive," Benadof recalled. "It was a factory. The country didn't have [a computer literate workforce]. We needed it urgently."[73]

EMCO provided the Chilean government with a center of calculation, where populations, salaries, economic activities, and national resources came together as census data, economic data, and administrative data. Newly trained operators inscribed these data on punch cards read by a central mainframe computer, compiled the data into quantified maps of Chile, and used the maps to create future plans of action. The computer, operating around the clock, generated a new wealth of data and created new forms of national knowledge that allowed the government to specify with increasing exactitude its program for development and set benchmarks for success and failure. Moreover, it allowed government officials to demonstrate these plans and their projected results to sources of foreign aid and conform to the top-down, technocratic ideas of development advocated by the United Nations and the Alliance for Progress.

[72] United Nations Department of Economic and Social Affairs, "The Application of Computer Technology for Development," 1971, New York, 15.

The formation of this centralized computer service agency paralleled the other policies of state intervention put in place by the Christian Democrats. Centralized computing embodied and reflected the party's vision of a centralized Chilean state, which demanded quantification to control and coordinate the greater wealth of information being generated. Moreover, the state and its computing machines both projected an outward image of modernity and offered techniques for national progress. Although Chile's computing resources were few, Chilean public officials acknowledged their importance. In his analysis of the economic policies advanced by the Christian Democrats, Finance Minister Molina wrote:

> The introduction of the science of informatics with its technological element, the electronic computer, has come to revolutionize the techniques of administration through system analysis, programming, and data storage, with the consequent extension and extraordinary speed to compile data and provide the necessary statistical information.[74]

Molina also credited computers for being "indispensable in diagnosing, analyzing, and implementing new methods and functional administrative procedures" that paralleled the planning techniques the government introduced through ODEPLAN, among others. Information-processing technologies made programs of centralized economic planning possible and facilitated the growth and expansion of state bureaucracy.

The amount of information collected and generated by the Chilean government between 1964 and 1970, coupled with technological capabilities of rapid data processing, resulted in an extraordinary leap in the annual production of government documents and reports. The exponential growth of punch cards processed annually by the Chilean treasury paralleled the rising number of pages

[73] Benadof interview.

generated annually by the Chilean treasury (see table 3.2) as well as the number found in the annual presidential address before Congress (105 pages in 1965; 496 pages in 1967; and 1,075 pages in 1970, each year containing a higher volume of graphs and tables).[75]

While the Chilean government worked to establish its own computer-processing center, Freidmann positioned Chile as a new center of computation within the developing world and encouraged other nations to adopt the EMCO model. A multitalented engineer, Friedmann held degrees in electrical engineering, civil engineering, and nuclear science from the University of Chile and the University of Michigan. During the early 1950s he worked as a researcher for General Electric Research Laboratories in England. He returned to Chile in 1954 and accepted a position in the state energy company ENDESA, working as the head of electrical systems and later as the head of nuclear engineering. He also assumed a professorship at the University of Chile. During the presidency of Jorge Alessandri, Friedmann served as a scientific adviser to the Ministry of Economy. In 1964 Friedmann became the director of mathematics at the University of Chile and began publishing on the subject of computation.[76] When Frei formed CONICYT in 1967, the president gave Friedmann a seat on the agency's executive committee, a role that Friedmann fulfilled while serving as the executive director of the Chilean Commission on Nuclear Energy. In March 1967 Freidmann, in his role as the

[74] Molina Silva, *El proceso de cambio en Chile: la experiencia 1965-1970*, 177.
[75] *Sexto mensaje del Presidente de la República de Chile don Eduardo Frei Montalva al inaugurar el periodo de Sesiones Ordinarias del Congreso Nacional, 21 de Mayo de 1970.* Computer use in the Finance Ministry increased from 700 hours per month in 1964 to 1,260 hours per month in 1970.
[76] Efraín Friedmann, "Los computadores y los ingenieros," *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, no. 312 (1965). His brother Santiago Friedmann also held considerable expertise in the area of computation and published one of Chile's first technical articles on computers in the *Annals of the Institute of Engineers,* the official magazine of Chile's professional engineering society. See Santiago I.

director of mathematics at the University of Chile, delivered a series of talks on computation and management to the Ministry of Housing, that the University of Chile printed and distributed widely.[77] Friedmann strongly supported the formation of a central state computing agency, and when the government announced the formation of EMCO, it seemed logical that he would preside over the new agency as its first general director.

Friedmann played a pivotal role in EMCO's early development and raised government awareness of computer technology and its applications. However, he also raised Chile's profile within the international community as a leader in applying computer technology to state administration and economic development. In February 1970 Friedmann represented Chile at the U.N.-sponsored meeting of the Ad Hoc Panel of Experts on Computer Technology and helped write a report that was widely circulated within the United Nations and professional computer organizations. He was the only representative from a Latin American nation invited to participate. Friedmann also served as a special consultant to the U.N. Department of Economic and Social Affairs and contributed to a 1971 report entitled "The Application of Computer Technology for Development." In addition, Friedmann drew upon his international connections to advance Chile's computing capabilities and establish relations between the Chilean computing community and its counterparts in other nations. In July 1969 he hosted a conference on government information systems and invited computing luminaries such as Herb Grosch, the director of the Center of Computing Science and Technology at the U.S. National

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Friedmann, "La era del computador se inicia en Chile," *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, October 1962.

Bureau of Standards, and Dov Chevion, director of the Office Mechanization Center for the Israeli Ministry of Finance, to give presentations in Santiago.[78] The conference drew a crowd and provided a venue for Friedmann to speak of EMCO's accomplishments as well as the agency's plans for the future. Among the registered participants were representatives of Chilean national banks, the armed forces, members of the various government agencies and ministries, academics from the Chilean universities, representatives from the United Nations, and President Frei himself. In 1971 Friedmann traveled to Israel to speak at the Jerusalem Conference on Information Technology and delivered a talk in support of the EMCO model entitled "Management of Computer Resources in Lesser Developed Countries."[79] He promoted EMCO with such enthusiasm that his name became inextricably linked with the computer agency's, and centralized government control of computation became known as the "Chilean model."[80] Chile possessed fewer computers than several of its Latin American neighbors, yet, according to Barquín, it was perceived as a leading user of computers in Latin America. Chile influenced the computer policies later implemented in Bolivia, Uruguay, Ecuador, and, to some extent, Colombia.[81] Barquín writes that by 1973, "studies on the centralization of

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[77] In 1969 EMCO printed a second edition of Friedmann's presentation, citing the "great diffusion" of the first edition published by the University of Chile. Efraín Friedmann, *La gestión y los computadores: conferencias* (Santiago de Chile: Empresa de Servicio de Computación Ltda., 1969).

[78] EMCO, "Seminario sobre sistemas de información en el gobierno." Dov Chevion served on the U.N. Ad Hoc Panel of Experts on Computer Technology with Friedmann, as did Vicktor Glushkov, the Russian cybernetician who championed the creation of a national computer system for Soviet economic management.

[79] Efraín Friedmann, "Management of Computer Resources in LDC's," paper presented at the Jerusalem Conference on Information Technology, Jerusalem, August 1971.

[80] Barquín defined the Chilean model as "based on the national computer enterprise concept put forth by Friedmann and embodied in ECOM." EMCO changed its name to ECOM in 1971. Barquín, "Some Political Effects of Computation in Latin America," 24-25.

[81] Ibid., 29. Brazil also formed a federal service for data processing in 1970 known as SERPRO (Serviço Federal de Processamento de Datos).

computation within government [were] advanced by almost all countries [in Latin America] . . . as a manner of reducing costs."[82]

The Chilean experience complicates studies of computer history that have positioned the United States as the center of technological development and portrayed the country as the model for computer adoption and application elsewhere. Chile illustrates that there was not one model but many. Developing nations, such as Chile, created their own policies for computer use that suited their needs, limited resources, and ideological programs. The Chilean government invited foreign experts from a range of countries, including France, Britain, the United States, and Israel, to share their knowledge and technological capabilities. Chilean officials used facets of each national experience to shape Chile's distinctive computer policy. Chile, in turn, offered an alternative model for developing nations whose size, wealth, or technology was closer to Chile's than to that of the nations of the developed world. Instead of a simplistic concept of center and periphery, we see the presence of many computational centers and an idea of periphery that changed with time and perspective. Computers allowed developing nations to mimic the technology-centered concept of development found in the industrialized nations of North America and Western Europe. They also provided an instrument for developing nations to advance their programs for sustained economic growth and material modernization. At the same time however, computers created new gradations of development and expertise that developing nations, such as Chile, could use to reposition themselves with respect to the rest of the world.

[82] Ibid., 19.

As national governments renegotiated and complicated the idea of center and periphery, multinationals such as IBM continued to view Chile as a peripheral market, but one still worth dominating. Although members of the Chilean government frequently framed EMCO as an attempt to control costs, another rationale surfaced that viewed EMCO as an institutional effort to limit government dependence on any one multinational computer company -- particularly IBM. Throughout 1967, critiques of Frei's economic policies had mounted from the Left and from within the Christian Democracy. The benefits given to foreign investors and U.S. multinationals in attempts to industrialize the country drew fire in particular. A new school of economic thought critical of ISI-led development emerged from the offices of the United Nations Economic Committee on Latin America, located in Santiago. Known as dependency theory and advocated by a group of young, highly intelligent South American economists, this new economic framework gained popularity toward the latter part of the 1960s and subsequently became an economic pillar for the Leftist platform. While ISI tried to end underdevelopment through industrial growth, dependency theory viewed industrialization as insufficient for ending the inequalities of the world capitalist system. In place of the United States' assertion that all countries could achieve development if given the right opportunities, dependency theory cast underdevelopment as the necessary flip side of the wealth amassed in the developed world nations. Underdevelopment was the very product of the existing global economic order. Industrialized nations, such as the U.S. and Europe continued to own the means of production in the ISI model and used their economic advantage to control the industrialization of Latin American nations and prevent them from achieving economic equality.

The failures of ISI and Frei's willingness to sacrifice the social components of the revolution in liberty for continued foreign investment caused fissures within the Christian Democratic Party. In 1967 when two of its subgroups, the rebels *(rebeldes)* and thirdists (*terceristas*), gained control of the party and pushed the government-supporting faction *(oficialistas)* into a minority position. The rebels were frustrated with the government and wanted to accelerate the pace of reform outlined in the revolution in liberty while maintaining the party's commitment to social change. Their leader, Jacques Chonchol, subsequently drafted a report entitled the "Non-Capitalist Way of Development," which criticized Chilean economic policies that favored U.S. corporations and foreign investment. Faced with these challenges, IBM took measures to secure their position of dominance within the Chilean market.

"La Mamá" IBM

As the story goes, Thomas J. Watson Sr. formed IBM World Trade in 1949 to end the rivalry between his two sons. His elder son, Thomas J. Watson Jr., became CEO of IBM's massive U.S. operation. His younger son, Dick Watson, presided over the newly formed World Trade Corporation, which their father established as an independent subsidiary responsible for all company business outside the United States. This arrangement permitted Watson Sr. to provide ample opportunity for his younger son and prevented the ambitious elder son from trying to sabotage the career of his younger brother.[83] Dick Watson was fluent in Spanish, French, and German. He traveled extensively but spent most of his time overseeing IBM's European operations and rubbing elbows with the European elite. While his brother

[83] David Mercer, *IBM: How the World's Most Successful Corporation Is Managed* (London: Kogan Page, 1987); Thomas J. Watson Jr., *Father, Son, & Co.: My Life at IBM and Beyond* (New York: Bantam, 1990).

increased IBM's dominance in the U.S. market, Dick Watson made World Trade a lucrative and successful operation, transforming the company into a true multinational. In 1965 World Trade had a gross income of more than $1 billion, a figure that had doubled by 1968 and approached the $3 billion mark by 1970.[84] IBM President Al Williams quipped in the early 1960s that Big Blue's competitors were "fighting us so hard here [in the United States] that they're not even thinking about overseas. Wait until they find out how thoroughly World Trade has gotten itself entrenched."[85]

Dick Watson and World Trade recognized the importance of tailoring IBM sales tactics to the conventions of local cultures. In Europe IBM hired members of the aristocracy and used their connections among the European elite to build the company's customer base. In Chile IBM hired largely from the Chilean navy, a recruiting ground that provided IBM with not only a technically literate workforce but also connections within government and military organizations. As in IBM's other international offices, IBM Chile hired local branch managers and staff and channeled profits back into its Chilean operations, rather than to the company's central headquarters in New York.

Alfredo Acle began working for IBM in 1964, the year the Christian Democrats came to power. He was employed first in the education division and later as the director of systems engineering for IBM Chile. Acle also directed IBM Chile's government operations branch and participated in many of the government projects that applied computer technology to administrative operations. He retired after

[84] IBM Archives, *IBM Highlights, 1885-1969,* IBM Archives Documents, 2004, http://www-03.ibm.com/ibm/history/documents/pdf/1885-1969.pdf (18 February 2004); IBM Archives, *IBM Highlights, 1970-1984* IBM Archives Documents, 2004, http://www-03.ibm.com/ibm/history/documents/pdf/1969-1984.pdf (18 February 2004).

twenty-seven years with the company and continues to live off of his pension check. He gushes when speaking of his former employer, to which he refers affectionately as "la mamá IBM," and praises the company for the many benefits that he and his family received over the years, including health care, educational opportunities, job security, and a generous retirement plan. He once considered leaving the company, but his wife would not let him. Laughing, he recounted his many job offers and his wife's protestations of "Don't go! We are so protected here!"[86] Forty years after he began working for Big Blue, Acle could still recite IBM's company principles verbatim. When asked how the culture at IBM Chile differed from the IBM culture in other countries, Acle replied, "There was no difference--the culture of the country was different, but the culture of IBM was the same. IBM was like a family or a separate country. We were a country within other countries. . . . I believe that almost all of IBM's old employees think that way."

Fernando Villanueva, a former navy engineer who began working for the company in 1962 and managed IBM's education center from 1964 to 1968, recalled several cultural differences that the company needed to accommodate. "The first cultural change that took place in Chile is when we explained to the United States that in Chilean and Latin American culture, we drink wine with our food. There were official IBM meals where there was no alcohol. If you do not offer wine at lunchtime, you are offending someone."[87] The company also had to confront and overcome differences between what Villanueva described as the "American spirit" and the "Latin spirit." "When making a promise," Villanueva said, "Latinos tend to be a little more lax with respect to the promise. Do something, yes, now [*ahora*].

[85] Watson, *Father, Son, & Co.*, 344.
[86] Acle interview.

When is 'now'? 'Now' can be tomorrow or never." Chilean employees of IBM also had to adapt to the company's strict dress code. "I entered in the age of the white shirt. They never told you [how to dress, but] you saw everyone dressed that way and you copied it," Villanueva said. Repeating the instructions that he received in a training course, Villanueva added that employees had to "always be ready to meet with the president of a company." He acknowledged that IBM's formal style of dress was not normal in Chile and that "not all companies had a policy of being correctly well dressed." For this reason "people looked at us . . . strangely." Villanueva recalled leaving a meeting with several coworkers and bumping into his aunt on the Santiago streets. "She asked me," he said laughing, "'What are you doing with all of these Mormons?'"

Both Acle and Villanueva recalled IBM's close relationship with the Chilean government, regardless of the ideological bent of the administration. "IBM never had politics," Villanueva said. "It maintained good relations with the governments [of Alessandri, Frei, Allende, and Pinochet]." He also noted that the Chilean government "always had a place for IBM at some table of government," a comment that clearly illustrates the economic motives behind the company's unwillingness to align itself outwardly with any political ideology. "That's why President Frei went to inaugurate the computer and push the button," Villanueva concluded. "There was a very good relationship." IBM enforced its "apolitical" position within the company as well as without and was known as one of the few companies that never dealt with a unionized workforce, a considerable feat given the rise of organized labor in Chile during the 1960s. Management prohibited employees from expressing political views in newspapers or other public forums and viewed any infraction as a serious matter.

[87] Villanueva interview.

The company also sponsored workshops on how to deal with labor conflicts that included role-playing exercises in which employees simulated negotiations between managers and disgruntled workers. The company instituted an open door policy, whereby anyone with a grievance was entitled to an audience with his manager, decreeing that employees therefore did not need to unionize to be heard. Like the U.S. government, multinational companies also played a role in stifling Chile's revolutionary process.

IBM tended to its culture. "The culture of IBM was not that simple," Acle acknowledged. "It had to be manufactured, it had to be maintained, and it had to be studied." The company began using the phrase "la mamá IBM" in the 1960s in parallel with the rise of the labor movement. During the socialist government of the early 1970s, Acle said company officials "always referred to themselves as 'la mamá.'" He added, "Behind all of the politics going on," such as strike activity, land seizures, and public demonstrations, "there was a great IBM family. This was the slogan. And how do you maintain the great IBM family? You maintain it with a few meals during the year, where they invited your wife, a celebration at the end of the year that your whole family attended. They gave you food, gifts for the children, Santa Claus came . . . [The feeling of the great family] was not born inside, [IBM] had to inject elements to keep it alive."

IBM navigated the Chilean political landscape and dominated government computer sales with the same dexterity that it displayed in keeping politics out of its offices. Rental contracts for IBM machines included maintenance and training classes, services that many IBM clients perceived as free but that IBM saw as increasing its market penetration. At one point a government law required that all individuals holding the job description of card puncher and data entry operator receive a "degree" from IBM. "They [the government] gave us tremendous responsibility," Villanueva said. "We were practically dictating who the programmers and card punchers were." The only problem was that IBM did not give degrees or certificates for completion of its courses. "They [the students in the training classes] came to us and asked, 'I want my degree,'" which of course Villanueva's education center could not provide.

Acle, who was in charge of IBM's government branch, said, "I worked for the government as a systems engineer, always in the technical aspects of engineering, advising the client. I introduced myself to the client without the goal of selling, which gave a different image. I helped the client solve his problems." Acle's presence kept the IBM name circulating among Chilean government administrators so that they would call IBM, rather than one of its competitors, for their computer needs. These strategies proved so effective that the name IBM became synonymous with the technology itself. Villanueva explained that if "someone [was] talking about computation or data processing [he] would say 'IBM.' Within the fiscal enterprises you would find 'IBM departments' and years earlier 'Hollerinth departments.' [Saying] 'IBM' in Chile was like talking about a Frigidaire or a Gillette razor--you could have any razor, but the people say 'Gillette.'"

Unlike Gillette, however, IBM sold an extremely expensive product with a prohibitively high price tag. Given the newness of the technology, and the many other demands for foreign credit, many potential clients viewed the purchase or rental of an IBM machine as lunacy. But the government was in a unique position: it could avoid paying the hefty customs fees that barred the entry of computers in the private sector.[88] This difference made the government IBM's single biggest customer. Acle said, "The government was a very important client of IBM's, very important. They . . . [government agencies accounted for] forty percent of our income--that was an enormous amount, forty percent came from only one type of organization [the Chilean government]." By serving as a central purchasing office, EMCO reduced the government's potential spending on computation, provided a means for smaller government agencies to reap the benefits of this technology, and, as Acle put it, allowed the government "to control the expenditures being given to a private firm, IBM." Critics pointed to the hazards of the government's growing dependency on the U.S. company, sentiments reflected in the work of ECLA's dependency theorists as well as in the dominant current of thought in Frei's own Christian Democratic Party. Other events, such as the U.S. intervention in the Dominican Republic in 1965 and the discovery of the U.S. defense-funded "Project Camelot," a program accused of sponsoring social science research as a cover for spying on the Left, further provoked Chilean outrage against the United States.

Frei also began to criticize the United States and the Alliance for Progress. In 1967 Chile refused all loans proffered by the Agency for International Development, and Frei, despite no support from other Latin American nations, spoke out against U.S. involvement in the Dominican Republic at a meeting of the Organization of American States. That year Frei published an article entitled "The Alliance That Lost Its Way." Written in English, the article appeared in the U.S. journal *Foreign*

[88] According to Law 17271 of the Ministry of Finance, computing machines purchased for the exclusive of the Chilean state administration, including all EMCO machines, were exempt from tariffs. The law applied retroactively but stated that all such machines bought under these conditions needed to remain in government service for ten years. Otherwise, for the machine to stay in Chile, the new owners needed to pay prorated tariffs for the remaining ten-year period. *Ministerio de Hacienda*, Ley-17271, (31 December 1969).

Affairs, self-described as "America's most influential publication on international affairs and foreign policy."[89] The mounting tensions with the United States, recognition of the negative effects of capitalism on Chilean development, and the rising popularity of dependency theory provided an added impetus for EMCO. "A series of elements came together in the [formation of EMCO]," Acle explained, "political, strategic, that we can't continue to depend on the same institution or only one business, that, moreover, was American. All of the businesses that were here in Chile were yankee [*yanqui*]--[EMCO] went against the American private sector that was exploiting the country. There already was a sentiment of '*anti-yanquismo*.' IBM was Yankee."

The formation of EMCO, however, did not curb the level of influence that IBM exerted in within the Chilean government or within Chilean computing circles. The government may have been criticized for depending on the flow of expertise and machinery that IBM offered, but the multinational also depended on the government as its most important customer. IBM trained many of EMCO's programmers, systems engineers, and upper management, and the first machine EMCO purchased was an IBM 360. The company also provided funds to the University of Chile to establish one of the leading computer science programs in Latin America and provided scholarships for Chileans to travel to the University of Waterloo in Canada to study computing using IBM machines. Although the Chilean market was small, IBM invested in it, creating a group that would be inclined to buy IBM's products for the government.[90] By expanding its web of contacts within the universities and

[89] Council on Foreign Relations, *About Foreign Affairs* http://fullaccess.foreignaffairs.org/about/. Last accessed 18 February 2004.
[90] "Valioso aporte de IBM a la 'U.'" *La Nación*, 23 March 1969. René Peralta, interview by author, 12 January 2004.

government agencies, maintaining an outwardly apolitical stance, and promoting the idea of the IBM family, the company's Chilean branch hoped to withstand the effects of rising political polarization and social mobilization.

As the 1960s progressed, computers became symbols of modernization and dependency, objects of desire and resentment, and instruments of greater efficiency and an expanding bureaucracy. Given IBM's near monopoly in the Chilean market, the government and IBM Chile found themselves tied to one another in an increasingly conflicted relationship. The government wanted to apply modern computer technologies to its state rationalization and planning efforts, but these applications increased the nation's economic dependence on a foreign multinational firm. IBM Chile in turn sought to establish, dominate, and reap a profit from the Chilean market while resisting the politicization of Chilean society, the rejection of capitalism, and the social upheavals unleashed by the PDC's call for labor to organize. These very same tensions, and the government's allegiance to foreign investment, ultimately plagued the Alliance for Progress and diminished popular support for Frei's presidency. Foreign lending agencies such as the International Monetary Fund and the World Bank demanded that the government cut spending as a condition for receiving aid, including the funding for the social programs described in the revolution in liberty. The Alliance for Progress also linked economic incentives for foreign investment and U.S. multinationals with the granting of U.S. monetary aid. By 1969 the Chilean government increasingly had to subsidize its programs for economic growth with foreign investments, in essence proving the developmentalist economic program to be unsustainable. In the end, Frei found himself trapped by the need to keep foreign capital flowing into Chile. As Michaels writes, "Frei opted for economic growth and social stability at the expense of social justice. The United

States had opted for protecting its economic interest at the cost of slowing down the political momentum of its most successful Latin American ally."[91] Both IBM and the Alliance for Progress valued economics over ideology and stability over change.

After we had discussed IBM's significance to the Chilean government for several hours, I asked Acle to consider the importance of IBM's Chilean operation to the multinational firm. After some thought he replied, "We were a pilot country for several of IBM's world projects. . . . We were a country that contributed quite a lot in these sorts of things." He went on to describe a new system for machine assembly in Chile that the company put in place during the military government of Augusto Pinochet. "When you asked for a computer, you had to ask for the disks from a plant in Canada, the central processing unit from an American plant, the tape from a French plant. . . . When you had an order in those days you sent it to a distribution center, and the center distributed the order across the world--it was a great process of people." The new system eliminated the distribution center and demanded that IBM Chile contact each factory separately and have the parts sent for assembly in the country, cutting the intermediary costs. The company chose Chile for the pilot program because it had the ability to use the technology, the necessary machinery, and the management infrastructure to implement the program. And, Acle added, "What is the risk if Chile makes a mistake? It's negligible from the point of view of IBM worldwide."[92] The pilot program was a disaster and wrought havoc with the Chilean operations. "For us it was a tremendous chaos," Acle said. Then, reflecting beyond the years of company dinners, pension plans, and dedication ceremonies, he added, "For IBM, what did Chile matter?"

[91] Michaels, "The Alliance for Progress and Chile's 'Revolution in Liberty,'" 83.

Conclusion

Using the mantra "order is power," the Christian Democrats pursued a technocratic vision of state organization that introduced new administrative techniques and technologies to better direct economic growth and map Chile's fiscal, human, and natural resources. Moreover, the creation of global plans at the national, regional, and local levels offered quantifiable plans for national progress and charted a path to future development that strengthened the position of state technocrats. The emphasis the Chilean government placed on planning, organization, and rationalization also helped Chile obtain the foreign aid necessary for their developmentalist policies of ISI. The United States and France in particular played an important role in these changes to Chilean state management. In the case of the United States, global planning provided a necessary prerequisite for obtaining Alliance for Progress dollars. The style of administrative dirigisme that flourished in France after World War II provided Chile with a model for state growth and directed industrialization within a mixed economy and French credit and technical assistance helped Chile implement changes based on the French experience. The confluence of economic planning, dirigisme, and technocracy that occurred during Frei's presidency, as well as the government's fetishism for advanced technology, gave new importance to data processing technologies and helped explain the rapid adoption of computers by the Chilean state despite their high price.

In this context, the government's swift formation of a state enterprise dedicated to providing the public administration with computer services is

[92] According to Villanueva, Burroughs also used the Chilean market as a test site for new machines. Villanueva interview.

understandable -- and impressive given that the first mainframes entered the country only a few years prior. It is also important to recognize the significance of the period marked by Frei's presidency (1964 - 1970) from the perspective of computer history. Digital mainframe technology, in particular the IBM 360 series, reached the market while the Christian Democrats were in office; prior administrations could not have made comparable changes to data processing practices even if they had wanted to. Moreover, the very nature of these machines, from their large size to their expense, provided a strong motivation for the centralization of government computer power. EMCO therefore represented the limitations of computer technology during the 1960s as well as the rational and interventionist state envisioned Christian Democracy. The elaborate inauguration ceremonies held for Chile's early mainframes further demonstrate the functional *and* symbolic importance of these machines to the Chilean government.

The top-down, technocratic state created by the Christian Democrats supported the adoption of expensive computing machines. Computer technology, in turn, advanced PDC programs for state modernization, economic development, and material progress. This arrangement strengthened the position of machines and politicians alike. At times, the PDC framed the application of scientific methods and the use of technical expertise as both apolitical and vital for national progress. Ideas of economic productivity, modernization, and progress appealed to members of various Chilean parties, including those of the Right and the Left.[93] By linking development to technocracy rather than to politics, the PDC defended its right to rule as a single party while empowering the significant number of university-educated professionals and academics within its ranks. However, this strategy had limited success. The reticence of Chilean senators to support the formation of an executive planning office (ODEPLAN), which they argued would represent the president's interests and not those of the nation, shows that they understood that technocracy at bottom served real political interests. Sometimes the PDC's privileging of technical expertise proved to be more alienating than persuasive and hindered the party's ability to broaden their base of support. In his analysis of Chilean economic policy during the Frei government, Molina observed that the use of highly technical language by economists, particularly economic planners, put off Chilean politicians from other parties and broke down lines of communication.

The president's unwillingness to compromise with the wishes of Chile's other political parties and the failure of his economic policies to change the quality of life for most Chileans diminished Frei's popularity and distanced him from his own party. As Frei's presidency progressed, political divisions deepened. The Right and the Left continued to gain strength at the expense of the Center. In January 1967 Chile's Congress denied the president permission to visit the United States, an embarrassing turn of events for the leader of the nation heralded as the shining star of the Alliance for Progress. The Chilean Right, spurned by the unwillingness of the PDC to recognize its demands, took up the role of opposition party and refused to form a coalition with the Center against the Left for the 1970 presidential elections. Members of the Left criticized Chile's increased dependence on foreign capital and the failure of the revolution in liberty to bring the social changes that it had promised. Together the Left and the "rebel" factions of the PDC pushed for even

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[93] As the historian Anson Rabinbach remarked, "Productivism, in short, was politically promiscuous." Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (New York: Basic

greater mobilization in the Chilean countryside and urban centers. Collectively, the PDC asked their president for greater change and questioned the benefits of foreign investment and Chile's close relationship to the United States. Toward the end of Frei's presidency, the PDC stepped up its support for Andean economic integration and open relations with Cuba. The party also supported reformist Radomiro Tomic as its candidate for the 1970 presidential election.[94]

As members of the Left and Center moved to accelerate the pace of social change, Frei's technocratic approach to modernization seemed increasingly at odds with the mounting demands to rectify class inequalities. Reports of fiscal gains fell flat as unemployment climbed. Most Chileans failed to appreciate the fruits of material progress heralded by their president, such as the domestic production of television sets or automobiles, when few could afford to purchase such luxury items. While government computer purchases fueled the public imagination with talk of electronic brains and celebrations of technological modernity, the technological fetishism displayed by the PDC deepened Chilean dependence on foreign multinationals and U.S. capital. The same could be said of the other technological wonders, such as televisions, radios, automobiles, and washing machines that were entering the Chilean markets and being praised a signs of material progress. The disconnect between the developmentalist discourse articulated by Frei and the lived experiences of Chile's popular classes fueled frustration on both sides. In his 1969 State of the Union speech, Frei again responded to the criticism of his economic program by citing abstract economic gains and technical successes. He chastised the Chilean public, demanding:

Books, 1990), 272.

> Have you known before higher importations of machines than what the country receives today? Do you remember a period when the balance of payments has been better? Have you seen more spectacular growth in bank savings and bonds? Why don't you realize the fact that the automobile industry produces twice as many automobiles as they did five years ago, and that automobiles, buses, taxis, and trucks fill the streets and roads? Why do you ignore that we sell seven times more televisions than five years ago? . . . It is absurd that all of the speculations of crisis appear . . . when it is evident that there had been a great activation of production . . . . I invite everyone to look at their own homes and see for yourselves how in these years you have acquired a house, a car, a television, radio, refrigerator, washing machine, sewing machine, stove, or new clothes for your family . . . . I know that no one is satisfied. This always happens. If you acquire a radio, you want a television. If you buy a house, you want to get around better. If you have a bicycle, you desire an automobile.

Despite these "attacks without justification," the president promised, "Chile and Chileans continue forward, so that progress reaches everyone in the community."[95]

Yet the measures of political, social, and economic reform outlined in Frei's revolution in liberty and demanded by growing sectors of the Chilean population continued to take a backseat to the interests of foreign investors and foreign governments. By the end of Frei's presidency, greater numbers of foreign businesses, educators, economists, scientists, engineers, and government advisers exerted influence in Chile than ever before. While Chile strove to either emulate or import the fruits of Western development in the hope of constructing a modern nation, "progress" came at the price of social change. Seventeen months after Frei chastised the Chilean people for wanting more than his government could provide, Chileans chose to accelerate the pace of revolution and elected the socialist candidate Salvador Allende.

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[94] According to the Chilean Constitution, a president cannot serve consecutive six-year terms. Frei could not run in the 1970 election.

[95] *Quinto mensaje del Presidente de la República de Chile don Eduardo Frei Montalva al inaugurar el periodo de sesiones ordinarias del Congreso Nacional, 21 de Mayo de 1969,* Departamento de Publicaciones de la Presidencia de la Republica, Santiago, 73-74.

Chapter 3: Images

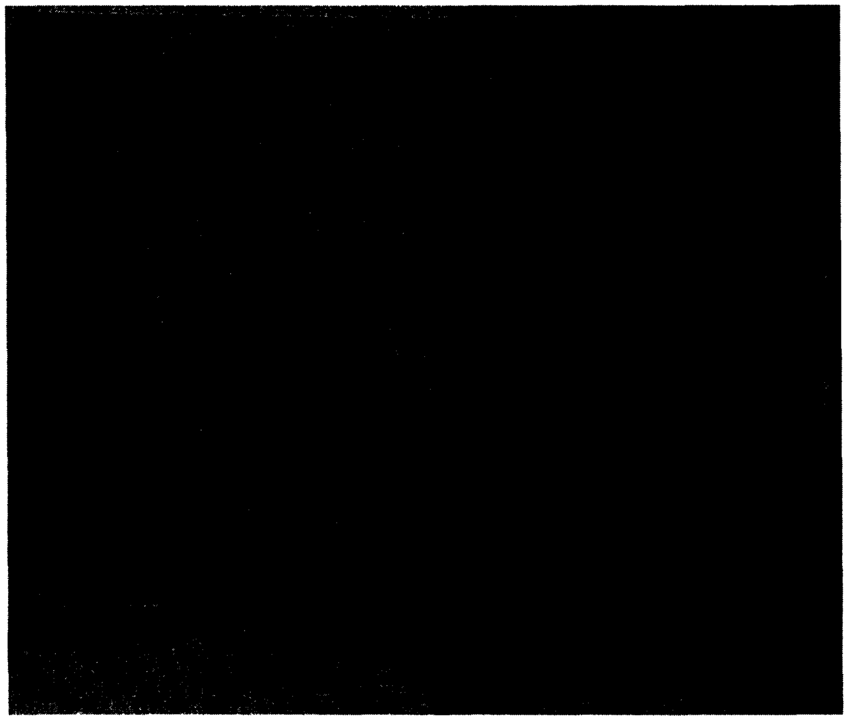

Figure 3.1: President Eduardo Frei types his name as part of the inauguration ceremony for the first computer acquired by the state computing service enterprise, EMCO. (Image reproduced with permission from the National Library, Santiago.)

Figure 3.2: The first computer purchased by the University of Chile, a German-made Standard Electric Lorenz ER-56 (Image reproduced with permission from the National Library, Santiago.)

Figure 3.3: President Eduardo Frei holds a computer-generated reproduction of his likeness at the inauguration ceremony for the IBM 360 at the University of Chile, while Efrain Friedmann looks on. (Image reproduced with permission from the Instituto de Ingenieros de Chile, Santiago.)

Figure 3.4: Inauguration of IBM's headquarters in 1960, located at Agustinas 1235 in downtown Santiago. (Image reproduced with permission from IBM Chile, Santiago.)

Table 3.1: Accumulated Number of Computers Installed in Chile
By Year and Model

Year of installation	IBM 1401	IBM 1620	IBM 1130	IBM 360	NCR 315	NCR 200	Burroughs B-3500	PDP PDP-8	Other Models	Total
1962	3								1	4
1963	8								1	9
1964	10	2							2	14
1965	10	2							2	14
1966	13	3		1					2	19
1967	13	3	1	6	1				2	26
1968	14	3	3	8	1				3	32
1969	14	3	4	10	1				4	36
1970	14	3	8	12	1	3		1	4	46
1971	14	3	9	14	1	3	2	4	7	57

Source: United Nations, "The Application of Computer Technology for Development, Second Report of the Secretary General," New York, 1973.

Table 3.2: Data Processing and Documentation Output for the Chilean Treasury (1962-1969)

Year	Number of Punch Cards Processed	Number of Report Pages Produced
1962 –1964	540,000	231,000
1965 – 1966	600,000	245,000
1967	2,307,000	736,000
1968	5,500,000	1,080,000
1969	5,200,000	1,200,000

Source: *Sexto mensaje del Presidente de la República de Chile don Eduardo Frei Montalva al inaugurar el periodo de sesiones ordinarias del Congreso Nacional,* 21 May 1970.

Table 3.3: Dollar Value of Electronic Digital Computers Imported to Chile from the United States, Including Process Control Equipment (1965-1973)

Year	Dollar Value (U.S.)*
1965	0
1966	77,460
1967	713,930
1968	35,514
1969	41,782
1970	881,244
1971	1,376,244
1972	249,819
1973	176,599

Source: Bureau of Foreign and Domestic Commerce, U.S. Department of Commerce, "Foreign Commerce and Navigation of the United States," compiled by the Division of Foreign Statistics, 1965-1973, Washington, D.C.

* Figures do not include the movement of U.S.-owned or -financed merchandise from one foreign country to another, only the movement of goods from the United States to a foreign country. They do include shipments from a U.S. company to a branch office overseas. Values shown as reported by the shipper for bringing the good to the point of exportation. Values do not include tariffs within local countries.

Chapter 4

Political Science, Revolutionary Technology

THE ELECTION of Salvador Allende Gossens as president radically changed the path of Chilean history. His victory in 1970 signaled the success of the center-left Popular Unity coalition (UP), a mixed group of socialists, communists, and small factions of the Radical and Christian Democratic parties, as well as the failure of the Christian Democrats to garner sufficient support for their stalled "revolution in liberty." The refusal of the Christian Democrats to build political alliances with the right or to reach out to members of the left during their previous six-year administration alienated both ends of the political spectrum and caused fractures within their own ranks, deepening the polarization and fragmentation of Chilean politics. In the absence of an effective center-right coalition, Allende's winning margin was slim--1.3 percent--over his closest competitor, the rightist candidate Jorge Alessandri. Although the UP won the electoral support that it needed to begin implementing its forty-point program of economic and social reforms, the country remained sharply divided about the correct path for the nation.[1] Allende, however, had a reason to feel optimistic. All three candidates had run on a platform of change. Both Allende and the Christian Democratic candidate Radomiro Tomic had stressed accelerating the social and economic reforms begun by the Frei administration. In this context, Allende felt confident that he could increase his base of popular support and leverage it to implement change democratically, rather than by force, using Chilean legal and political institutions.[2] It would be a revolution with "the taste of empanadas and red wine." Change would occur without bloodshed and possess a distinctively Chilean flavor.

Allende ranks among the more controversial figures in Latin American history.[3] He was a medical doctor by training, a career path that introduced him to

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[1] "Popular Unity Program" in James D. Cockcroft, ed., *Salvador Allende Reader* (Hoboken, N.J.: Ocean Press, 2000), 257-85.

[2] The Popular Unity period has generated a wealth of literature; I will cite here only a representative excerpt. Historical overviews of the UP era can be found in Leslie Bethell, *Chile Since Independence* (New York: Cambridge University Press, 1993); Simon Collier and William F. Sater, *A History of Chile, 1808-1994, Cambridge Latin American Studies* (New York: Cambridge University Press, 1996); Brian Loveman, *Chile: The Legacy of Hispanic Capitalism*, 3rd ed. (New York: Oxford University Press, 2001); Paul E. Sigmund, *The Overthrow of Allende and the Politics of Chile, 1964-1976* (Pittsburgh: University of Pittsburgh Press, 1977). Analyses of the period from the perspective of political economy appear in Stefan De Vylder, *Allende's Chile: The Political Economy of the Rise and Fall of the Unidad Popular, Cambridge Latin American Studies* (New York: Cambridge University Press, 1976); Barbara Stallings, *Class Conflict and Economic Development in Chile, 1958-1973* (Stanford: Stanford University Press, 1978). Peter Winn, *Weavers of Revolution: The Yarur Workers and Chile's Road to Socialism* (New York: Oxford University Press, 1986) and Margaret Power, *Right Wing Women in Chile: Feminine Power and the Struggle Against Allende* (University Park: Pennsylvania State University Press, 2002) document the revolution and counterrevolution as seen from below. Sergio Bitar, *Chile: Experiment in Democracy*, trans. Sam Sherman, vol. 6, *Inter-American Politics Series* (Philadelphia: Institute for the Study of Human Issues, 1986) offers a rather balanced first-hand account. Nathaniel Davis, *The Last Two Years of Salvador Allende* (Ithaca: Cornell University Press, 1985) provides an interesting, if less balanced view from the perspective of the U.S. Embassy in Santiago. U.S. intervention in the Allende government has similarly been documented in Peter Kornbluh, *The Pinochet File: A Declassified Dossier on Atrocity and Accountability* (New York: New Press, 2003). Fernando García and Oscar Sola, *Salvador Allende: una época en blanco y negro* (Buenos Aires: El País Aguilar, 1998) depicts Salvador Allende's life through interlaced text and black and white photographs.

[3] The University of Arcis hosted a panel on September 4, 2003, dedicated to historical interpretations of Allende thirty years after his death. The Chilean historian Diana Veneros observed that "the exercise of studying and really trying to understand Allende presents a difficult task in subjectivity." Members of the center have tended to portray Allende as a conflicted and contradictory figure whose love of women and bourgeois luxuries paralleled his political dreams for socialist transformation. Members of the left have transformed Allende into a martyr who refused to compromise his ideals and died gripping a gun given to him by Fidel Castro. The right blamed Allende for destroying the economy and creating an era of political chaos. More recently, members of the right have adopted a new line of argument that urges Chileans to

the afflictions of the poor while he was still enrolled at the university. He became a socialist when he was twenty-four and entered politics fighting on behalf of his cousin Marmaduke Grove Vallejo, the Air Force commander who became Chile's first socialist president for twelve days in 1932. After establishing a branch of the socialist party in his hometown of Valparaíso, Allende quickly rose through the ranks of the party and was elected to Congress in 1937. He was elected to the Senate in 1945 and subsequently ran for president in the 1958 and 1964 elections. Unlike many of his more radical contemporaries, Allende always favored pursuing socialist reform through existing democratic practices and consistently pushed for a Leftist agenda from the Senate floor and later from the presidential palace.

The success of the UP in the 1970 election vaulted Chile onto the world political map and drew international attention, particularly that of the United States, to events in this slender South American nation. Many progressives believed that Chile would pioneer a political third way between the ideological poles of the superpowers, a possibility that was both frightening and inspiring in those Cold War years. U.S. government documents reveal that on the day of Allende's election, U.S. Ambassador Edward Korry sent eighteen cables from Santiago to Washington, D.C., apprising the Nixon administration on the latest poll results. According to Secretary of State Henry Kissenger, "Nixon was beside himself" with the election returns and promised to "circumvent the bureaucracy" in the future.[4] On the morning of September 15, 1970, eleven days after the election, Nixon held a private breakfast meeting with Kissinger, Pepsi Cola chairman Donald Kendall, Attorney General

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move beyond the past and focus on the future. This strategic move undermines the importance the UP, Allende, and current efforts to document the acts of violence and repression that occurred during the Pinochet dictatorship.

[4] Henry Kissinger, *White House Years*, 1st ed. (Boston: Little, Brown, 1979), 671. Cited in Davis, *The Last Two Years of Salvador Allende*, 6.

John Mitchell, Augustín Edwards, owner of the conservative Chilean newspaper *El Mercurio* and a Pepsi Cola bottling plant. Edwards pleaded for Nixon's assistance in preventing Allende's presidency and predicted disaster for the region if the United States permitted the socialist government to assume power. The report from Senator Frank Church's Select Committee on Intelligence Activities, which documented the Covert Action in Chile from 1964-1973, reveals that after this meeting Nixon met with CIA Director Richard Helms and instructed the CIA to prevent Allende from taking power by arranging a military *coup d'etat* without the knowledge of the State Department, the Department of Defense, or the U.S. ambassador in Santiago. In addition, the Church Committee report "Alleged Assassination Plots Involving Foreign Leaders" asserts that Helms left the meeting with a page of handwritten notes authorizing a budget of ten million dollars—"more if necessary"—to prevent Allende's confirmation and instructions to "make the economy scream."[5] These instructions evolved into Track II of Project FUBELT, an operation that resulted in the death of Chilean Army General René Schneider, but failed to provoke a military coup or block Allende's confirmation on November 3, 1970. They also set the tone for the hostility of U.S. foreign policy toward Chile from 1970-1973 that resulted in an overt economic blockade and a multitude of covert CIA initiatives. Over the next three years, the CIA channeled more than eight million dollars to covert operations in Chile, which were designed to destabilize and overthrow the Allende government. These operations ranged from the manipulation of the Chilean media to "direct

[5] United States Senate, "Alleged Assassination Plots Involving Foreign Leaders: An Interim Report of the Select Committee to Study Governmental Operations with Respect to Intelligence Activities," (U.S. Government Printing Office, 1975), 227; United States Senate, "Covert Action in Chile, 1964-1973: Staff Report of the Select Committee to Study Governmental Operation with Respect to Intelligence Activities," (U.S. Government Printing Office, 1975), 170.

attempts to foment a military coup."[6] We are still continuing to uncover the full extent of these actions.[7]

Given the magnitude of the U.S. response, and the White House's commitment to overthrowing Allende, the number of changes completed by the government during Allende's first year in office is quite remarkable. From the outset, the government pursued an aggressive nationalization program that expropriated the U.S.-owned copper mines, purchased almost all of the banks, and nationalized major industries. By the end of 1971, Allende had succeeded in nationalizing sixty-eight of Chile's most important industries, particularly in the areas of metalworking, textiles, and construction materials.[8] By September 1973, the government had requisitioned more than four hundred foreign and Chilean elite-owned industries, a pace that exhilarated workers and frightened the owners of small and medium-sized businesses who feared their property might be next. In response, many owners reduced the size of their business operations or refused to invest in factory improvements. Others, such as Pepsi Cola and International Telephone and Telegraph (ITT) requested direct assistance from the U.S. government to help protect their investment by undermining support for the UP. In the countryside, the UP accelerated the agrarian reform begun by the Christian Democrats. By the end of 1972, the government had expropriated all estates larger than eighty hectares and had converted more than forty-four hundred estates into peasant cooperatives.[9] This redistribution of land dramatically changed the long-

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[6] United States Senate, "Covert Action in Chile, 1964-1973: Staff Report of the Select Committee to Study Governmental Operation with Respect to Intelligence Activities," 148.
[7] See Kornbluh, *The Pinochet File: A Declassified Dossier on Atrocity and Accountability*
[8] Bitar, *Chile: Experiment in Democracy*, 45.
[9] Collier and Sater, *A History of Chile, 1808-1994* ; Peter Winn, *Victims of the Chilean Miracle: Workers and Neoliberalism in the Pinochet Era, 1973-2002* (Durham, N.C.: Duke University Press, 2004).

standing power structure of the Chilean countryside and ended the hacienda system that had dominated rural life since colonial times.

This revolution from above paralleled a revolution from below. Workers pushed the government to requisition their factories, and peasants seized land from wealthy landowners, both acting without the expressed permission of or encouragement from the presidential palace.[10] As a result of the income redistribution policies, members of the working and lower classes could afford goods and services that they formerly regarded as unobtainable luxuries and that allowed them to make improvements to their homes and communities. Groups traditionally marginalized within Chilean society—women, peasants, the poor—dramatically increased their public activity. Marxist readings of history, expressed in political speeches, made it dignified to be poor and emphasized the historic importance of the proletariat to national progress.[11] The promise of revolution sparked a counterrevolution; both encouraged popular mobilization. Women, particularly those from the middle and upper classes, occupied an important role in the counterrevolution against Allende, banging empty pots in protest of consumer shortages and positioning themselves as the moral defenders of family life against the evils of socialism.[12] The levels of political participation observed during the UP era and the government's continued commitment to respecting opposing voices, have

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[10] Winn, *Weavers of Revolution.*

[11] In a conference paper presented at the 2003 Meeting of the Latin American Studies Association (LASA), Winn argued the Chilean revolution added "dignity" to the tripartite of "liberty, equality, and fraternity" that characterized the French revolution, an addition he believes marks another unique facet of the Chilean revolution.

[12] Power, *Right Wing Women in Chile: Feminine Power and the Struggle Against Allende* . Historians have also documented the significant presence of working class and poor women in the protests against Allende, a phenomenon that equally reflected the inattentiveness of the UP program to women's needs and the outward respect shown to Chilean women by the opposition for their role as wives and mothers. See Camilla Townsend, "Refusing to Travel *La Via Chilena:* Working-Class Women in Allende's Chile," *Journal of Women's History* 4, no. 3 (1993) and Thomas Miller Klubock, "Writing the History of Women and Gender in Twentieth Century Chile," *Hispanic American Historical Review* 81, no. 3-4 (2001).

caused some historians to label the period between 1970-1973 the most democratic moment in Chilean history, an observation that challenges the assumptions made by the White House and the appropriateness of U.S. foreign policy toward Chile during the early 1970s.

The reforms of the UP program also fueled artistic and scientific creativity and encouraged freethinking and interdisciplinary collaboration.[13] Notions of Chilean individuality and national destiny influenced Chilean scientific and technological undertakings and contributed to a new articulation of modernity that reflected the principles of the socialist revolution and the distinctive needs of the Chilean nation. University administrators and public officials developed science policies that stressed a fundamental commitment to achieving national autonomy, raising levels of production, and pursuing a path to development that broke from the model offered by the industrialized world. Rather than concentrate on capital-intensive goods for elite consumption, Chilean engineers and industrial designers set about creating products suitable for popular markets. Behind these activities was a conviction that politics should guide the direction of science and engineering pursuits, given their potential to realize the ideological aims of the UP coalition.

Orienting Science

In Chile, as in many Latin American countries, science and technology occupied an important place in the national strategy for development and material progress.

[13] The UP forty point plan called for the creation of a National Institute for Art and Culture. A history of Chilean music during the UP era, especially of *la nueva canción*, appears in César Albornoz, "Los sonidos del golpe," in *1973 La vida cotidiana de un año crucial*, ed. Claudio Rolle (Santiago de Chile: Planeta, 2003).

After World War II, the U.S. government emphasized technological assistance to developing nations instead of monetary aid and argued that the universal benefits of technological progress transcended cultural differences.[14] The *desarrollista* policies of the Christian Democrats echoed these sentiments and elevated science and technology as vital to national progress and economic growth. Chilean policies for modernizing industries, training a technically literate workforce, and increasing the scope of state planning practices reflected a particular set of beliefs about economic development and the political goals of the Kennedy administration's Alliance for Progress. These programs strove to change Chile's social and economic conditions by "modernizing" the existing economic structure instead of questioning the assumed benefits of foreign investment and the production of capital-intensive goods. Within the limits of this framework, political promises of increased equality and redistributed national wealth failed to change the concentration of property and capital that characterized industrial and agricultural sectors and placed the interest of foreign multinational firms ahead of the social and economic reforms outlined in the "revolution in liberty." Foreign technological assistance and the arrival of multinational firms throughout the 1960s, particularly from 1964 to 1970, introduced Chile to the manufacture of high-end luxury items, but only a limited percentage of the population could enjoy these fruits of economic growth. Foreign firms exacerbated these unequal consumption patterns, even encouraged them. Far from being neutral, the technology policies of the Christian Democrats directed Chilean resources toward expanding elite markets and paid less attention to the wider needs of the Chilean nation. As these consumption patterns intensified the

[14] Arturo Escobar, *Encountering Development: the Making and Unmaking of the Third World*, ed. Sherry Ortner, Nicholas Dirks, and Geoff Eley, *Princeton Studies in Culture/Power/History* (Princeton: Princeton University Press, 1995).

gap between rich and poor, movements of workers and peasants continued to gain momentum throughout the country.[15]

Once the UP came to power, the discourse of development changed. Under the policies of *desarrollismo* advocated by the Christian Democracy, foreign investment spurred national development. In contrast, economists within the UP coalition mixed the ideological goals of socialism, namely social equality and state-owned production, with the economic framework of relations described by dependency theorists.[16] Responding to the modernization theories advocated by the United States and international lending organizations, which delineated a universal framework for development, the UP emphasized the uniqueness of Chilean history within the Latin American region. Chilean economists noted that the nation's mature industries and political institutions were not so different from those of the developed world. Given the ineffectiveness of past development models, progressives and dependency theorists alike called for a new economic model. Marxists and other members of the UP coalition criticized the social and economic inequalities of capitalism. Dependency theorists rejected modernization models that assumed a universal transition from "traditional" to "modern" societies. Cardoso and Faletto observed that "there exists among the developed and underdeveloped economies a difference, not only of the stage or the state of the production system, but also of function or position within the international economic structure of production and

[15] For this reason Bitar writes, "the Frei government intensified the contradictions in the system by moving in opposite directions: on the one hand it fed popular mobilization and organization; on the other it attempted a course of economic development which left the economic structure practically intact." Bitar, *Chile: Experiment in Democracy*, 12.

[16] Several dependency theorists, most notably Fernando Henrique Cardoso, have argued that dependency theory grew out of Marxist theory. In his reading of dependency school texts from the 1960s, Love challenges the ubiquity of Marxist influence, but writes that by the 1970s "many writers on dependency adopted an exclusively Marxist perspective, and dependency analysis for this group matured as a "region" of Marxism. Joseph L. Love, "The Origins of Dependency Analysis," *Journal of Latin American Studies* 22, no. 1 (1990): 167.

distribution."[17] Understanding underdevelopment, therefore, required more than positioning a nation on a universal trajectory of progress. Underdeveloped nations needed to understand the history of their integration to the world market and their positioning as central or peripheral economies. According to both Marxism and dependency theory, every economic link behaves as a social link capable of establishing relations of domination and subordination. National progress, therefore, hinged on increasing national autonomy, decreasing the reliance on foreign capital, changing Chilean economic structures, and establishing Chile's economic centrality to the world market. As a result, Chilean leaders redefined their approaches to modernization and redirected national science and engineering efforts toward the distinctive needs of the Chilean nation and the political goals of the UP.

The acceptance of dependency theory within the socialist program of the UP changed national perceptions of science and technology and their role within Chilean development policies. The government expanded the role of science and technology to one of directing the knowledge produced in Chilean laboratories. Technologies became instruments of political domination or liberation. Moreover, "development" ceased to be a universal process and instead reflected the unique facets and political aims of the Chilean revolution. Science and technology should "not repeat the development of other countries or close the technological gap with them, but break the different forms of technological and cultural domination, and freely choose and bring into being ways of life that are in accordance with [Chilean] society."[18]

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[17] Fernando Henrique Cardoso and Enzo Faletto, *Dependency and Development in Latin America*, trans. Mariory Mattingly Urquidi (Berkeley: University of California Press, 1979), 17.
[18] José Valenzuela, "Apuntes sobre la política de acción del INTEC," *INTEC* 1 (1971): 11. In his report analyzing the distribution of resources for research in Chilean universities, Engineering Professor Eugenio Yunis Ahués argued that Chile "must have the capacity to observe and study their own problems, and find for themselves the most appropriate solution for their cultural, geographic, social, and economic

Government and university bodies highlighted the potential of science and technology to resolve problems of direct national interest in areas such as health care, industrial production, goods for export, and living conditions. Increased government involvement in research and development changed the objects of scientific study, the practice of science and engineering, and the motivation for scientific research.

Historians have often criticized the UP for pursuing long-term objectives without a short-term plan of action. However, this does not appear to be the case regarding the UP's stance toward science and technology. The range of state-sponsored science and engineering endeavors pursued by university and government organizations from 1971 to 1973 illustrates a real commitment to "the absolute necessity of organized, systematic, and coherent government support for science and technology research activities."[19] Government monies supported inventories of Chilean science and engineering resources, such as the numbers of trained personnel, availability of scientific equipment, and the areas of research being pursued in Chilean universities, government agencies, and industries. The government also sponsored studies cataloging the technological needs of the nationalized industries within the "social property area" (APS) and those within the "mixed property area" (APM) a term used to describe industries requisitioned by the government that retained a minority percentage of private ownership. In addition, the Chilean government commissioned and published works that documented these resources, including a volume consisting solely of the curriculum vitas of Chileans in

characteristics." Eugenio Yunis Ahués, *Asignación de recursos y política de investigación para la ciencia y la tecnología: El caso de la Universidad de Chile* (Santiago, Chile: Ediciones C. P. U., 1972), ix.

[19] *Mensaje Presidente Allende ante congreso pleno, 21/Mayo '73*, (Santiago, Chile: Departamento de Publicaciones de la Presidencia de la Republica - Chile, 1973), 266. See also Augusto Salinas Araya, *Ciencia, estado y revolución* (Santiago de Chile: Ediciones Universidad Finis Terrae, 1994).

possession of a four-year university degree in science or engineering disciplines. The national science and technology agency, CONICYT, expanded the size of its library collections and catalogued a greater number of holdings. However, CONICYT's greatest accomplishment was coordinating the First National Congress of Scientists, which brought together more than 3,000 Chilean scientists at regional meetings in Arica, Antofagasta, Valparaíso, Santiago, Concepción, Valdivia, and Punta Arenas and culminated in a series of plenary talks in August 1972. From these meetings, CONICYT not only generated a map of the research topics being pursued throughout the nation, but also of the areas and resources that needed improving. This information subsequently guided a structural reorganization of CONICYT in 1973. The benefits of cultivating national scientific and technological capabilities extended beyond economic development and took on a symbolic value. Innovation offered a new form of propaganda that illustrated the success of the Chilean political experiment. This new role for scientific accomplishment is perhaps best seen in the government's plan to distribute the publication *Science and Technology Week* to all Chilean embassies beginning in August 1973. The magazine served as a vehicle for the international dissemination of Chile's science and engineering accomplishments.[20]

Government attention to national science and engineering activities echoed within the universities. The University of Chile, where the majority of science and technology research occurred, published studies in 1971 and 1972 outlining university practices and policies in regard to research and the allocation of

[20] *Mensaje Presidente Allende ante congreso pleno, 21/Mayo '73*, 263.

resources.[21] "It is not enough to document or create scientific knowledge," one report noted as justification for its self-described "vast and complete plan, in which the university supports the scientific, technological and creative infrastructure [of the country]."[22] Given the importance of science and technology to national development policies, the report encouraged the government to expand the scope of state involvement in research and development. Both the 1971 and the 1972 report targeted new areas of study, made suggestions to encourage interdisciplinary collaboration and communication across departments, suggested priorities for university-level research, and called for research directed toward problems of national need. Individually, these reports set goals for national science education at all levels, proposed specific criteria for reviewing research proposals, made specific suggestions for the allocation of resources, and proposed expanding the scope of "science" to include work within the fine arts and humanities.[23] The confluence of national goals and scientific activities within Chilean universities similarly dominated the First National Congress of Scientists and provided the impetus for its organization.[24]

Policies favoring "oriented research" over "basic research" raised objections within Chilean scientific communities and opened debates about the fundamental

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[21] *Hacia una política de desarrollo científico y tecnológico para Chile,* (Santiago, Chile: Universidad de Chile Rectoria, 1972); Yunis Ahués, *Asignación de recursosAsignación de recursos y política de investigación para la ciencia y la tecnología* . According to Yunis Ahués, 55% of individuals engaged in scientific research were connected with the University of Chile. Of those, 40% were within the exact and natural sciences, 35% were affiliated with technology, and 25% had positions within the social sciences and humanities.
[22] *Hacia una política de desarrollo científico y tecnológico para Chile,* 10.
[23] Ibid. The report argued for the inclusion of human sciences and works of artistic creation within the category of "basic science" given their contributions to the creation of knowledge and cultural independence. At the Catholic University, the heading of "science" also served as shorthand for Marxist science.
[24] Margaret Power, "The Popular Unity Government, Science, and Development: The First National Congress of Scientists in Chile," in *Congress of the Latin American Studies Association* (Las Vegas: Unpublished Manuscript, 2004) *Mensaje Presidente Allende ante congreso pleno, 21/Mayo '73*, 254.

nature of scientific knowledge and the practice of technological development. Factions of university scientists highlighted the importance of pursuing pure knowledge, independent of any ideological project. They worried that marrying scientific practice with political considerations threatened to compromise rigor and the ability to think freely without bias.[25] In his study of the University of Chile, Yunis Ahués pleaded: "Don't deny the necessary academic liberty" or the "autonomy and independence" needed by university researchers when selecting projects and methodological approaches. Universities, he felt, must preserve some fundamental or basic science, not tailored to the fulfillment of short-term objectives.[26] As a compromise, Yunis Ahués proposed that only a portion of university-supported work fall under the heading of oriented research. The university would not attempt to control the central questions or methodologies pursued by researchers undertaking projects of national interest. Of the proposals submitted to the Scientific Research Commission of the University of Chile, a body created in 1970 to coordinate science and technology research across the various faculties of the university, only 54% were evaluated according to national importance in 1972, whereas 95% were judged on their originality and proposed methodology.[27]

Members of science and engineering communities also questioned the idea of technological neutrality. "The myth of aseptic technological neutrality has been destroyed," announced an article in the magazine *INTEC*. "Extra-technologic decisions infiltrate techno-scientific work, although the subjective conscience does

[25] Members of the scientific community voiced similar concerns regarding the overt political motivations of the National Congress of Scientists. Power, "The Popular Unity Government, Science, and Development."
[26] Yunis Ahués, *Asignación de recursosAsignación de recursos y política de investigación para la ciencia y la tecnología*, 13.
[27] Ibid., 82. A date did not appear on this study, although given that the Commission began in 1970 and the report was published in 1972, we can assume that the study referred to proposals made during the UP government.

not always realize this and at times represses it." Contrary to the positivist thought that had dominated the previous part of twentieth century, the article observed that science and technology did not exist as "an untouchable king, undisturbed by conflicts and interests."[28] Directed national research and development efforts produced technologies tailored for Chilean industries and could boost the productivity of Chilean resources. Technologies developed in this vein were better suited for advancing UP social programs. Moreover, government scientists and engineers developed technological systems to assist with nationalizing the economy, as is illustrated by the Cybersyn system, the subject of chapters 5 and 6. By questioning the assumed superiority of imported technologies, Chilean scientists, engineers, and designers expanded the criteria for measuring technical superiority and introduced design considerations they had ignored in the past. Like the work in university laboratories, the design and development of technology could no longer be separated from national problems and national needs.

The structural changes to the Chilean economy, such as the income redistribution and the nationalization policies put in motion by the UP, heightened the importance of Chilean science and engineering and their application to improving the quality of life for impoverished sectors of the Chilean population and augmenting the economic productivity of the nation. As a result, research and development practices changed. Instead of keeping science, technology, and politics separate, members of Chilean government agencies, industries, and academic institutions argued for their collective synthesis and rejected such concepts as technological neutrality and scientific purity. Through their program of democratic socialism, the Chilean government tried to pioneer a political "third way" that broke

[28] INTEC, "Introducción a una nueva revista," *INTEC*, December 1971.

from past models of governance and struggled to create something new. In the same vein, Chilean scientists and engineers worked to generate a corpus of knowledge that reflected Chile's unique path of historical development and its hopes for the future. This should not imply that all Chilean scientists and engineers agreed with the UP program or even viewed their work as political.[29] However, if we view these directed research and development efforts as a component of the multi-sited UP project for socialist transformation, we see that Chilean laboratories also became spaces for revolution.

Popular Consumption

Advancing national scientific and technological capabilities meshed with state plans to stimulate industry and diminish economic dependency. Government agencies and universities believed oriented research and development supported economic growth, improved manufacturing practices, diversified national industries, raised output levels, extracted natural resources, and identified new export opportunities. Applied correctly, science and technology promised to lower production costs and create domestic goods tailored for Chilean consumers, including the expanded manufacture of low-cost products designed for massive consumption. This section provides a brief overview of some of the products and technologies developed from 1971 to 1973 that reflected, or furthered, the ideas of the UP program. Through these technologies, Chilean scientists and engineers articulated a new form of material progress that was defined by the widespread use of everyday objects.

The industrial production of goods for mass consumption constituted one of the central goals pursued by CORFO, the state development agency, while the UP

[29] This will be discussed at greater length in the following two chapters.

was in power. Beginning in 1971, CORFO pursued a number of programs to "augment the production capacity of goods for popular consumption," including plans for the design and manufacture of low-cost automobiles, bicycles, motorcycles, sewing machines, household electronics, and furniture, among other items.[30] These projects paralleled UP policies for income redistribution and represented a "diversification and decentralization" of property, distribution patterns, and commercialization practices within Chilean industrial firms.[31] As a result of these efforts, poor Chileans and members of the working classes gained access to products and services previously reserved for the elite, a maneuver that raised levels of popular support for the UP, particularly during 1971 and the initial parts of 1972.

UP policies of income redistribution expanded Chileans' access to consumer goods while increasing the range of products produced for domestic, popular consumption.[32] These actions are perhaps best illustrated by the work of INTEC, a filial organization of CORFO. As mentioned in the previous chapter, CORFO created INTEC in September 1968 to "promot[e] technology research in the country" and create "studies for the development of new industrial products and/or the perfection of those that already exist."[33] In March 1971, presidential appointments changed INTEC's upper management; Fernando Flores was named institute president and José Valenzuela became vice director. Both men later played central roles in

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[30] Luis Ortega Martínez, *Corporación de Fomento de la Producción: 50 años de realizaciones, 1939-1989* (Santiago de Chile: Universidad de Santiago Facultad de Humanidades Departamento de Historia, 1989), 233-34; Hugo Palmarola Sagredo, "Productos y socialismo: diseño industrial estatal en Chile," in *1973 La vida cotidiana de un año crucial*, ed. Claudio Rolle (Santiago de Chile: Editorial Planeta, 2003), 225-96. The University of Chile similarly supported the application of technological resources to the creation of goods for mass consumption. *Hacia una política de desarrollo científico y tecnológico para Chile*, 15.
[31] CORFO Relaciones Publicas, "Rol de CORFO en los propósitos de cambios," *CORFO en el gobierno de la Unidad Popular*, 4 November 1971.
[32] Real wages increased by an average of 30% during Allende's first year in office. Winn, *Weavers of Revolution*, 142.
[33] Uldaricio Acosta, "Datos sobre el Instituto Tecnológico/CORFO," *INTEC* 1 (1971): 7.

developing the Cybersyn project. By October 1971, INTEC employed 5 electrical engineers, 7 mechanical engineers, 21 specialists in chemistry and metallurgy, and 8 economists to pursue state funded projects related to technological innovation. The figure doubles when including individuals without full-time appointments.[34] INTEC also supported the first state-sponsored industrial design group in the country.[35] Collectively, the organization commanded a diverse group of technically educated professionals whose projects ranged from ecological studies of pesticides promoted by U.S. chemical companies and the Rockefeller Foundation's Green Revolution to improving the efficiency of Chilean refrigeration units.

INTEC demonstrated a strong commitment to developing products and technologies intended for popular use. In the first issue of the bi-annual magazine *INTEC*, Valenzuela observed, "Technology is not an end in itself, but a means to achieve social objectives."[36] Manufacturing low-cost, durable goods for widespread consumption fell in line easily with UP programs for industrial expropriation, agrarian reform, and the national redistribution of wealth. The production of these goods simultaneously increased the scope of Chilean import substitution capabilities, decreased expenditures on foreign patent licenses, and lowered overall production costs.[37] These products, moreover, help create a distinctively Chilean material culture, domestically manufactured and designed to meet national needs. Use value combined with profit as the central motives for the social and mixed property areas and replaced the exclusive profit-driven mentality of the private

[34] Ibid.
[35] For a concise history of the Grupo de Diseño Industrial, refer to Palmarola Sagredo, "Productos y socialismo: diseño industrial estatal en Chile," 225-96.
[36] Valenzuela, "Apuntes sobre la política de acción del INTEC," 11.
[37] By 1967, 94.5% of all patents registered in the Oficina de Patentes y Marcas de Chile were held by foreigners, up from 89% in 1958 and 65.5% in 1937. CORFO, "La propiedad industrial en Chile y su impacto en el desarrollo industrial," 1970, cited in Yunis Ahués, *Asignación de recursosAsignación de recursos y política de investigación para la ciencia y la tecnología*, 4.

sector. The increased attention given to a customer's purchasing constraints and his or her use of a consumer good raised awareness for the importance of good industrial design. Within INTEC, young Chilean industrial designers working under the direction of Gui Bonsiepe (a former instructor at the renowned German design school Hochschule für Gestaltung (HfG) in Ulm) adopted a scientific approach to design. Their methods upheld function over form and used systems theory to study how objects interact with their environment. From 1971 to 1973, the Industrial Design Group developed nearly twenty products, including inexpensive cases for electronic calculators; agricultural machinery for sowing and reaping that furthered the agrarian reform by raising the productivity of the land; spoons for measuring rations of powdered milk given to children through the National Milk Plan; a system of inexpensive, durable furniture for use in public housing projects and playgrounds; and a record player inexpensive enough for popular use. These goods were simple in design, easy to construct, inexpensive, and of good quality, important considerations for the majority of Chilean consumers. INTEC's interdisciplinary approach to product development, and the incorporation of design considerations within the development process, eventually produced a merger between the Mechanical Engineering Division and the Industrial Design Group, known thereafter as the division of "Product Development."[38]

Outside INTEC, other industries within the social and mixed property areas began developing products for popular markets, particularly within the microelectronics and transportation sectors. The production of the Antú television offers one illustrative example. In 1971, CORFO assumed partial control of the Chilean branch of RCA International, Ltd. CORFO administrators renamed the

[38] Palmarola Sagredo, "Productos y socialismo: diseño industrial estatal en Chile."

mixed-area enterprise Industría de Radio y Television S.A., or IRT, for short. When the CORFO Sector Committee for Electric and Electronic Industries announced plans to manufacture 130,000 low-cost televisions for popular consumption between 1971 and 1972, IRT assumed responsibility for the project.[39] It created the IRT Antú, a small black-and-white unit with an 11-inch screen, housed in a plastic case that read: "IRT. Built by order of the Electric and Electronic Committee, CORFO. Chilean Made." According to Palmarola, the Antú made television accessible to the masses. Instead of being an elite luxury item, it soon became a basic staple of Chilean homes and "one of the most remembered products of the UP."[40] However, sustaining the Antú's inexpensive price tag depended on developing a domestic industry for the manufacture of reliable microelectronic component parts. A study published by the University of Chile in 1971 estimated that the consumer electronics industry paid nearly $2.5 million annually in foreign patent royalties, money that could be saved if Chileans developed their own designs and manufacturing processes for microelectronic goods and their components--radios, televisions, tape players, telephones, and even small computers.[41] Many parts found within the Antú's plastic casing were manufactured in the Chilean city Arica, a free-trade zone and one of the manufacturing centers of the country.[42]

[39] CORFO controlled 51% of the company, while RCA maintained the minority 49% share. CORFO, "Comite de las Industrias Electricas y Electronicas," *CORFO en el gobierno de la Unidad Popular*, 4 November 1971.
[40] Palmarola Sagredo, "Productos y socialismo: diseño industrial estatal en Chile," 275.
[41] *Hacia una política de desarrollo científico y tecnológico para Chile*, 99-100.
[42] The domestic manufacture of microelectronic components and the government's insistence on their use presented numerous difficulties for Chilean factories. According to Barrie Lawson, manager of the Chilean Phillips plant during the UP era, the new Chilean-made components did not share the same specifications or tolerances as the components the company had used previously in their assembly lines. As a result, Phillips engineers were forced to redesign their televisions repeatedly in order to accommodate the introduction of these new components. Barrie Lawson, interview by author, 20 January 2001.

While IRT worked to make the television accessible to a broader consumer base, Citroën of Arica began constructing a new "automobile for the people." In 1971, Minister of the Economy Pedro Vuskovic ordered the manufacture of a utility vehicle akin to the jeep that would cost less than $250 to produce—a Chilean version of the German Volkswagen.[43] Using funding and technology from its parent company, Citroën, the Chilean plant drew up plans for a utility vehicle modeled after the Citroën Baby Brousse, which the French manufacturer had designed for public transport in Vietnam. Citroën christened the new design "Yagán," after a Chilean Indian tribe indigenous to Tierra del Fuego. Cristian Lyón, then director of Citroën, Arica, remembered that the designers "wanted to see [a vehicle] that was native like the Yagáns."[44]

The size and scope of Chilean automobile production had grown significantly during the 1960s, thanks in part to the protections given to the automobile industry by the previous two government administrations. The Yagán, however, is widely regarded as the first automobile completely designed and assembled in Chile, although the veracity of this claim is subject to debate.[45] Lyón described building the

[43] Automobiles were among the most highly politicized technologies of the UP era. Although the Popular Unity Program banned government workers from using automobiles for private use, government workers received priority in the distribution of new cars produced by Chilean factories and sparked charges of favoritism. In 1971, CORFO created the Automotive Commission in efforts to coordinate the distribution of Chile's limited automobile supply in the face of rising demand and bring Chilean automobile production in line with the goals of the UP. Among their core objectives was the production of utility vehicles and automobiles for mass consumption. *Primer mensaje del Presidente Allende ante el congreso pleno, 21 de Mayo de 1971*, (Santiago, Chile: Departamento de Publicaciones de la Presidencia de la Republica - Chile, 1971), 119.

[44] Cristián Lyon, *Creando El Yagán* [webpage] (Corporación de Televisión de la Pontificia Universidad Católica de Chile, 2003 [cited 11 November 2004]); available from http://www.reportajesdelsiglo.cl/reportajes/reportajes/auto/entrevista/lyon.htm.

[45] In actuality, Citroen employees only designed and assembled the Yagán body. They used the suspension system, motor, and other key components from other Citroen vehicles. According to the Chief Methods Officer for Citroen Arica, Pedro Medina, Citroen Arica previously designed and assembled a new automotive body in 1960, eleven years before Vuskovic commissioned the Yagán. Therefore, the Yagán was not fully designed and manufactured in Chile, nor was it the first automobile to sport a body that was

Yagán as an artesanal undertaking rather than a science: cutting here, straightening there, and creatively combining parts from Citroën vehicles past to produce a distinctively Chilean automobile. "I insist it was almost a metaphor for the history of Chile," Lyón remarked, perhaps referring to the ad hoc willingness of Citroën workers to construct something from the ground up or the excitement of creating something new with only limited resources. "It's incredible what objects can say about the characteristics of a people, a nation, and a time."[46] The UP believed income redistribution programs would increase demand for automobiles—a prediction that came to pass. In the end, however, Citroën sold only four hundred Yagáns. Despite its low cost to manufacture, it failed to substantially undercut the prices of competing models destined for the popular market. Its creators lamented that it never had the chance to secure a solid market share before the end of the UP government in 1973.[47]

Taken together, these projects illustrate a shift in the definition of industrial success and the considerations driving technological innovation. Instead of giving priority to the production of capital-intensive goods and the maximization of profit, as private firms had in the past, the government emphasized accessibility, use value, and the geographic origin of component parts. These new considerations reflected the economic policies of the UP and the social goals of the Chilean revolution. Far from being neutral, the technologies described here intentionally reflect the philosophy of the UP. In this setting, televisions, automobiles, measuring

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100% Chilean made. This raises the question of why the Yagán has assumed this place of honor in Chilean history. Pedro Medina, interview by Cristian Medina and the author, 20 December 2004.

[46] Ibid.

[47] In recent years, the Yagán has emerged as an object of nostalgia. A recent documentary entitled, "La huella del Yagán" (The Tread of the Yagán) illustrates this sentimentality by recording the road trip of two young Chileans as they drive a Yagán from Santiago to Arica, in a sense bringing the historic vehicle back to its birthplace.

spoons, and electronic calculators all became tools for revolution and signaled the beginnings of a material culture that Chileans could call their own.

State Computing

On December 24, 1970 EMCO, the computer service enterprise (*Empresa de Servicio de Computación)* changed its name to ECOM, the national computer and informatics enterprise (*Empresa Nacional de Computación e Informática).* According to *La Nación*, the government newspaper, the change acknowledged that EMCO's important activities "go beyond the traditional limits of a computer service" and therefore warranted dropping the word "service" and raising the agency to the level of a national enterprise, akin to ENTEL or ENDESA.[48] "This is an enterprise," the newspaper read, "whose objectives are clearly national, without the goal of profit, and that will operate throughout the country." The announcement signified more than a name change. From 1970-1973, ECOM expanded to near monopolistic proportions and controlled almost all of Chile's computer related activities, including those in the private sector, and dictated national computer policies. Although other Latin American nations, such as Brazil, established their own centralized computer agencies, ECOM's strict controls were reportedly the strongest in the region.[49]

Raimundo Beca, the general director of ECOM during the Allende period, succinctly stated that although the agency was small, "ECOM had a lot of power, power is order." When pushed to explain, Beca said, "because all of the computers entering the country required the signed authorization of ECOM." However,

[48] "ECOM: nuevo nombre para una empresa que surge," *La Nación*, 7 January 1971.
[49] Ramón C. Barquín, "Some Political Effects of Computation in Latin America," in *M.I.T. Alfred P. Sloan School of Management Working Paper no. 655-73* (Cambridge, Mass.: M.I.T. Alfred P. Sloan School of Management, 1973).

"ECOM did not authorize anyone to purchase a computer, ECOM bought them and people had to use ECOM's machines. There were some large private companies and other large public agencies that wanted to buy [their own computing machines] but ECOM did not let them." ECOM was "a monopoly of calculation, because it provided services," Beca said. Although it was also the only entity with the power to purchase and import computing machines. ECOM's growth mirrored the overall expansion of the Chilean state under Allende, which extended the programs of state-led economic growth begun by the Christian Democrats. ECOM's tight regulations reflected government attempts to direct the national economy and control the distribution of national resources. Moreover, computer technology allowed the government to manage the payroll records for the growing numbers of state employees who entered the workforce as a result of government employment and income redistribution programs. Once aligned with the economic goals of socialism, computers also presented new technological possibilities for directed economic management and control, an area of application that will be addressed at great length in the following two chapters.

The reaction of the U.S. computer companies IBM and Burroughs to the Popular Unity government further complicated Chile's ability to purchase computing hardware. When the Popular Unity came to power, Burroughs decided to suspend all Chilean operations rather than risk expropriation. IBM, however, took a different tack. Alfredo Acle, then director of systems engineering at IBM, reported that the company viewed the potential expropriation of IBM Chile as a legitimate threat; IBM was a large, foreign-owned enterprise of near-monopolistic proportions that sold high-end technology to the Chilean market.[50] However, instead of ending its Chilean operations, the company decided to use its international presence to relocate more than eighty Chilean employees to other IBM offices throughout Latin America and Europe. This reduced the size of the Chilean operation to the bare minimum required to maintain existing service contracts. IBM's culture of company loyalty assisted these efforts, presenting relocation as a worthy sacrifice for saving "La Mamá IBM." Decreasing the size of the Chilean office, the company argued, made the enterprise less desirable to the state and could allow the company to continue operating under private ownership and maintain its management structure.[51] The relocation program, moreover, served the interests of the company. Trained Chilean employees filled vacancies in other IBM World Trade operations, many at the executive level. According to Acle, the majority of employees who decided to relocate had engineering degrees and years of experience working for the company. Acle, however, decided to remain in Santiago "to turn out the lights."[52]

The Chilean government never nationalized IBM Chile. The strategy of reducing the number of employees succeeded in lowering the company's profile. And because the company consisted of white-collar employees, rather than blue-collar workers, IBM never attracted the levels of worker or government attention found in other foreign-owned firms. ECOM supported the continued presence of IBM Chile, and Acle considered ECOM director Raimundo Beca "a friend" of the company, although ECOM insisted that IBM lessen its influence in national operations.[53] The previous IBM practice of recruiting engineers from the Chilean Navy further

[50] Alfredo Acle, Interview with the author, 18 December 2003.
[51] Moreover, it would allow the company to maintain the promise of "full-employment," upholding IBM's reputation of providing their employees job security for life.
[52] Acle, interview.
[53] Acle, interview.

benefited Big Blue. Many of the employees who decided to stay behind, particularly those in upper management, maintained ties with members of the armed forces. Acle reported receiving word of the military coup the night before it happened, as did all of his coworkers but one. On the morning of the military coup, that lone IBM employee showed up for work as usual.[54]

IBM's reduction in force and the closure of Burroughs, combined with the outward economic and political hostility expressed by the United States toward the Allende government, forced ECOM to look beyond these corporate mainstays for Chile's computing needs. In 1973, Chile finalized plans to purchase machines from the French company CII (Machines Bull). Beca cited economic and technological considerations as the primary motives for purchasing CII mainframes, independent of politics. However, CII's past willingness to sell computing machinery to Cuba under Castro, as well as the French willingness to assist the financially strapped Chilean government, likely also played a role.[55] ECOM finalized the contract with CII in June 1973 and agreed to purchase an Iris-80 and an Iris-60 for approximately US$8 million. Due to the differences in the CII, IBM, and Burroughs hardware, the government developed a training program to teach government employees to use of the new French machines.[56]

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[54] Acle recounted the misfortune of this particular employee, who spent three days holed up in the downtown IBM office eating crackers and other food items he found in the desk drawers of his co-workers. Acle, interview.

[55] Barquín, "State of Computation in Cuba," Beca, interview.

[56] ECOM, "Caracteristicas principales de los sistemas Iris-80 e Iris-60," in *Conferencia de processamiento electronico de datos para empresas y organismos gubernatales* (Santiago de Chile: Empresa Nacional de Computación e Informática Ltda., 1973).; ECOM, "Programa capacitacion Iris-80," in *Conferencia de processamiento electronico de datos para empresas y organismos gubernatales* (Santiago de Chile: Empresa Nacional de Computación e Informática Ltda., 1973). Following the military coup, the new director of ECOM, Patricio Léniz canceled the contract for the two Iris machines, discretely paying the French company $500,000 indemnification. According to Léniz, the machines were an unreasonable purchase given that they were not compatible with existing Chilean hardware and software systems. Patricio Léniz, Interview with the author, 23 December 2003.

The UP government not only changed the character of Chilean politics, the role of the state, and the structure of Chilean society. It also drastically affected Chile's ability to purchase foreign technologies and altered the manner in which these technologies could be applied. The UP, like the Christian Democrats before them, recognized the importance of science and technology. However, Chile's trajectory of technological development, which from the time of Ibañez to Frei had emphasized advanced technology, expertise, and a technocratic elite, could not continue under Allende's ideological program for peaceful revolution. Political revolution led to technological rupture. The technological history of the U.S. during the twentieth century has been characterized incremental developments afforded by political continuity and economic stability. In the Chilean case, incremental change was made impossible by the radical changes in the prevailing political ideology and the subsequent reaction to these changes at home and abroad.

Interdisciplinary Problem Solving

Science, technology, and politics merged to an unprecedented degree during the UP years, often with government and/or university support. Linking science and technology to societal concerns, moreover, resulted in changes in the practice of research. Members of academic and government communities argued for deeper and more "global" understandings of Chilean society and studies examining how socialist transformation affected all aspects of Chilean life. This new wave of research demanded holistic scholarship, which transcended disciplinary and institutional boundaries and broke from the traditional university structure of department- and discipline-oriented research. The presence of interdisciplinary thought, collaboration, and communication in scientific undertakings became a feature of work conducted during UP and influenced research and development activities in university, industrial, and government settings.[57] Only a brief discussion of the university experience will be presented here; the interdisciplinary collaborations formed among government agencies will provide one focus of chapter 5.

The University of Chile recognized that interdisciplinary scholarship constituted an important component of research that was oriented toward areas of social and economic concern. In a report published in 1972, the executive secretary for the Commission on Scientific Research at the university urged the university to form temporary interdisciplinary working groups dedicated to solving "human problems." The proposed groups cut across university departments and applied the expertise of each discipline to the collective knowledge of a particular theme or social issue. In the process, these groups encouraged creative synthesis and cross-fertilization among diverse bodies of academic thought.[58] The report received the support of the university rector, Edgardo Boeninger.[59]

The Center for Studies on National Reality (CEREN) at the Catholic University provides one of the more illustrative examples of the push for interdisciplinary research and collaboration within Chilean universities during this period and links these activities to the political changes instigated by the UP. The center grew out of the university reform movement of the late 1960s and represented

[57] The Chilean government also proposed bridging the gap between national needs and national research activities by encouraging direct contact between university researchers, government researchers, and members of industry. *Mensaje Presidente Allende ante congreso pleno, 21/Mayo '73*, 254.

[58] Yunis Ahués, *Asignación de recursosAsignación de recursos y política de investigación para la ciencia y la tecnología.*

[59] Boeniger also wrote the forward to *Hacia una política de desarrollo científico y tecnológico para Chile*, a text that argued for the importance of science and technology in national policy.

a response to student demands that the university "adopt a critical stance."[60] CEREN promoted itself as a space for interdisciplinary scholarship that addressed issues relevant to the long-term future of Chilean society. Jacques Chonchol, then a member of the Christian Democrats, served as the founding director of the center and held that position until Allende appointed him to be Minister of Agriculture, a cabinet position.

While the center's formation predated Allende's presidency, Chonchol's initial description of CEREN communicates how the center rapidly evolved into a space for creative, interdisciplinary thinking during the UP.[61] According to Chonchol, intellectuals from different disciplines, or even from different universities or institutions outside academia, came together at the center to theorize the future of Chilean society. He equated CEREN's activities with those of U.S. think tanks, such as RAND, or state planning agencies in France or Poland—organizations concerned with the *significance* of change, including the social and economic changes spurred by innovations in science and technology.[62] Understanding these changes required studies of Chilean society in its totality and brought together economic, scientific, cultural, and institutional perspectives, among others. Chonchol credited science and technology with the level of economic progress found in the developed world and the idealization of modern society copied by underdeveloped nations such as Chile. The emphasis placed on emulation, rather than innovation, prevented underdeveloped nations from finding their own unique path to economic and social advancement. CEREN, therefore, tried to understand science and technology from

[60] "CEREN: ciencia en la tradición del Marxismo," *Qué Pasa*, 14 June 1973; Jacques Chonchol, "Qué es el CEREN," *Cuadernos de la realidad nacional* 1 (1969). On the university reform movement of 1967 see Carlos Huneeus, *La reforma universitaria: veinte años después*, 1st ed. (Santiago, Chile: CPU, 1988).
[61] Chonchol, "Qué es el CEREN."
[62] Ibid.: 6.

the perspective of the developing world and proposed ways that Chile could adopt and adapt technology to better suit its particular situation.[63]

After Allende was elected in 1970, CEREN became an official academic unit within the Catholic University. It grew to employ twenty-five full-time professors and an even larger number of part-time affiliates, who published a number of books, working papers, and journal editions while educating a student body of approximately one thousand.[64] When Chonchol left to join the cabinet, the CEREN directorship passed to Manuel Antonio Garretón, a former student leader and one of the original founders of the MAPU Party, a relatively new political organization of young intellectuals that had split from the Christian Democracy to join the Popular Unity coalition in support of Allende. Under Garretón, CEREN assumed a strong Marxist bent and promoted interdisciplinary collaborations in the service of Chile's socialist project. Work at the center focused on four key areas: the economic transition to socialism, ideologies and cultures of change, the state and socio-political organization, and studies of technology.[65] Within CEREN "science" often became shorthand for Marxist science, even though the center outwardly maintained a commitment to representing heterogeneous perspectives.[66] By 1973, CEREN and its triennial publication *Cuadernos de la Realidad Nacional* (Notebooks of the National Reality) emerged as one of the strongest critics of the Chilean "bourgeois media," particularly of the unabashedly rightist newspaper *El Mercurio*.

[63] Ibid.: 12-13.
[64] "CEREN: ciencia en la tradición del Marxismo." This figure does not include the number of professors with split or part-time appointments in CEREN.
[65] "CEREN: doble desafío en el plano universitario y social," *La Nación*, 3 January 1971.
[66] In an interview, journalists from *Qué Pasa* asked Garreton if CEREN's commitment to plurality would include a hypothetical "scientific line" developed by the extreme rightist party Patria y Libertad (Fatherland and Liberty). Garretón responded, "All scientific positions have a right to CEREN…[but] obviously this depends on other factors…Patria y Libertad is a fascist political movement and it inspires nothing of intellectual value." "CEREN: ciencia en la tradición del Marxismo."

Moreover, CEREN became a treasured source of information for leftist journalists while evoking scorn and skepticism from those who claimed that the center had replaced academic rigor with assumptions grounded in political ideology.[67]

This political controversy, however, veils one of the most impressive facets of the CEREN, namely, its commitment to interdisciplinary research and its unique perspectives on topics such as science, technology, urbanism, industry, and even feminism. The diverse range of articles found in the *Cuadernos* provides lasting proof of the creative research and interdisciplinary thinking that flourished within CEREN. Its contributors included the demographer Armand Mattelart, sociologist Jorge Larrain, economist Sergio Bitar, industrial designer and professor of engineering Gui Bonsiepe, writer and novelist Ariel Dorfman, and economist Stephan de Vylder.[68] An article written for the *Cuadernos* not only discussed methods for directed economic planning, as did the majority of texts from the Frei period, but also considered who would benefit from their application and raised questions about power and justice.[69] The *Cuadernos* similarly introduced gender issues to work in labor studies, as evidenced by Lucía Ribeiro's work on the plight of female Chilean workers.[70] Reviews of books by the feminist writers Betty Friedan,

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[67] Ibid; "Cuadernos del CEREN: ¿Donde queda el rigor universitario?" *Qué Pasa*, 1 February 1973.
[68] Sergio Bitar and Eduardo Moyano, "Redistribución del consumo y transición al socialismo," *Cuadernos de la realidad nacional* 11 (1972); Gui Bonsiepe, "Subdesarollo, tecnología y universidad. Reflexiones metatecnológicas," *Cuadernos de la realidad nacional*, no. 11 (1972); Stefan De Vylder, "La UNCTAD III. ¿Hacia un tercer fracaso?" *Cuadernos de la realidad nacional* 12 (1972); Jorge Larrain, "Orientaciones y actividades de la Confederación Democrática de Partidos durante la crisis de octubre de 1972," *Cuadernos de la realidad nacional* 16 (1973); Armand Mattelart and Michèle Mattelart, "Ruptura y continuidad en la comunicación: puntos para una polémica," *Cuadernos de la realidad nacional* 12 (1972); Michèle Mattelart, "La prensa burgesa ¿No será más que un tigre de papel?" *Cuadernos de la realidad nacional* 16 (1973); Urs Muller Plantemberg and Franz Hinkelammert, "Condiciones y consecuencias de una política de redistribución ingresos," *Cuadernos de la realidad nacional* 16 (1973).
[69] See for example Guillermo Geisse and Enrique Browne, "¿Planificación para los planificadores o para el cambio social?" *Cuadernos de la realidad nacional* 11 (1972).
[70] Lucía Ribeiro, "La mujer obrera chilena. Una aproximación a su estudio," *Cuadernos de la realidad nacional*, no. 16 (1973).

Germain Greer, and Kate Millet also graced the pages of the *Cuadernos*, disseminating the ideas of the U.S. women's movement to a Chilean academic audience.[71] Science and technology often appeared in articles relating to underdevelopment, discussions of technological transfer, or critiques of capitalism and dependency. Moreover, these essays enjoyed a significant presence within the CEREN curriculum. In 1972, the center offered such courses as "Technology and Social Change in Chile," "Ideology and Means of Communication in Chile," and "Copper Mining and Industry: Technological Conditioning and Socio-Political Effects," as well as related seminars on social aspects of biology, mathematics, chemistry, and psychiatry.[72] The following year, CEREN's course offerings included "Technology and Ideology" and "Ideology and Science."[73]

The interdisciplinary approach pursued by CEREN permitted the creative merging of science and technology with themes found in the humanities, social sciences, and politics, generating new research questions and original topics of study. However, CEREN's clear political position often fueled critiques that the center produced ideological rather than scientific research. In response, Garretón asserted that science and technology had upheld and even promoted state ideological projects in the past and could thus be directed responsibly in the service of the Chilean revolution. These sentiments similarly appeared in the articles published by CEREN, as well as in the center's course offerings. However, Garretón also argued that science possessed the ability to understand "ideological elements." CEREN

[71] Ísabel Gannon and Lucía Ribeiro, "El problema que no tiene nombre: la situación de la mujer," *Cuadernos de la realidad nacional* 13 (1972).
[72] "Programa docente del CEREN primer semestre de 1972," *Cuadernos de la realidad nacional* 12 (1972).
[73] "Programa docente del CEREN," *Cuadernos de la realidad nacional* 16 (1973). Additional CEREN activities and class listings appear in "Investigaciones y otras actividades del CEREN," (Santiago de Chile: CEREN Apartado de Cuadernos de la Realidad Nacional, 1971).

researchers therefore used scientific methodologies to purify themselves and their work of ideological bias and maintain the required level of academic rigor.[74] This observation echoed the stance adopted by the University of Chile—science could be directed in the service of particular research questions, including the study of ideology, but its practice needed to remain free from political thought. Unlike CEREN, however, the University of Chile did not conflate facets of Marxism, such as class struggle, with claims to objectivity.

The work produced by CEREN, from its inception through 1973, demonstrated a sophisticated and well-developed stance toward science, technology, ideology, and politics within the Chilean context, often framed in relationship to Marxist ideas of class struggle and the ownership of production. Given Garretón's prior claims to scientific purity, this practice may continue to raise eyebrows now, just as it did then. The more interesting observation, however, is that the interdisciplinary research supported by CEREN (as well as the research supported by other interdisciplinary gatherings of scientists, researchers, and engineers within Chilean government agencies and universities) enabled the formulation of new research questions and encouraged the generation of original scholarship and collaborative projects that crossed boundaries in innovative and unprecedented ways.

Conclusion

The structural changes set in motion by the UP extended beyond political, economic, and social spheres and entered Chilean laboratories, classrooms, and businesses. They shaped technological design processes, the use and availability of technological

[74] "CEREN: ciencia en la tradición del Marxismo."

resources, and the practice of scientific research. The UP program expanded role of the state and the desire for greater coordination within this growing apparatus provided both a mechanism and a desire for mapping science and engineering resources with greater precision. On one hand, the generation of these maps illustrates the continued influence of past development models, which valued identifying and quantifying national activities and incorporating this knowledge to improve state planning efforts. On the other hand, state planning now had a different ideological framework. Information from these studies now assisted in coordinating the activities of an increasingly nationalized economy and helped government and university officials channel Chile's limited science and engineering resources in support of the peaceful socialist revolution.

While dependency theorists and members of the Left uncovered the relations of domination and exploitation embedded in economic practices, similar challenges arose that questioned modernist faith in empiricism and scientific purity. Scientific knowledge and technological transfer no longer provided universal benefits for national progress. Government, industrial, and academic communities oriented research and development toward the central problems facing the Chilean nation, as determined by the UP political project. Struggles for national autonomy conflated with desires to pursue certain aspects of scientific knowledge, particularly those geared toward solving industrial and social problems. Past fetishism for imported high-end durable goods and foreign technologies gave way to critiques of their appropriateness for Chilean markets. In this context, Chilean designers equated technological superiority with an object's ability to meet Chilean needs and reflect the national vision for the future.

In spite of these efforts, the Chilean government could not surmount its dependence on imported spare parts, foreign expertise, or foreign patents. Shortages of components parts and the government's inability to obtain replacements from U.S.-owned companies—a result of the White House's open hostility toward Allende—continued to plague Chilean industries. Moreover, several oriented science and engineering projects occurred under the leadership of European experts. Given the short lifespan of the UP and the levels of economic and political instability that intensified throughout Allende's presidency, directed research and development proved inadequate for surmounting the economic dislocations that intensified from 1970 to 1973. These included, among others, widespread consumer shortages, labor strikes, black market hoarding, and the aforementioned U.S.-led economic blockade. Given the gravity of these problems, the level of creativity and energy displayed within scientific, engineering, and industrial design communities seems rather remarkable, as does the level of government attention to their cultivation. This moment in Chilean history gave rise to interdisciplinary combinations and confluences of knowledge and resulted in new questions, new combinations of source materials, and new frameworks for analysis. The richness and diversity of science and engineering activities pursued during the UP era suggests that Chile's unique interpretation of socialism fostered innovation and proposed new articulations of modernity, material progress, and development. This chapter has illustrated how science, engineering, and design practices reflected the institutional and political changes of the Chilean revolution and the shared sense of possibility. From the drawing board to the shop floor, Chileans were taking control of their destiny.

The changes that occurred in Chilean scientific and technological circles during the Allende period provides a backdrop for the material presented in chapters 5 and 6, both of which document the construction of the Cybersyn computer system. The history of this computer project brings together many of the ideas introduced here, including the recognized importance of interdisciplinary collaboration; the interplay of science, technology, and politics; and the expressed desire to construct technologies tailored for Chilean needs and ideological framings. By redefining what it meant to be modern while encouraging creative collaboration and technological innovation, the Allende government provided the conditions suitable for constructing this unprecedented computer system that resulted in a new technology for state management.

Chapter 4: Images

Figure 4.1: Pedro Medina sits in the driver's seat of the Citroën Yagán, a vehicle widely viewed as the first automobile produced completely in Chile. Medina was the Chief Methods Officer for Citroën and played a key role in designing the Yagán's production process. (Claudio Rolle ed., *1973 La vida cotidiana de un año crucial*, Santiago de Chile, Editorial Planeta, 2003. Image used with permission.)

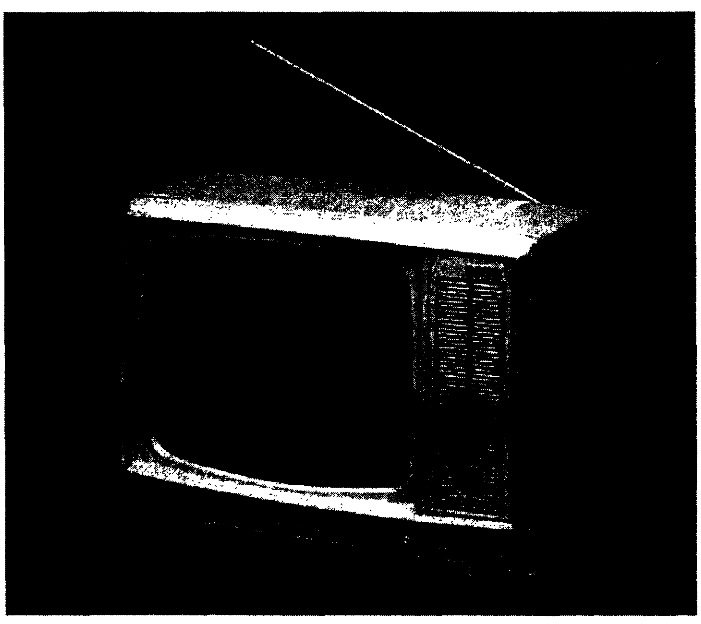

Figure 4.3: Image of the Antú television set designed by IRT for popular consumption. The image to the right shows the Chilean shield ("*escudo*") imprinted on the front panel of the television set, a symbol of national manufacture. After the coup, Antú televisions were made without the shield. (Images used with permission from Hugo Palmarola Sagredo.)

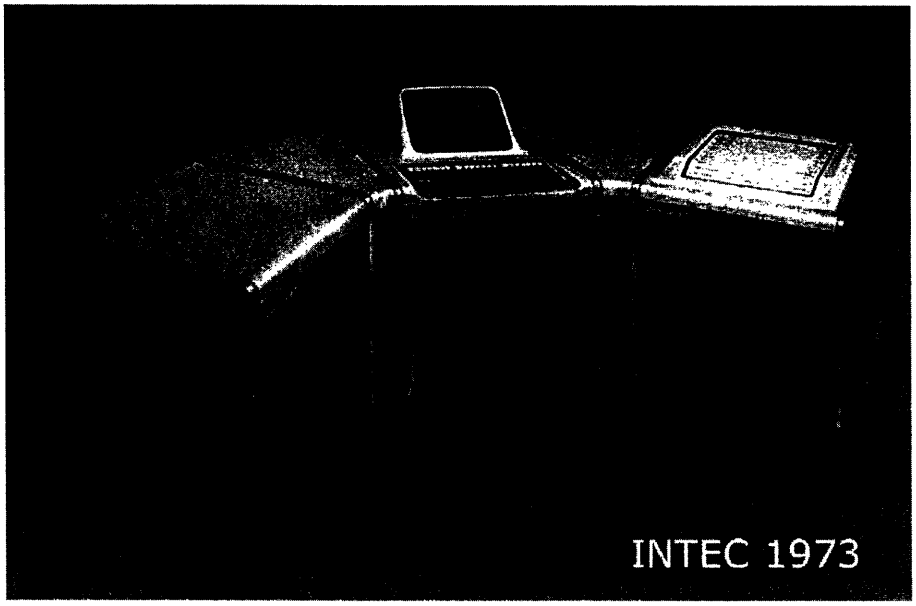

Figure 4.4: Design of a modular computer case created by INTEC industrial designers in 1973. This project never made it past the initial planning stages. (Image used with permission from Rodrigo Walker.)

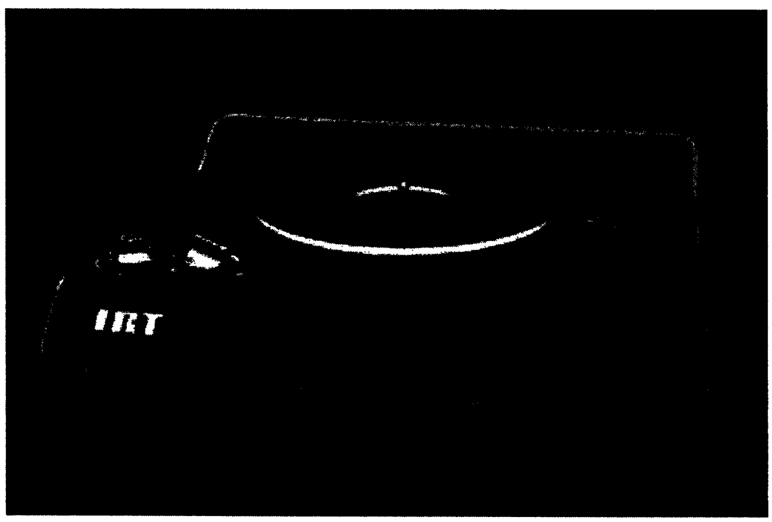

Figure 4.5: A portable record player designed by the INTEC industrial design group and manufactured by IRT. (Image used with permission from Rodrigo Walker.)

Chapter 5

Constructing Cybersyn

ON NOVEMBER 12, 1971 British cybernetician Stafford Beer met with Chilean President Salvador Allende to discuss constructing an unprecedented tool for economic management. For Beer, the meeting was of the utmost importance; the project required the President's support. During the past ten days, Beer and a small Chilean team had worked frantically developing a plan for a new technological system capable of regulating Chile's economic transition in a manner consistent with the socialist principles of Allende's presidency. The project, later referred to as "Cybersyn" in English and "Synco" in Spanish, would network every firm in the expanding nationalized sector of the economy to a central computer in Santiago, enabling the government to grasp the status of production quickly and respond to economic crises in real-time.[1] Although Allende had been briefed on the project ahead of time, Beer was charged with the task of explaining the system to the President and convincing him that the project warranted government support.

[1] "Cybersyn" comes from a synthesis of the two concepts driving the project, "cybernetics" and "synergy." The abbreviation "Synco" conveyed the objective of the project, namely "Sistema de Información y Control." The project name has also appeared erroneously as "Sinco" or "Cinco."

Accompanied only by his translator, a former Chilean Navy officer named Roberto Cañete, Beer walked to the presidential palace in La Moneda while the rest of his team waited anxiously at a hotel bar across the street. "A cynic could declare that I was left to sink or swim," Beer later remarked. "I received this arrangement as one of the greatest gestures of confidence that I ever received; because it was open to me to say anything at all."[2] The meeting went quite well. Once they were sitting face to face (with Cañete in the middle, discretely whispering translations in each man's ear), Beer began to explain his work in "management cybernetics," a field he founded in the early 1950s and cultivated in his subsequent publications.[3] At the heart of Beer's work stood the "viable system model," a five-tier structure based on the human nervous system, which Beer believed existed in all stable organizations—biological, mechanical, and social. Allende, who had trained as a pathologist, immediately grasped the biological inspiration for Beer's cybernetic model and nodded knowingly throughout the explanation. This reaction left quite an impression on the cybernetician. "I explained the whole damned plan and the whole viable system model in one single sitting ...and I've never worked with anybody at the high level who understood a thing I was saying."[4]

Beer acknowledged the difficulties of achieving real-time economic control but emphasized that a system based on a firm understanding of cybernetic principles could accomplish technical feats deemed impossible in the developed world, even with Chile's limited technological resources. Once Allende gained a familiarity with the mechanics of Beer's model, he began to reinforce the political

[2] Stafford Beer, *Brain of the Firm: The Managerial Cybernetics of Organization*, 2nd ed. (New York: J. Wiley, 1981), 257.
[3] Wiener himself christened Beer the "father of management cybernetics."
[4] Stafford Beer, Interview by the author, 15-16 March 2001.

aspects of the project and insisted that the system behave in a "decentralizing, worker-participative, and anti-bureaucratic manner."[5] When Beer finally reached the top level of his systematic hierarchy, the place in the model that Beer had reserved for Allende himself, the president leaned back in his chair and said, "At last, *el pueblo*."[6] With this succinct utterance, Allende reframed the project to reflect his ideological convictions and view of the presidential office, which often equated his political leadership with the rule of the people. By the end of the conversation, Beer had secured Allende's blessing to continue the project.

At face value, a meeting between a British cybernetician and a Chilean president, particularly one as controversial as Allende, seems most unusual. The brief presidency of the Unidad Popular (UP) has arguably inspired more historical scholarship than any other moment in Chilean history, even more so following the recent 30-year anniversary of the military coup. But despite all that has been written about that period, little is known about the Chilean government's experiment with cybernetics and even less is known about its contribution to the UP's experiment in democratic socialism.[7] The nature of the meeting between Beer

[5] Beer, *Brain of the Firm: The Managerial Cybernetics of Organization*, 257.
[6] Ibid., 258. The meeting between Allende and Beer constitutes one of the most popularly printed anecdotes of the Cybersyn project, always constructed from Beer's account. Here I have retold the story drawing from Beer's account in *Brain of the Firm*, an interview with Beer, and an interview with Roberto Cañete, Viña del Mar, Chile, 16 Jan. 2003.
[7] This should not imply that the project has not been documented. Beer published his account of the project in the last five chapters of *Brain of the Firm,* as well as in the last chapter of Stafford Beer, *Platform for Change: A Message from Stafford Beer* (New York: Wiley, 1975). Other references include Armand Mattelart and Héctor Schmucler, *Communication and Information Technologies* (Norwood: Ablex Pub. Corp., 1985), which has devoted several pages of text to the Cybersyn project. Project participants, such as Raúl Espejo, Herman Schwember, and Roberto Cañete have also published their account of Cybersyn in international cybernetics journals. See Roberto Cañete, "The Brain of the Government: An Application of Cybernetic Principles to the Management of a National Industrial Economy" (paper presented at the 22nd Annual North American Meeting Avoiding Social Catastrophes and Maximizing Social Opportunities: The General Systems Challenge, Washington, D.C., 13-15 February 1978); Raul Espejo, "Cybernetic Praxis in Government: The Management of Industry in Chile 1970-1973," *Cybernetics and Systems: An International Journal* 11 (1980); Herman Schwember, "Cybernetics in Government: Experience with New Tools for Management in Chile 1971-1973," in *Concepts and Tools of Computer-Assisted Policy Analysis*,

and Allende suggests that writing technology into one of the most widely studied periods of Latin American history will bring to light an unstudied facet of the Chilean revolution and, in the process, demonstrate the value of this approach. On one hand, documenting the construction of this system provides information about the extent of Chile's technological capabilities during the early 1970s, particularly with respect to computation. More important, however, is that the project provides a window for viewing new tensions within the UP coalition, Chile, and the international community at large. Furthermore, the impressions and aspirations expressed by various project participants reveal an alternative history of the UP era that is grounded in technological optimism and the merging of science and politics in order to bring about social and economic change.

Similarly, the meeting between Beer and Allende suggests that cybernetics, an interdisciplinary science encompassing "the entire field of communication theory, whether in the machine or in the animal," achieved a level of importance in Chile during this period and that Allende's Chilean revolution was open to these cybernetic ideas and their application.[8] However, most discussions of cybernetics to date focus on the evolution of these ideas and their application in the United States and Europe and do not address how they migrated to other parts of the world such as Latin America. The same could be said of the literature dedicated to the history of computing, which has an almost exclusive focus on the United States and Western

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ed. Hartmut Bossel, *Interdisciplinary Systems Research* (Basel, Germany: Birkhäuser, 1977). Discussions of the project have similarly appeared in publications such as *New Scientist, Datamation* and *Data Systems*. R. C. Barquín, "State of Computation in Cuba," *Datamation* 19, no. 12 (1973); Herb Grosch, "Chilean Economic Controls," *New Scientist*, 15 March 1973; Rex Malik, "Chile Steals a March," *Data Systems*, April 1973; Rex Malik, "Inside Allende's Economic Powerhouse," *Data Systems*, May 1973. These, however, are all publications dedicated to science and technology and not to the documentation Chilean history during the Allende period.

[8] Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine*, 2nd ed. (Cambridge: M.I.T. Press, 1965), 11.

Europe. Chilean history provides a clear of example of how alternative geographical and political settings gave rise to new articulations of cybernetic ideas and innovative uses of computer technology, ultimately illustrating the importance of including Latin American experiences in these bodies of scholarship.[9]

From yet another angle, the meeting between Beer and Allende illustrates the importance of both technological soundness and political ideology in Cybersyn's construction. Although the project was technically ambitious, from the outset it could not be characterized as simply a technical endeavor to regulate the economy. Project team members in fact thought that it could help make Allende's socialist revolution a reality—that Cybersyn would constitute "revolutionary computing" in the truest sense—and that it could do so in a way that was ideologically congruent with Allende's politics. Indeed, the tensions surrounding Cybersyn's design and construction mirrored the struggle between centralization and decentralization that plagued Allende's dream of democratic socialism. Throughout Allende's presidency, Chile's political polarization strongly influenced the perception of the project and its role in Chilean society. The interplay of cybernetic ideas, Marxist ideology, and computer technology found in the project illustrates how science and technology contributed to Chilean ideas of governance during the early 1970s and altered the possibilities for socialist transformation.

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[9]Although little attention has been paid to cybernetics in Latin America, scholars have addressed the development of cybernetic ideas in the Soviet Union, most notably Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge: MIT Press, 2002).

Chilean Cybernetics

The origin of cybernetics has been well documented elsewhere.[10] Previous scholarship has shown that cybernetics grew out of a World War II project to create anti-aircraft servomechanisms capable of accurately aiming weapons at the future position of an enemy aircraft. This problem led Norbert Wiener, Julian Bigelow, and Arturo Rosenblueth to develop a theory of predictive feedback control capable of making predictive calculations from an incomplete set of information. Their work later evolved into a theory for self-corrective control that many believed could be applied to both machines and organisms. Attempts to bridge the mechanical and the biological appeared as early as 1943 when Rosenblueth and colleagues wrote that "a uniform behavioristic analysis is applicable to both machines and living organisms, regardless of the complexity of the behavior."[11] This conviction laid the foundation for cybernetics, a new interdisciplinary science that strove to apply concepts from mathematics and engineering—such as statistical modeling, information theory, and the feedback loop—to a myriad of systems, including those outside the mechanical and biological domains.

Humberto Maturana and Francisco Varela provided one of the initial links between Chile and the cybernetics community, although Maturana never identified himself as a cybernetician.[12] Born in Chile in 1928, Maturana studied medicine at

[10] For a more in depth treatment of the origin of cybernetics, refer to Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge: MIT Press, 1996); Steve J. Heims, *The Cybernetics Group* (Cambridge: MIT Press, 1991). An alternative reading of the field's evolution is presented in David A. Mindell, *Between Human and Machine: Feedback, Control, and Computing Before Cybernetics* (Baltimore: Johns Hopkins University Press, 2002). It is also worth noting that the British cybernetics community, of which Beer was a part, placed a greater emphasis on applying their cybernetic ideas outside of the laboratory than did their American counterparts. Andrew Pickering, "Cybernetics and the Mangle: Ashby, Beer, and Pask," *Social Studies of Science* 32, no. 3 (2002).

[11] Arturo Rosenbluth, Norbert Wiener, and Julian Bigelow, "Behavior, Purpose, and Teleology," *Philosophy of Science* 10 (1943).

[12] Humberto Maturana, Interview by the author, 8 September 2003.

the University of Chile and later pursued his graduate studies in the Biology Department of Harvard University. In 1959, he co-authored the important paper "What the Frog's Eye Tells the Frog's Brain" with Warren McCulloch, Jerome Lettvin, and Walter Pitts, all of whom were important figures in the growing field of cybernetics.[13] After Maturana completed his doctoral degree, he returned to Chile and assumed a position in the biology department of the University of Chile, the most respected public university in the country. Here, he continued his work on the optic nerve, but more broadly he was trying to uncover the organizational structure of living organisms. Varela began his studies under Maturana's tutelage at the University of Chile and followed his mentor's footsteps to the doctoral program in biology at Harvard University. Like Maturana, Varela accepted a faculty position at the University of Chile upon his return to Santiago. The title of their first co-authored book, *De Maquinas y Seres Vivos* (On Machines and Living Beings), illustrates the continued presence of cybernetic ideas in their biological studies.[14] Here, the authors presented their groundbreaking theory of self-organizing systems, known as *autopoeisis*.

However, neither Maturana's nor Varela's contribution to Chilean cybernetics during the 1960s and early 1970s extended beyond the laboratory. On occasion, Maturana would later advise Beer on the theoretical aspects of the system—the men had traveled in the same circles and Beer knew of Maturana before Allende came to power. Maturana and Varela later delivered several lectures

[13] J. Y. Lettvin, H. R. Maturana, and W. S. McCulloch, "What the Frog's Eye Tells the Frog's Brain," *Proceedings of the Institute of Radio Engineers* 47, no. 11 (1959).
[14] Humberto R. Maturana and Francisco J. Varela, *De máquinas y seres vivos: una caracterización de la organización biológica* (Santiago de Chile: Editorial Universitaria, 1973). This book was later translated into English as Humberto R. Maturana and Francisco J. Varela, *Autopoiesis and Cognition: The Realization of the Living* (Boston: D. Reidel Pub. Co., 1980) with an introduction written by Stafford Beer.

to the core members of the Cybersyn team, but they always did so in an unofficial capacity.[15] Although these biologists provided one of the first bridges between Chile and the international cybernetics community, they did not contribute to the Chilean government's familiarity and acceptance of cybernetics during Allende's presidency. Beer himself would unwittingly provide this connection.

The scope of this chapter does not permit a full biography of Beer, but a brief sketch will enable the reader to appreciate the unorthodox nature of his character in both business and cybernetic circles. Unlike many of his contemporaries in the cybernetics community, Beer never received a formal degree; his undergraduate studies in philosophy were cut short by military service in the British army during World War II. Following the war, Beer entered the steel industry and ascended rapidly to the management level. In 1950, a friend serendipitously handed Beer a copy of Norbert Wiener's groundbreaking publication, *Cybernetics.* Reading the book changed Beer's life and spurred him to write an enthusiastic letter to the famous MIT mathematician detailing his application of cybernetic principles to the steel industry. Wiener, who was unfamiliar with the business world and intrigued by this new application of his work, invited Beer to visit him at MIT. Beer eventually became an informal student of MIT biologist Warren McCulloch's and a friend to Wiener and Heinz Von Foerster, an electrical engineer at the University of Illinois. An independent thinker, Beer once gave a paper entitled "The Irrelevance of Automation" at an international automation conference, an occasion that reportedly convinced Von Foerster that the British did indeed possess a sense of humor.[16] In line with his beliefs as an "old-fashioned leftist," Beer tried using his understanding

[15] Beer, interview.
[16] Ibid.

of cybernetic principles to bring about social change, as evidenced by a series of lectures he gave between 1969 and 1973 that he later published as *Platform for Change*.[17] Known for his long beard, the ever-present drink in his hand, and his habit of smoking 30 cigars a day, Beer cultivated an image that, in one journalist's words, resembled a "cross between Orson Welles and Socrates."[18]

After serving for a number of years as the director of cybernetics and operations research at United Steel, the largest steel company in the United Kingdom, Beer left to run Science in General Management (SIGMA), a French-owned consulting company that applied operations research techniques to business problems. Beer recalled that he was trying to use operations research "to change industry and government in the same way that the army, navy, and air force had been changed [during World War II] by making mathematical models."[19] This was quite an ambitious goal, considering the numerous contributions that operations research techniques had made to the Allied antiaircraft and German U-boat efforts during the war.[20]

SIGMA's reputation grew, and gradually the company began attracting an international clientele. In 1962, the director of Chile's steel industry requested SIGMA's services. Beer refused to go himself—he had never been to South America, and his hectic schedule made the lengthy transit time seem unreasonable—but he put together a team of English and Spanish employees to travel to Chile in his place. SIGMA's work in the steel industry gradually expanded to include the railways. Due

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[17] Beer, *Platform for Change: A Message from Stafford Beer* and Beer, interview.
[18] Michael Becket, "Beer: The Hope of Chile," *The Daily Telegraph*, 10 August 1973.
[19] Beer, interview.
[20] See for example Agatha C. Hughes and Thomas Parke Hughes, *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After*, ed. Agatha C. Hughes and Thomas P. Hughes (Cambridge: MIT Press, 2000).

to the large amount of work, the Chilean SIGMA team often hired students to pick up the slack. Among them was Fernando Flores, a young Chilean who studied industrial engineering at the Catholic University in Santiago.

A workaholic by nature, Flores devoted himself to mastering the principles of cybernetics and operations research practiced at SIGMA and became intimately familiar with Beer's work after reading his books, *Decision and Control* and, later, *Cybernetics and Management.*[21] Flores's knowledge of operations research led to a teaching position at the Catholic University in Santiago and by his twenty-seventh birthday he had become the acting dean of the Department of Engineering Science. Like many of his contemporaries, Flores was active in both academic and political circles. In 1969, a group of young intellectuals at the Catholic University, which included Flores, broke from the Christian Democratic Party and established the Movement of Popular Unitary Action (MAPU), a political party of young intellectuals who were critical of the Christian Democrats and aligned with the Communists and Socialists of the UP coalition. MAPU's joining with the UP, combined with the inability of the right and the Christian Democrats to form a winning coalition, resulted in Allende's narrow victory in the 1970 presidential election. As an acknowledgement of Flores's political loyalty and technical competency, the Allende government appointed the then twenty-eight-year-old professor to serve as general technical manager of the Corporación de Fomento de la Producción (CORFO), the state development agency that Allende had charged with

[21] Stafford Beer, *Cybernetics and Management*, 2nd ed. (London: English Universities P., 1967); Stafford Beer, *Decision and Control: The Meaning of Operational Research and Management Cybernetics* (New York: Wiley, 1966). While at the Catholic University, Flores studied Operations Research with Arnoldo Hax, a professor who left the university shortly thereafter to teach management at the MIT Sloan School. Flores maintained his connection with Hax and through this channel learned of other research within the United States and Great Britain pertaining to management science and operations research. Flores, interview.

nationalizing Chilean industry. It was the third highest position within CORFO, the highest position within the state development agency held by a member of the MAPU, and the management position most directly linked to the daily regulation of the nationalized factories.[22]

Nationalizing the Economy

Allende believed that the nationalization of major industries deserved the utmost priority and later referred to the task as "the first step toward the making of structural changes."[23] The nationalization effort would not only restore foreign-owned and privately owned industries to the Chilean people, it would, he said, "abolish the pillars propping up that minority that has always condemned our country to underdevelopment"—a reference to the industrial monopolies controlled by a handful of Chilean families.[24] The majority of the UP coalition believed that by changing Chile's economic base, they would subsequently be able to bring about institutional and ideological change within the boundaries of Chile's preexisting legal framework, a facet that set Chile's path to socialism apart from that of other socialist nations.[25]

After Allende's inauguration in November 1970, the government used the first few months to implement policies grounded in structuralist economics and Keynesian "pump priming," whereby economic growth would be achieved through

[22] Fernando Flores, Interview by author, 30 July 2003; Oscar Guillermo Garretón, Interview by the author, 4 August 2003.
[23] Régis Debray and Salvador Allende Gossens, *The Chilean Revolution: Conversations with Allende*, 1st American ed. (New York: Pantheon Books, 1972).
[24] Salvador Allende, 'The Purpose of Our Victory: Inaugural address in the National Stadium, 5 November 1970', in Salvador Allende Gossens, *Chile's Road to Socialism*, ed. Joan E. Garces, trans. J. Darling (Baltimore: Penguin Books, 1973), 59.
[25] Sergio Bitar, *Chile: Experiment in Democracy*, trans. Sam Sherman, vol. 6, *Inter-American Politics Series* (Philadelphia: Institute for the Study of Human Issues, 1986)

increased purchasing power and higher employment rates in order to pull the Chilean economy out of the recession that the Allende administration had inherited. Land reform programs and the inception of government-sponsored assistance to rural workers augmented the purchasing power of individuals in the impoverished agrarian sector, while workers in Chilean factories enjoyed a 30% average increase in real wages during Allende's first year in office.[26] Initially, these initiatives to redistribute income succeeded in creating a growing segment of the population with money to spend, stimulating the economy, increasing demand, raising production, and expanding the popular base of support for the UP coalition. In the government's first year, the GDP grew by 7.7%, production increased by 13.7%, and consumption levels rose by 11.6%.[27] These economic policies, however, would soon come to haunt the UP government in the form of inflation and massive consumer shortages.

On the production front, the government wasted no time expanding the existing nationalized sector and pushed it to a new level. By the end of 1971, the government had transferred all major mining firms and sixty-eight other private companies from the private to the public sector.[28] The rapid pace of the government's nationalization program, coupled with its lack of a clear, consistent structure and delimitation, exacerbated the fears and insecurities expressed by owners of small- and medium-size Chilean businesses. Promises of social change, moreover, helped provoke a revolution from below: workers sometimes seized control of their factories against the explicit wishes of their *compañero presidente*. Less than

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[26] Peter Winn, *Weavers of Revolution: The Yarur Workers and Chile's Road to Socialism* (New York: Oxford University Press, 1986), 142.
[27] Bitar, *Chile: Experiment in Democracy*, 52.
[28] Ibid., 45.

one quarter of the firms expropriated during Allende's first year had been on the government's list for incorporation into the public sector.[29]

Foreign investors in Chilean copper mines and telecommunications companies (for example, ITT) further complicated the situation by insisting that they be fully compensated for the businesses that the government proposed to nationalize.[30] In July 1971, the alienated Christian Democrats accused the government of abusing legal loopholes to acquire desirable industries and proposed an amendment that would require congressional approval for all acts of appropriation. The Christian Democrats claimed that the government had invoked a law written during the Great Depression to prevent layoffs and plant closings as a means of nationalizing factories once workers aligned with the Left had gone on strike and interrupted production. They proposed an amendment that would curb the pace of nationalization by requiring Congress to pass a law authorizing every new factory acquisition, a legislative maneuver that considerably weakened Allende's executive power.

Moreover, the rapid growth of the nationalized sector quickly created an unwieldy monster. The increasing number of industries under state control and the number of employees within each industry presented the government with the difficult task of managing a sector of the economy that became harder to monitor with each passing day. In accordance with a decree passed in 1932, the government sent "interventors" to replace previous management and govern activities within

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[29] Winn, *Weavers of Revolution: The Yarur Workers and Chile's Road to Socialism*, 228.
[30] Nathaniel Davis, *The Last Two Years of Salvador Allende* (Ithaca: Cornell University Press, 1985), 23-6, 67-71.

these newly nationalized industries.[31] These representatives, however, often created new problems. Although many were competent and dedicated to their jobs, others were severely unqualified for the positions, and some were corrupt. The problem of effectively managing the new "social property area" (APS) was exacerbated by the decision to distribute appointments equally among the political parties, regardless of the level of competency found in their respective talent pools. Even parties within the UP coalition criticized Allende's choice of the interventors. For example, members of the Communist Party argued that some interventors merely served as replacements for the managers who had preceded them, occupying similar houses and driving similar cars.[32] From the Communists' perspective, not only did these representatives fail to provide an adequate means of bringing production under the control of the people, but they also helped veil the social reality of a continuing status quo. Daily operations within the factories suffered further from the political strife caused by interventors who saw themselves as representatives of their party. At times, workers in some enterprises refused to listen to managers hailing from political parties different than their own; this in turn necessitated a frustrating process of party meetings and negotiations.[33]

As the bliss of the honeymoon period began to fade, the long-term instability of Allende's approach became apparent. Politically motivated reforms, such as the income redistribution championed by the UP, emphasized long-term structural transformation over short-term economic management. Consumption started to

[31] Allende's administration used the word "interventor" to refer to the politically appointed officials who replaced the previous factory managers and literally intervened in factory production practices by bringing each newly nationalized factory under the control of state.
[32] Arturo Valenzuela, *The Breakdown of Democratic Regimes: Chile* (Baltimore: Johns Hopkins University Press, 1978), 66.
[33] Ibid., 62.

outstrip production, inflation began to skyrocket, and the government's deficit spending continued to grow, all of which were exacerbated by shrinking foreign reserves and the denial of foreign credits. By July 1971, inflation had climbed by 45.9% and would continue to rise to unprecedented levels throughout Allende's presidency.[34] From a production standpoint, the UP program of industrial expansion through massive hiring initially helped factories increase their output and attain full productive capacity, but once they reached that capacity, the number of employees began to exceed the amount of work available, and productivity began to fall. Although the symptoms of Chile's economic crisis assumed many forms, many of which were already apparent during Allende's first year in office, Valenzuela's retrospective observation that the "economic crisis during the Allende period clearly became the government's chief unsolvable problem" succinctly characterizes the magnitude of Chile's economic decline.[35]

However, at the time the government viewed the economic situation as far from unsolvable. On July 13, 1971, Beer received a letter from Flores stating that he was familiar with Beer's work and was "now in a position from which it is possible to implement on a national scale—at which cybernetic thinking becomes a necessity—scientific views on management and organization."[36] He asked for Beer's advice about applying cybernetic principles to the management of the nationalized sector. Beer's response was enthusiastic:

> I simply must ask you whether I could play some part, although I do not know what to suggest... . Believe me, I would surrender any of my retainer

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[34] Ibid., 55.
[35] Ibid., 61.
[36] Letter from Fernando Flores to Stafford Beer, 13 July 1971, box 55, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.

> contracts I now have for the chance of working on this. That is because I believe your country is really going to do it.[37]

One month later, Flores flew to England to meet with the man whose work he had studied during his years working for SIGMA. The two met at Beer's club in London, the Athenaeum, a gentlemen's club for the British intelligentsia. Flores did not speak much English, and Beer did not speak any Spanish, but the two men managed to communicate in a mixture of French, English, and Latin. Flores informed Beer that he had assembled a small government team and asked the cybernetician to travel to Chile and direct their efforts to apply cybernetic principles to the nationalization effort. In November 1971, Beer arrived in Santiago.

Constructing Cybersyn

Beer landed in Chile on the same day that Allende celebrated the one-year anniversary of his election. Before a packed audience at the National Stadium, the president informed the crowd that now "more than ever one has to be aware of what Chilean life is and of the path that is authentically ours, which is the path of pluralism, democracy, and freedom, the path that opens the doors of socialism."[38] It was a speech of celebration, promise, and national pride that electrified the nation. Shortly thereafter, the minister of finance announced that Chilean expenses had topped $100 million, far exceeding the predicted $67 million inflow for the year.[39] "When Stafford [Beer] came, it was around the time that Fidel Castro came," Flores recalled, referring to Castro's extended visit to Chile that began on November 10,

[37] Letter from Stafford Beer to Fernando Flores, 29 July 1971, box 55, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.
[38] Salvador Allende, "First Anniversary of the Popular Government, National Stadium, Santiago, November 4, 1971," James D. Cockcroft, ed., *Salvador Allende Reader* (Hoboken, N.J.: Ocean Press, 2000), 123-4.
[39] Bitar, *Chile: Experiment in Democracy*, 65.

1971, and lasted for twenty-five days. "Most of the Chilean guys were [going] to see Fidel Castro," Flores laughed, "I [went] to see Stafford Beer. It was kind of a joke. But that was good because it gave me a lot of time."[40]

Flores's handpicked Chilean team included representatives from various academic disciplines, which set the tone for the interdisciplinary work that the effort would require and reflected the trend toward cross-disciplinary collaboration that characterized the research being conducted in other areas.[41] During his ten-day visit, Beer met various influential people in the Chilean government, including Pedro Vuskovic, the minister of economics, and Allende himself. Meanwhile, each member of Flores's team read the manuscript version of Beer's book *Brain of the Firm* and made the language of Beer's management cybernetics their lingua franca.[42] The book outlined the "viable system model," a system that Beer believed could describe the stability found in biological, mechanical, social, and political organizations. Cybersyn's design cannot be understood without a basic grasp of this model, which played a pivotal role in merging the politics of the Allende government with the design of this technological system.

Although the viable system model first appeared in *Brain of the Firm* (1972), it still stands as one of the guiding concepts behind Beer's work.[43] It is defined as "a system that survives. It coheres; it is integral ...but it has none the less mechanisms and opportunities to grow and learn, to evolve and to adapt."[44] The value of the

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[40] Flores, interview.
[41] Cañete, "The Brain of the Government: An Application of Cybernetic Principles to the Management of a National Industrial Economy"
[42] Beer, *Brain of the Firm: The Managerial Cybernetics of Organization*, 249.
[43] "Ten pints of Beer: The rationale of Stafford Beer's cybernetic books (1959-94)," *Kybernetes* 29, no. 5/6 (2000): 558-69.
[44] Beer, *Brain of the Firm: The Managerial Cybernetics of Organization*, 239. This statement illustrates a reoccurring characteristic of Beer's work, namely the synthesis of metaphors drawn from biology and engineering characteristic of work in the field of cybernetics.

system "variables" (inputs) determined the system's resultant "state"; Beer referred to the number of possible states as the system's "variety," a direct reference to Ross Ashby's important "Law of Requisite Variety."[45] A system able to maintain all critical variables within the limits of systemic equilibrium achieves "homeostasis," a quality desired by all viable systems. From these principles, Beer constructed a five-tier model for viable systems that he based on the human neurosystem. Despite the model's biological origins, Beer maintained that the abstraction of the structure could be applied in numerous contexts, including the firm, the body, and the state.

In its most basic form, the viable system model resembles a simple flowchart connecting the five levels of the system's hierarchy. In his writings, however, Beer switches freely among metaphors drawn from machines, organizations, and organisms when describing the purpose and functionality of each level. I will explain the viable system model here only as it applies to the Chilean industrial sector, focusing specifically on the five-tier cybernetic mapping of a general Chilean enterprise within the newly formed social property area, shown in figure 5.1. It is perhaps easiest to understand the model at this level, though bear in mind that the Cybersyn prototype operated initially within CORFO's management structure, a higher level of recursion than the model of the individual enterprise presented here. Although Beer hoped one day to restructure enterprise management to reflect this model, the hypothetical chain of command presented here does not reflect the documented management practices of the nationalized enterprises.

The model drew a distinction between the bottom three levels of the hierarchy, which governed daily operations (systems 1, 2, and 3) and the upper two

[45] This law holds that the variety in the control system must match the variety in the system to be controlled. See W. Ross Ashby, *Introduction to Cybernetics* (London: Chapman and Hall, 1956).

levels of management (systems 4 and 5), which determined future development and the overall direction of the enterprise. At the bottom of the hierarchy, individual plants within each enterprise interacted with the outside environment (represented by the cloud-like figures on the left hand side of the drawing) and through these flows of material inputs and outputs generated low-level, system 1 production indices. Factors such as energy needed, raw materials used, or even employee attendance could constitute such an index. Each plant behaved in an "essentially autonomous" manner, restricted only by the operational bounds needed to ensure the stability of the entire enterprise. System 2, which Beer equated with a cybernetic spinal cord, transmitted these production indices to the various plants and upward toward the director of operations (system 3). By assuming responsibility for the normal functioning of the plants within the enterprise, these lower three levels prevented upper management from being overwhelmed with the details of daily production activity. However, in the case of a serious production anomaly, one that could threaten the stability of the enterprise and that after a given period of time could not be resolved by the director of operations, or system 3, the next level of management was alerted and asked to provide assistance.

Systems 4 and 5 intervened in production only under these circumstances. Unlike the other levels of management outlined in Beer's hierarchy, system 4 required the creation of a new level of management dedicated to development and planning that would provide a space for discussion and decision making. This level did not exist within the vast majority of Chilean state enterprises or, as Beer noted, in the management configuration of most firms in operation during the 1970s. In the drawing it appears as the Subdirectorate for Development. System 4 also provided the vital link between volitional and automatic control or, in the case of industrial management, between centralized or decentralized regulation. Under normal circumstances, it allowed the lower levels to behave autonomously but could trigger intervention from upper management if necessary. Securing this balance between individual freedom and centralized control proved vital when attempting to align the Cybersyn project with the political ideals promoted by the UP coalition, a theme discussed at greater length in chapter 6. The final level of the model, system 5, occupied the "chief executive" position held by the appointed interventor, who determined the overall direction of the enterprise and the requisite levels of production.

In Beer's mind, this five-tier system not only provided the characteristic skeleton for all viable systems; it also existed recursively in each of the five levels. Beer writes: "The whole is always encapsulated in each part ...this is a lesson learned from biology where we find the genetic blue-print of the whole organism in every cell."[46] The state, the firm, the worker, and the cell all exhibited the same series of structural relationships. Applying his organizational vision to Chile, Beer wrote, "Recursively speaking, the Chilean nation is embedded in the world of nations, and the government is embedded in the nation ...all these are supposedly viable systems."[47] This characteristic allowed the team to design a system of management that theoretically could function anywhere, from the factory floor to the presidential palace.

Once armed with Beer's model for cybernetic control and convinced of its utility to Chile's economic transition, the project team examined its available resources. By 1968, three U.S. companies—NCR, Burroughs, and IBM—had

[46] Beer, *Brain of the Firm: The Managerial Cybernetics of Organization*, 156.
[47] Ibid., 249.

installed fewer than fifty computers in all of Chile; the largest was an IBM 360 mainframe.[48] According to the trade publication *Datamation*, Chile owned fewer computers than Brazil, Argentina, Colombia, and Venezuela.[49] The previous Christian Democratic government had encouraged U.S. investment and business with U.S. companies, but high import duties, combined with the already high price tag, made computer technology a less attractive option to Chilean industries than it was to those within the United States. Moreover, the National Enterprise for Computers and Informatics (ECOM), a centralized government agency established in the 1960s to oversee the purchase of Chilean computing technology and offer data-processing services on state-owned mainframes, tried to maintain its monopoly on computing machines by frequently denying requests from universities and private firms wished to acquire additional computing resources.[50] The government owned few mainframe computers and could allocate time on only one machine to the Cybersyn project.[51] The project leaders originally secured time on the top-performing IBM 360/50 but later transferred the project to the less heavily used Burroughs B-3500 mainframe when processing delays on the 360/50 exceeded forty-eight hours.[52] Because of the shortage of qualified personnel, ECOM agreed to assign several of its employees to assist with the project, including Isaquino Benadof, Juan Bulnes, Ricardo Majluf, Juan Francisco Letelier, and Hernan Avilés.

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[48] Aaron Finerman, "Computing Capabilities in Argentine and Chilean Universities," *Communications of the ACM* 12, no. 8 (1969): 427.
[49] Barry W. Boehm, "Computing in South America," *Datamation* 16, no. 5 (1970): 98.
[50] Raimundo Beca, Interview with the author, 9 September 2003.
[51] ECOM owned three IBM mainframes (two 360/40 models and one 360/50) and one Burroughs 3500 mainframe. Notes on available ECOM computing resources, 11 Nov. 1971, box 55, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.
[52] A forty-eight hour processing delay on the IBM machine prohibited real-time analysis and caused much frustration among the Cybersyn team members.

In addition to securing computing hardware and computer-literate personnel, the team needed a means to enable communication across factories, state enterprises, sector committees, CORFO management, and the central mainframe housed in CORFO headquarters. Eventually, team members settled on an existing telex network that once had been used to track satellites. Unlike the heterogeneous networked computer systems in use today, telex networks mandate the use of special terminals and can transmit only ASCII characters. However, like the Internet of today, this early network of telex machines was driven by the idea of creating a high-speed web of information exchange. The telex network would later prove more valuable to the government than the processing might of the mainframe, reaffirming a belief shared by both Flores and Beer that "data is wasted without action."[53]

Forming a Team

In the initial stages of the project, Flores assembled a small interdisciplinary project team that included members from several different government agencies, mostly friends of his. "It was very informal at the beginning," Flores noted, "like most things are. You look for support in your friends."[54] The team met at INTEC headquarters, where Flores, as institute president, had the power to allocate the resources needed for the project and to recruit expertise, such as that of industrial designer Gui Bonsiepe. Given his position as the general technical manager of CORFO, one of the biggest government agencies at the time, Flores also controlled a wealth of resources outside of INTEC. Operating through CORFO, Flores was able to put together the funding needed to pay Beer's exorbitant fee of $500 a day as well

[53] Flores, interview.
[54] Flores, interview.

as secure the other material and personnel expenses that the project demanded. Moreover, the CORFO connection gave Flores the power to recruit individuals who possessed expertise not found in his network of friendships. Crediting his leadership abilities, Flores boasted, "I didn't need to convince people. I had a lot of power or so to do it ...given the amount of resources I managed in all aspects of the economy. We [CORFO] were so immense compared with [the Cybersyn Project] ... it was a very small amount of resources compared with who we were and what were the stakes."[55] Several of his coworkers offered complementary explanations, describing Flores a "smooth operator" and a "wheeler dealer."

When Beer returned for his second visit in March 1972, the team had grown to include representatives from CORFO, INTEC, and ECOM, as well as representatives from other agencies such a CODELCO, the national copper corporation, and ENAP, the national petroleum enterprise. The different affiliations of the project team members broadened the group's range of expertise and gave it access to the informal networks within each agency. This strategic move proved invaluable for Flores and provided a non-technological approach to real-time communication. Flores explained, "[if] we have a crisis, I have people from the different places right there and they go to their own networks."[56] Principal members of the Cybersyn team included, among others, Raúl Espejo and Sonia Mordojovich from CORFO, José Valenzuela, Jorge Barrientos, Tomás Kohn, Humberto Gabella, Eugenio Balmeceda, Ernesto Valdívia, Gui Bonsiepe, and Rodrigo Walker from INTEC, Herman Schwember from CODELCO, Roberto Cañete as the project

[55] Flores, interview.
[56] Flores, interview.

translator, and the aforementioned members from ECOM.[57] In addition to bringing to the team a particular area of technological expertise, each could communicate in English with a reasonable degree of proficiency. Several participants credited Flores and Beer for creating a productive, interdisciplinary climate. Sonia Mordojovich, the only woman assigned to the project, described the working culture as "a space of creativity ... everyone had a wide range of freedom."[58] Benadof also pointed to the unique working environment, where "the glue [was] relationships, not technical skill."[59]

For many of the early members of the team, the Cybersyn project represented much more than making a technological system. It was an intellectual experience. Beer distributed copies of the inspirational books *Jonathan Livington Seagull* by Richard Bach and *Journey to Ixtlan* by Carlos Castaneda to all the Chileans working with him. "I was appalled by all these technies not knowing any larger things," Beer said. "I tried to advise them. They were amazed."[60] At one point Beer selected quotes from both books that were appropriate for every team member, copied them onto seagull cutouts, and distributed them. "It was the idea that everybody tried to share a vision of what we were doing," Benadof remarked. "We [are] like a team because we fly together."[61] During 1971 and 1972, the team also met for a series of seminars conducted by such scientific luminaries as Maturana, Varela, and Von Foerester. The topics discussed had no immediate application to the project, but they allowed the team members to deepen their understandings of cybernetics and

[57] Herman Schwember did not formally join the team until October 1972, but has participated informally from the outset.
[58] Sonia Mordojovich, Interview by the author, 16 July 2002.
[59] Isaquino Benadof, Interview by the author, 10 April 2002.
[60] Beer, interview.
[61] Benadof, interview.

biology and provided a source for additional intellectual stimulation. The team was small and at this point relatively unknown to the Chilean government, but its members felt as if they were part of something special.

During the course of the project, Beer and Flores cultivated a "unique friendship" grounded in mutual respect, a shared intellectual curiosity, and a common goal. "A level of sympathy was developed," Flores recalled. "I was a national leader, he was an international leader, and also we were of a different age."[62] While Beer imparted knowledge of cybernetics, Flores sought to educate Beer on Chilean politics, language, and South American culture. At Flores's insistence, Beer read Gabriel García Marquez's masterpiece, *One Hundred Years of Solitude,* and used it as a text for understanding the magic realism of South American life. Beer thereafter referred to Flores as "Aureliano," the name of Marquez's frustrated revolutionary who survived fourteen attempts on his life, seventy-three ambushes, and a firing squad. Flores responded in kind by calling Beer "Melaquíades," the name of Marquez's gypsy who brought news of scientific and technological innovations from the outside world to the tiny town Colombian town of Macondo.

Working together against the clock, the team designed a feasible schematic for the entire system with a finish date optimistically set for October 1972.[63] The design consisted of four subprojects: Cybernet, Cyberstride, Checo, and Opsroom. Work on each of would span 1971-73, a period in which Beer would make eleven trips to Chile, for approximately two weeks each time.[64] When Beer returned to Chile for the second time in March 1972, the team first applied the name "Cybersyn" to describe the entire scope of the system. A synthesis of "cybernetics" and "synergy,"

[62] Flores, interview.
[63] Beer titled one of the earlier project schedules, "Project Cybersyn, Programme Beat-the Clock."
[64] Beer, interview.

the project name firmly illustrated the team's belief that the whole system exceeded the sum of its parts, an observation that applied equally to the technological system being built and to the group of individuals charged with its construction.

Cybernet

The first component of the system, Cybernet, expanded the existing telex network to include every firm in the nationalized sector and allowed them to communicate with the mainframe computer, thereby helping to create a national network of communication throughout Chile's three-thousand- mile-long territory. Preexisting microwave links connected the northern city of Arica to the southern city of Puerto Montt, and with additional radio links, the network extended to Chile's southernmost city, Punto Arenas. Production information traveled from the factories to a telex control room at CORFO headquarters, where Benadof and other ECOM employees transferred the data onto punch cards and fed them into the mainframe computer for processing. Stafford Beer's early reports describe the system as a tool for real-time economic control, but in actuality each firm could transmit data only once a day.[65] This centralized design may appear to run counter to the UP commitment to individual freedom, but it coincides with Allende's statement that "we are and always shall be in favor of a centralized economy, and companies will have to conform to the Government's planning."[66]

Work on the network began in November 1971 under the leadership of Roberto Cañete, and, because a good number of Chilean factories already possessed telex capabilities, Cybernet became operational in March 1972 and continued to

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[65] Processing time lags of 2-3 days eventually forced the team to switch the project from the more powerful IBM 340/50 mainframe to a Burroughs mainframe. However, reminding factory managers to send data on a daily basis to the mainframe proved to be an even greater source of frustration. Benadof, interview.
[66] Debray and Allende Gossens, *The Chilean Revolution: Conversations with Allende*, 111.

grow. Cañete occasionally used the promise of free telex installation to convince factory managers to lend their support to the project, a ploy that made the project attractive even to managers of private sector firms.[67] Of the four subprojects comprising the Cybersyn Project, Cybernet was by far the most valuable to the government. In October 1972, the government constructed a telex control room within the presidential palace La Moneda and used the network to coordinate efforts to counter the forty thousand striking truck drivers who tried to bring an early end to Allende's presidency during the Paro de Octubre (October strike).

Cyberstride

Cyberstride, the second component of the Cybersyn system, encompassed the suite of computer programs written to collect, process, and distribute data to and from each state enterprise. Members of the Cyberstride team created "quantitative flow charts of activities within each enterprise that would highlight all important activities," including a parameter for "social unease" that was measured by the proportion of employees present on a given day of work in comparison to the number of employees on the factory payroll.[68] Cyberstride performed statistical filtration on the "pure numbers" output from the factory models, discarding the data that fell within the acceptable system parameters and directing the information deemed important upward to the next level of management. Equally important, the software used statistical methods to detect production trends based on historical data, theoretically allowing CORFO to prevent problems before they began. If a particular variable fell outside the range specified by Cyberstride, the system emitted a

[67] Roberto Cañete, Interview by the author, 16 January 2003. Cañete also noted that he received several inquiries from private factory owners of who wished to join the Cybersyn project in return for free access to telex technology.

[68] Beer, *Brain of the Firm: The Managerial Cybernetics of Organization*, 253.

warning, known as an “algedonic signal” in Beer’s cybernetic vocabulary. Initially, only the interventor from the affected enterprise would receive the algedonic warning and would have the freedom, within a given time frame, to deal with the problem as he saw fit. However, if the enterprise failed to correct the irregularity within this time frame, members of the Cyberstride team would alert the next level of management, the CORFO sector committee (e.g., Comitè Textil). Beer argued that this system of operation granted Chilean enterprises almost complete control over their operations while still permitting outside intervention in the case of more serious problems. He further believed that this ideal balance between centralized and decentralized control could be optimized if project engineers selected the correct period of recovery given to each enterprise before Cyberstride alerted higher management, ensuring maximum autonomy within the overall viable system.

Once complete, Cyberstride functioned as a predictive tool for mapping the future behavior of Chilean industries. The programmed algorithm used Bayesian probability theory to anticipate industrial performance in the short term. It analyzed the values of the indices collected from the factories, searching for outliers and identifying trends. This allowed members of the government to identify and correct problems before they became serious.[69] The suite also generated unitless measurements for “productivity,” “latency,” and “performance.” These enabled the untrained eye to grasp the state of factory activity without understanding the nuances of production.

Cyberstride represented a joint effort between a team of Chilean engineers headed by Isaquino Benadof, one of Chile’s leading computer experts and the head of

[69] P.J. Harrison and C.R. Stevens, "A Bayesian Approach to Short-Term Forecasting," *Operational Research Quarterly* 22, no. 4 (1971).

research and development at ECOM, and a team of British consultants at Arthur Andersen in London. The British team, led by Alan Dunsmuir, designed and coded a temporary suite of programs, which they gave to the Chilean team in March 1972 for final revisions. Meanwhile, Chilean operations research scientists and engineers from CORFO and INTEC visited plants throughout the country, met with workers and managers, selected approximately five critical variables of production, created flowchart models of factory operation, and translated these models into computer code that was read into the mainframe with punch cards. The scientists and engineers also determined the optimal amount of recovery time allotted to each firm before allowing an algedonic signal to percolate up the system hierarchy, a process that Beer referred to as "designing freedom."[70]

Generally speaking, the engineers from ECOM and Arthur Andersen worked well together, although the Andersen team did object to the lack of experience of several members of the Chilean team and the failure of the Chilean programmers to document what they were doing.[71] "What existed in ECOM was very poor," Benadof confirmed. "The Chilean way [was] go ahead [with] trial and error, trial and error. They gave us discipline, procedure, and documentation standard[s]. Very good work, I learned to work with them." When pressed to explain, Benadof described Dunsmuir, the Andersen team leader, as "a good guy, but too British ...a guy who needs his distance, he needs his work, just work."[72] The British habit of separating business from pleasure contrasted sharply with Chilean business practices that regularly interlaced one with the other.

[70] Stafford Beer, *Designing Freedom* (New York: Wiley, 1974).
[71] G.E. Hemmings, "Memorandum on status of the Cyberstride Suite," May 12, 1972, box 59, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.
[72] Benadof, interview.

Despite these stylistic differences, the collaboration between Arthur Andersen and members of ECOM and INTEC represented an important moment in the history of Chilean computing. Chilean engineers during the 1960s and early 1970s had little experience with computer programming. Computer science did not exist as a formal course of study in the Chilean universities, and the government had begun training computer programmers and systems analysts only in 1969.[73] Dunsmuir's team introduced such practices as the need to create thorough documentation for software programs, systematic methods for debugging and version control, the need to sequentially number punch cards, and how to make a library of programs. The Andersen team also imparted concepts such as quality assurance and stressed the need for discipline in a nascent field that still lacked structure in Chile.

The success of Cyberstride hinged on the work of the ECOM and Arthur Andersen engineers, as well as the creation of factory production models. Engineers from CORFO and INTEC visited factories within the social and mixed property areas, identified the factors most crucial to plant operations, and drafted flow diagrams detailing the relationship displayed among these indices.[74] For the purposes of management, the public and mixed property areas of the Chilean economy had been divided into a series of sectors, such as textiles, food, fuel and energy, and steel. Industries within the textile sector were among the first to be nationalized and the first to be modeled for the Cybersyn system by INTEC

[73] Benadof, interview. These ECOM training programs were modeled after those found in Britain's National Computer Center.

[74] Allende divided the Chilean economy into three areas: the social property area (APS) consisting of industries owned exclusively by the government; the mixed property area (APM), composed of industries with more than 51% of government ownership; and the private property area that included industries not owned in whole or in part by the Chilean government (APP).

engineers. Tomás Kohn drafted many of the initial models for the textile sector, including the Yarur, Bellavista, and Sumar textile mills. Project notes reveal that the team planned to have thirty enterprises on line by August 1972, a figure that would rise to include 26.7% of all nationalized industries by May 1973 (more than one hundred industries).[75] Skeptics doubted the team's ability to model a system as complex as the Chilean economy, but Beer believed that a successful manager did not need to know every production detail and that, in fact such a large amount of information could impede an individual's management capabilities. Instead, managers should have access to the most relevant pieces of information—a restriction that facilitated the process of making informed decisions quickly. Applying this principle to the nationalized Chilean industries, Beer argued that the most crucial aspects of production could be collapsed into five to seven indices of factory activity. By collecting and monitoring this subset of data, the government could focus and prioritize their efforts, predict and resolve economic crises with increased speed, and improve the efficacy of state-directed management. Production indices typically included sources of energy (e.g., oil, coal, or electricity), key raw materials, and worker satisfaction, as measured by the percentage of employees present on a given day. The success of this form of management depended on identifying and accurately collecting these central production indices and the speed of their transmission from the factory floor to higher levels of government administration. Beer emphasized that the process of creating factory models should include input from the workers, thereby increasing their participation in factory management. I will explore this observation in greater depth in chapter 6.

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[75] *Mensaje Presidente Allende ante Congreso pleno, 21/Mayo '73,* (Santiago, Chile: Departamento de Publicaciones de la Presidencia de la Republica - Chile, 1973), 412-13.

CHECO

CHECO (CHilean ECOnomy), the third part of the Cybersyn project, constituted an ambitious effort to model the Chilean economy and provide simulations of future economic behavior. Appropriately, it was sometimes referred to as "Futuro." The simulator would serve as the "government's experimental laboratory"—an instrumental equivalent to Allende's frequent likening of Chile to a "social laboratory." The bulk of the work on CHECO occurred in England, under the direction of Ron Anderton, a systems engineer and operations research scientist. The simulation program used the DYNAMO compiler developed by MIT professor Jay Forrester, a technology that was said to be one of Anderton's areas of expertise. However, the Chilean team, headed by a chemical engineer, Mario Grandi, kept close tabs on Anderton's model, laboriously checking his calculations, asking detailed questions about the model and the computer tools used in its implementation, and sending Hernán Aviles, a young Chilean engineer, to study with Anderton in London. The CHECO team initially used national statistics to test the accuracy of the simulation program. When these results failed, Beer and the other team members faulted the time differential in the generation of statistical inputs, an observation that reemphasized the perceived necessity for real-time data.

CHECO was designed to provide the government with new tools for planning and critiqued the modeling techniques used by the state planning agency ODEPLAN as well as those favored by Eastern bloc countries. These "input-output" models depended on a set of concrete structures and relationships and lacked the dynamic flexibility needed to model an economy in transition. By September 1972, the CHECO team had produced a tentative macroeconomic model, but given the learning curve of the team, "no-one was anxious to place reliance on the results."[76] The severity of the October strike further shifted the focus away from constructing an experimental economic simulator, although work on the project continued throughout 1973.

Opsroom

The final of the four components, Opsroom, created a new environment for decision making, one modeled after a British World War II war room (figure 5.2).[77] It consisted of seven chairs arranged in an inward facing circle and flanked by a series of projection screens, each displaying the data collected from the nationalized enterprises. In the Opsroom, all industries were homogenized by a uniform system of iconic representation, meant to facilitate the maximum extraction of information by an individual with a minimal amount of scientific training.

The Operations Room created a visual representation of Chilean economic activities using easy-to-read diagrams, graphs, and flowcharts. Recognizing the value of color, light, and movement, the Chilean design team produced display screens and user interfaces that incorporated these aspects in order to increase the speed of user comprehension and make the room easier to operate and control. Once complete, the room would open a space for Chilean leaders to summarize the state of the economy, share ideas, and set priorities.

The design of the Operations Room bore the mark of the Hochschule für Gestaltung (HfG), Ulm, one of the more influential design schools within the

[76] Beer, *Brain of the Firm: The Managerial Cybernetics of Organization*, 267. Also in September, the Chilean CHECO team also solidified to include Eugenio Fourt, Agustín Araya, Juan Francisco Letelier, Carlos Molina, and Julio Jimenez as well as Grandi and Avilés. Mario Grandi, "Progress Report No 4," September 1972, box 56, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.

[77] The idea of war occurs frequently throughout the project notes. Beer invoked the war room analogy as a means of conveying the importance of visual displays of information in rapid decision-making, but also as a means of reminding participants that they were fighting an economic war where time was of the essence.

developing world during the 1960s and 1970s, particularly in regions of Latin America. Under the HfG Ulm model, design moved beyond art, decoration, or styling and played an important role in solving industrial problems. Designers trained in this vein used ideas from science, engineering, and systems theory to analyze the function of a given product and determine its relationship with the surrounding environment.[78]

. The designers gave the room a hexagonal shape, illustrative of HfG preferences for geometrical order and the need to allocate space for five display screens and an entrance. The first wall to the immediate right of the entrance opened up into a small kitchen. Moving in a counterclockwise direction, the second wall contained a series of four screens exhibiting various representations of "structural information" (known as Datafeed). The large screen positioned above the three smaller screens contained instructions for changing the images displayed below, a mix of flow diagrams, factory photographs, and unitless mappings of actual and potential production capacities (figure 5.3). Two screens for recording "algedonic signals" appeared on the third wall. They displayed the overall production trends within different industrial sectors and listed urgent problems in need of government attention. A series of intermittent red lights appeared on the right hand side of each screen and blinked with a frequency indicative of the level of urgency. The fourth wall held a large reproduction of Beer's viable system model, known affectionately as "Staffy," and two large screens for back projecting any additional information of use to the occupants. The presence of a theoretical model within a control designed to manage day-to-day activity may appear strange at first. The team included the

[78] Hugo Palmarola Sagredo, "Productos y socialismo: diseño industrial estatal en Chile," in *1973 La vida cotidiana de un año crucial*, ed. Claudio Rolle (Santiago de Chile: Editorial Planeta, 2003).

model in the room's design to facilitate explaining the mechanisms of Beer's viable system model to outside visitors. Its presence was more pedagogical than practical, illustrating the room's dual purpose as a public relations vehicle and space for economic management. A large metal board covered in fabric occupied the final wall. Here users could change the configuration of magnets cut in various iconic forms, each simulating a component or function of the Chilean economy. Rather than bombard users with the numeric data, the designers made a concerted effort to maximize the use of colors, symbols, and diagrams in order to depict relationships among inputs and outputs, instead of simply charting raw performance.

User considerations similarly influenced the design of the chairs. The designers opted to place an odd number of chairs (seven) in the center of the room to enable democratic voting procedures. Each chair contained an ashtray and space for a drink, but no table or other area for writing. Beer believed that the use of paper detracted from, or even prevented, the process of communication; within the room, writing was strictly prohibited. Buttons found on the armrest of each chair allowed the occupants to control the material displayed on each of the Datafeed screens, a simplified interface that replaced the traditional keyboard and opened the user base to those lacking formal education or typing skills—a design decision that reflected Allende's emphasis on worker participation.

A prototype of the room was constructed in Santiago during 1972 using projection equipment primarily imported from England. Budgetary constraints required sidestepping the high tariffs imposed on imported goods. Beer smuggled several components of the room into Chile and was later reimbursed for his expenses.[79] Other pieces of the room were manufactured outside Santiago, including the seven orange and cream chairs, and their construction reflected the realties of Chilean life. Cañete laughed when he arrived to pick up the room's futuristic looking chairs from a manufacturer based in the Chilean countryside and found them covered with chickens.[80] Although the room never became fully operational, it quickly captured the imagination of all who viewed it, including members of the military, and it became the symbolic heart of the project.[81] "It was a room of the future, something absolutely outside of the Chilean context," remembered Mordojovich. "There was a sensation of unreality [during the UP era], and this was a great deal removed from reality."[82]

System Operation

An idealized correlation of Cybersyn's intended architecture, CORFO's organization, and Beer's five-tier viable system model appears in figure 5.4. This diagram outlines Cybersyn's theoretical design, not its actual level of functionality and implementation. At this level of recursion, the sector committees collected and sent production data daily through the telex network, which relayed the information to a data-processing center located within ECOM (system 2). A staff of computer technicians processed these data with a single mainframe computer and Cyberstride's specialized suite of computer programs, which searched for trends in production performance as well as irregularities. If a sector committee (system 1) failed to resolve a production irregularity on its own, ECOM engineers alerted members of CORFO general management (system 3). In the case of a particularly

[79] Schwember, interview; Cañete, interview; Beer, interview.
[80] Cañete, interview.
[81] General Carlos Prats, head of the Armed Forces and later Secretary of the Interior, expressed interest in the Cybersyn Operations Room for its potential military applications.
[82] Mordojovich, interview. Emphasis mine.

difficult or immediate problem, members of CORFO general management would convene with higher-ranking CORFO officials in the Operations Room (system 4) to discuss the problem and decide whether to reallocate resources or plan a new approach for managing the social property area. CHECO also operated at the level of system 4 and permitted CORFO management to test its ideas before implementing them. If lower management still could not solve the problem, CORFO senior management (system 5) then used the data provided by the cybernetic toolbox to make an informed decision about how to intervene in production activities.

The original plans called for similar management hierarchies at the level of the individual plants, state enterprises, and sector committees, although these ideas never came to fruition. Beer also began work on a series of training programs aimed at presenting the system to workers' committees and training them to use these new management tools to increase and coordinate their participation in factory operations. Perhaps the ambitious scope of this "work-in-progress" accounts for the discrepancies between the model of operations that I have described and the regular operational practices recounted by Chilean engineers involved with the project. For example, Benadof recalled that his office received information from the individual enterprises every afternoon and, after running the numbers through the mainframe computer, later transmitted the results to the telex control room at CORFO without notifying the individual interventors or passing through the algodonic processes outlined by Beer.[83] I will discuss this rift between theory and practice in greater detail in chapter 6.

Despite these inconsistencies, work on each component of the system advanced rapidly. The preexisting telex infrastructure contributed significantly to

[83] Benadof, interview.

the early operation of the Cybernet network, the first and only Cybersyn component used regularly by the Allende government. The Cyberstride suite generated its first printout on March 21, 1972. Beer sent an enthusiastic telex to Anderton: "Cyberstride suite really works.... The whole thing was impossible and we did it."[84] Because of problems in locating a suitable space for construction and delays in receiving equipment from the British company Electrosonic, the Opsroom prototype did not reach completion until late December 1972 and even then had very limited functionality.[85] The economic simulator never left the experimental stage.

However, the system proved instrumental to the UP even in its unfinished form. The new infrastructure for communication provided by Cybernet proved vital to the government during the opposition-led October strike of 1972.[86] In response to the strike, which threatened the government's survival, Flores created an emergency operations center where members of the Cybersyn team and other high-ranking government officials monitored the two thousand telexes that arrived every day, reporting on activities from the northern to the southern ends of the country.[87] The rapid flow of messages over the telex lines enabled the government to react quickly to the strike activity and mobilize its limited resources in a way that minimized the damage caused by the *gremialistas.* Gustavo Silva, executive secretary of energy within CORFO during the strike, credited the network for coordinating the two

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84 Telex from Stafford Beer to Ron Anderton, March 21, 1972, box 66, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.

85 Letter from Stafford Beer to Robert Simpson of Electrosonic, October 1, 1972, box 62, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.

86 The G*remialista* movement began in protest to government nationalization efforts and gained considerable momentum in October 1972 after a forty thousand member independent trucking association tried to prevent the creation of a parallel state-owned equivalent. The resultant *gremio* strike attempted to shut down the Chilean economy by mobilizing shopkeepers, professional and economic associations, bank clerks, truck drivers, and even several student and campesino organizations.

87 Flores, interview.

hundred trucks loyal to the government.[88] The successful management of the *gremio* strike established Flores as both technical expert and vital contributor to the survival of the UP, resulting in his promotion to minister of economics. It also publicly demonstrated Cybersyn's utility to the government, particularly the telex network. Several weeks after the strike's conclusion, Herman Schwember announced, "The growth of our actual influence and power has exceeded our best imagination."[89]

After the strike, the telex network permitted a new form of economic mapping that enabled the government to collapse the data sent from all over the country into a single report, written daily at CORFO, and hand-delivered to La Moneda. The detailed charts and graphs filling its pages provided the government with an overview of national production, transportation, and points of crisis in an easy-to-understand format that used data generated only days earlier. The introduction of this form of reporting posed a considerable advance over the six-month lag formerly required to collect statistics on the Chilean economy, and the report allowed the UP to track the dips and spikes of national production through September 1973.[90]

Flores' s success in the October strike put him in a unique position as the newly appointed minister of economics. He was relatively unknown to the opposition and for that reason believed he had a chance of increasing his support by "building a different personal image" based upon "a certain myth around [his] scientific

[88] Gustavo Silva, Interview by the author, 5 September 2003.
[89] Letter from Herman Schwember to Stafford Beer, 6 Nov. 1972, box 66, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.
[90] Comando Operativo Central, "Situación General del País," 3 September 1973, private collection of Roberto Cañete.

qualifications."[91] However, the new challenges that he confronted as minister in a situation of extreme and growing economic dislocation convinced him that technology could play only a limited role in saving Chile from a political and economic breakdown. As Flores began to distance himself from the project to assume his new duties in Allende's cabinet, Beer remarked that their relationship, which "was going great when [Flores] became Undersecretary," had "almost wholly collapsed."[92]

The October strike, moreover, signified a change in the dynamics of the Cybersyn team. As the team grew, the intimacy and informality that had previously characterized the working culture gave way to anonymity and a technology-centered focus. Raúl Espejo of CORFO became the overall head of the Cybersyn Project and later the director of information technology within CORFO. Given his close working relationship with the original Cybersyn team, Beer intensely disliked not having contact with the majority of these new team members and even thought of resigning from the project. Instead, he began directing his energies toward other projects that could change Chile's participative and administrative organization. This included a joint project with CEREN to install algedonic meters in a sample of Chilean homes that would allow Chilean citizens to transmit their pleasure or displeasure with televised political speeches to the government or television studio in real time.[93] Beer dubbed this undertaking "The People's Project" and "Project Cyberfolk" because he believed that the meters would enable the government to respond rapidly to

[91] Letter from Herman Schwember to Stafford Beer, 12 Nov. 1972, box 64, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.
[92] Letter from Stafford Beer to Herman Schwember, 21 Feb. 1973, box 66, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.
[93] Beer did not elaborate much on how these signals would travel from Chilean homes to the Chilean government, but the effect seems similar to the computerized "instant response" technique used by focus groups to monitor voter reactions to political speeches, debates, or advertisements second by second in real time.

public demands, rather than repress opposing views.[94] Barely one month later, Beer wrote to Espejo, "We are only beginning the reformation of the whole process of government. I do not exaggerate to say that the total concept is of two orders of magnitude bigger than cybersynergy.'"[95] By December 1972, one month after the *gremio* strike, Beer had completely revised the scope of the project, drawing two levels of recursion rather than the single viable system that initially characterized Cybersyn. The original technical project was now eclipsed by a new overarching project of state regulation that began with the Chilean people and ended with the Ministry of Economics; in this schematic Cybersyn provided one input rather than a systematic whole.

Flores similarly redirected his energies toward addressing the immediate problems of the Chilean nation. His logic was simple: "I knew that we could win a lot during the October Strike using my room ... [but] the room is not going to stop tanks and planes and bigger strikes. And an assassination attempt."[96] Building on his working methods of the past, Flores continued to form teams of engineers and economists and applied their technical expertise to ameliorating Chile's mounting financial woes. Consumer shortages had reached severe levels by the end of 1972 and continued to worsen. A survey conducted by the newsmagazine *Ercilla* reported that 99% of upper-class Chileans viewed buying essential products for their homes as difficult, an observation seconded by 77% of the middle class questioned.[97] Between March 1972 and March 1973, prices increased by 183.3%, a rate of inflation

[94] Stafford Beer, "Project Cyberfolk," March 1972, box 61, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.
[95] Telex from Stafford Beer to Raúl Espejo, 6 Nov. 1972, box 66, The Stafford Beer Collection, Liverpool John Moores University, Liverpool, England.
[96] Flores, interview.
[97] *Ercilla,* 13 September 1972, 10, cited in Valenzuela, *The Breakdown of Democratic Regimes: Chile*, 59.

that the government proved unable to curb.[98] However, the congressional elections held the same month served to increase the representation of the UP from one third to almost 45%. Members of the opposition panicked, while the government interpreted the election results as a sign that it could still survive. At that time Flores, now minister of finance, transferred Kohn and Barrientos from the Cybersyn Project to the third floor of the Ministry of Finance, where they applied their experience in modeling Chilean industries to the management of national finances.[99] Despite these efforts, Chile's deteriorating economic and political situation blocked Allende's plans for peaceful revolution and set the stage for the military coup that would take place on September 11, 1973. Equating the situation with that of a Greek tragedy, Radomiro Tomic, the Christian Democratic candidate for the 1970 presidential election, observed that "everybody knows what will happen, everybody says they do not wish it to happen, and everybody does exactly what is necessary to bring about the disaster."[100]

Allende continued to support the Cybersyn project throughout his presidency, and Beer met with the president as late as July 1973. When a second *gremio* strike occurred in August 1973, the telex network once again proved vital to keeping the elected government in power. On September 8, 1973, Allende sent a communication to the Cybersyn team asking that the Operations Room be moved to the presidential palace in La Moneda—a mere three days before the military coup that would end his dream and take his life.

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[98] Ibid., 65.

[99] Kohn, interview.

[100] Cited in Simon Collier and William F. Sater, *A History of Chile, 1808-1994, Cambridge Latin American Studies* (New York: Cambridge University Press, 1996).

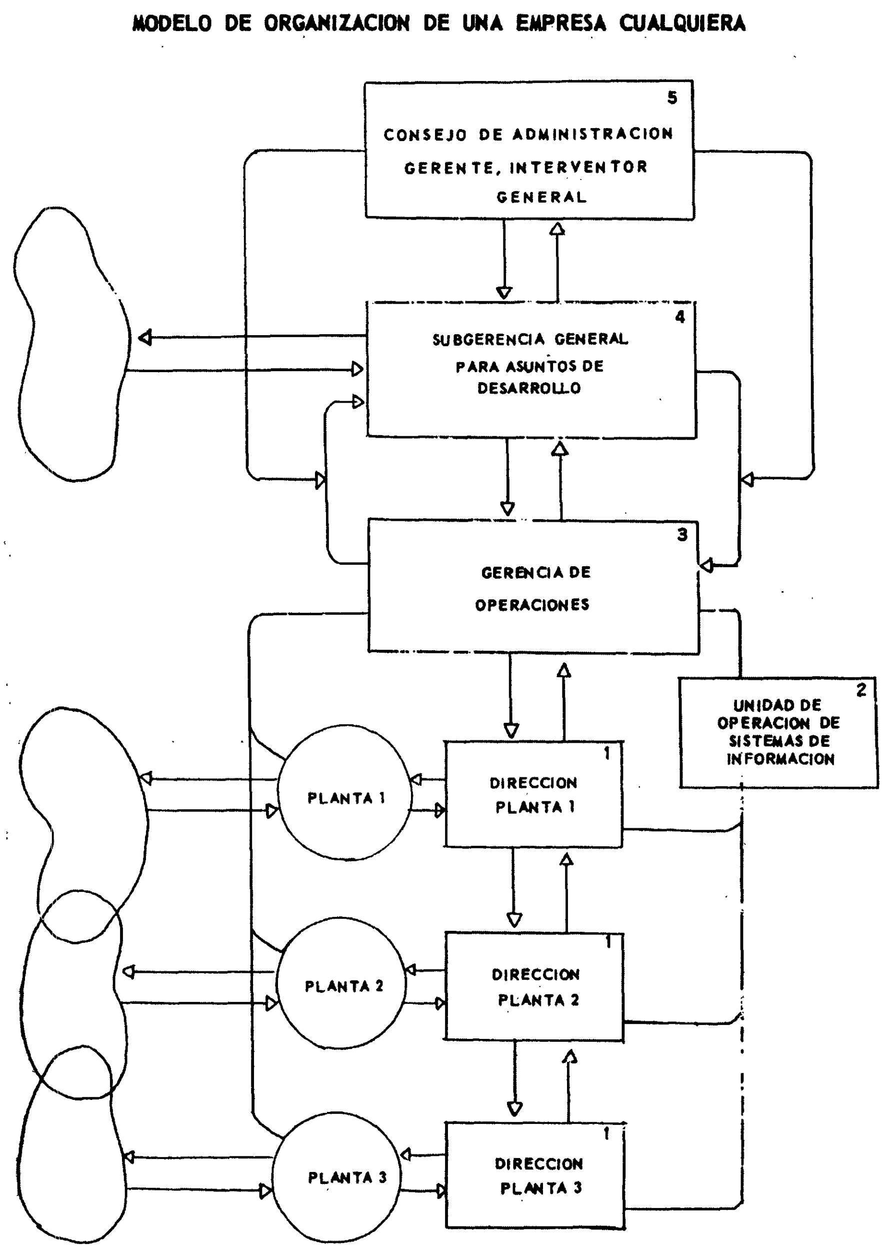

Figure 5.1: The Chilean State Enterprise drawn as a five-tier viable system model. (Image used with permission from the Corporación de Fomento de la Producción, Santiago.)

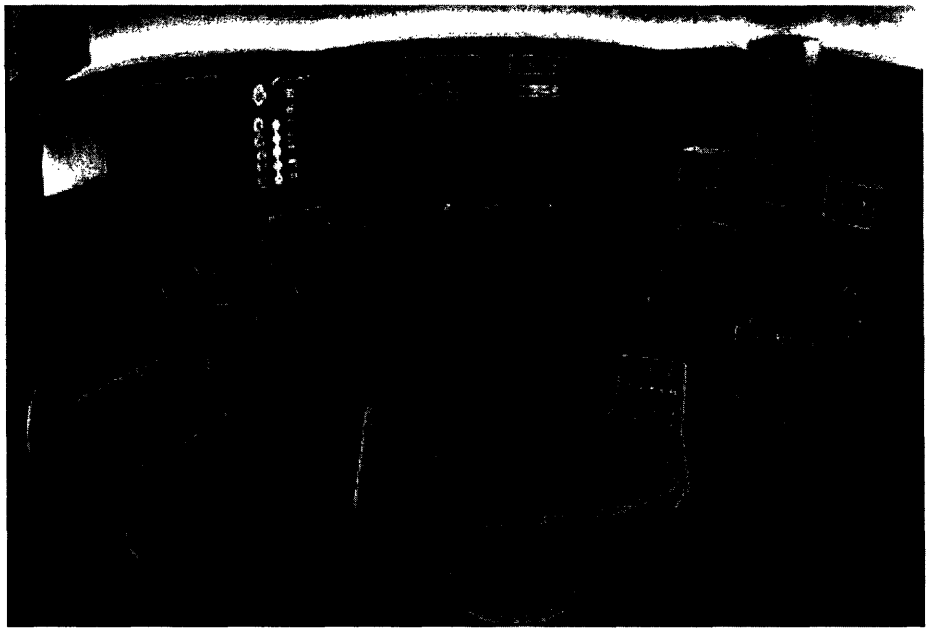

Figure 5.2: The Cybersyn Operations Room. (Image used with permission from Rodrigo Walker.)

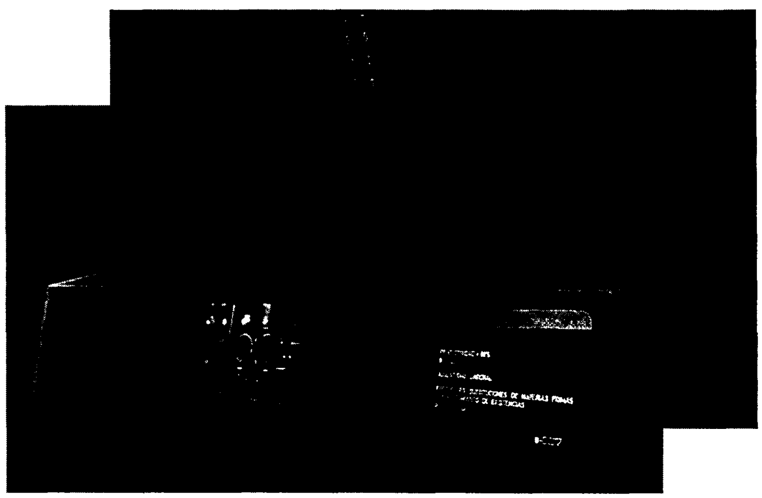

Figure 5.3: The Datafeed screens of the Cybersyn Operations Room. (Image used with permission from Rodrigo Walker.)

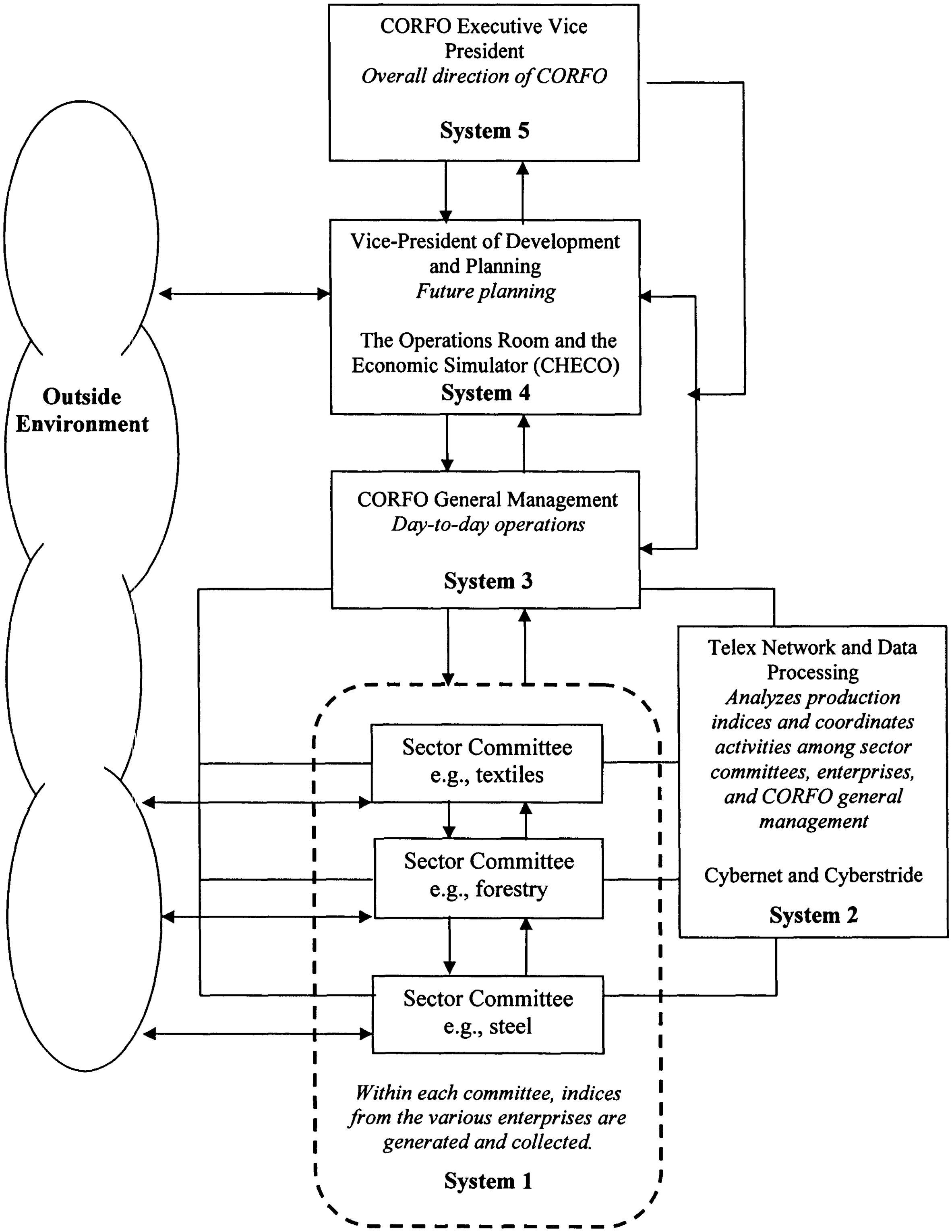

Figure 5.4: CORFO drawn as a viable system. (Image drawn and compiled by the author.)

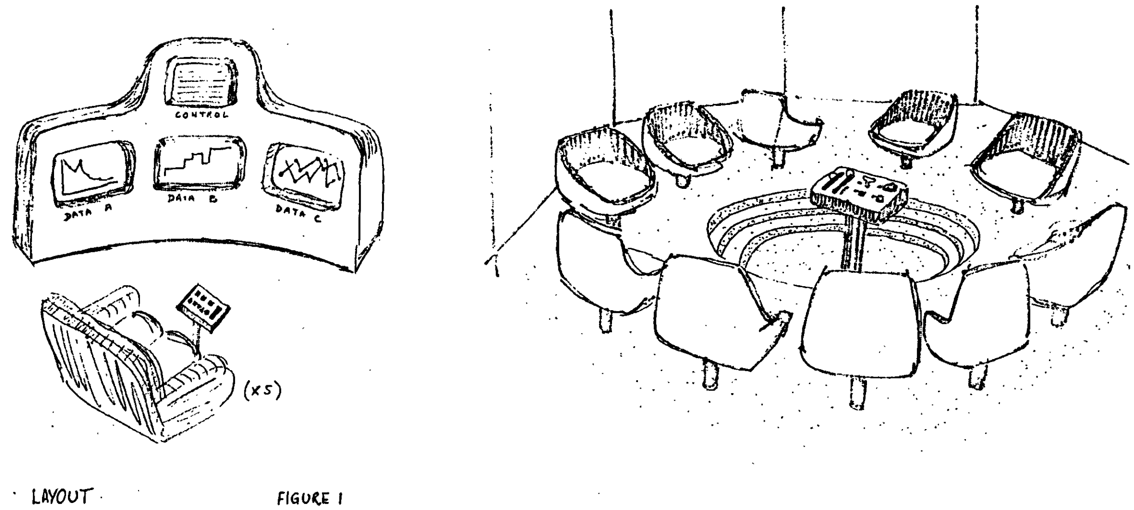

Figure 5.5: Two early sketches of alternative Operations Room designs. (© JMU. Reproduced by permission of Liverpool John Moores University Learning and Information Services and The School of Business Information. Originals kept at Liverpool John Moores University, Learning and Information Services, Special Collections and Archives.)

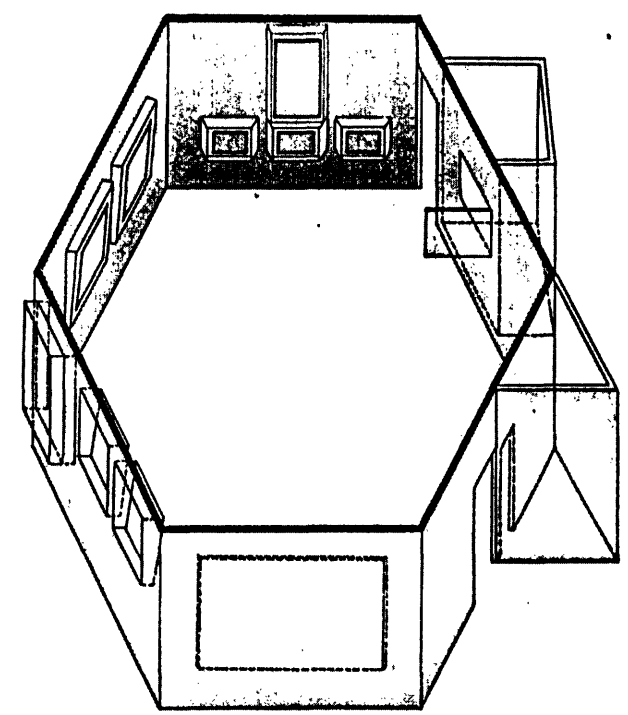

Figure 5.6: Design drawing of the eventual Operations Room layout. (Image used with permission from INTEC, Santiago.)

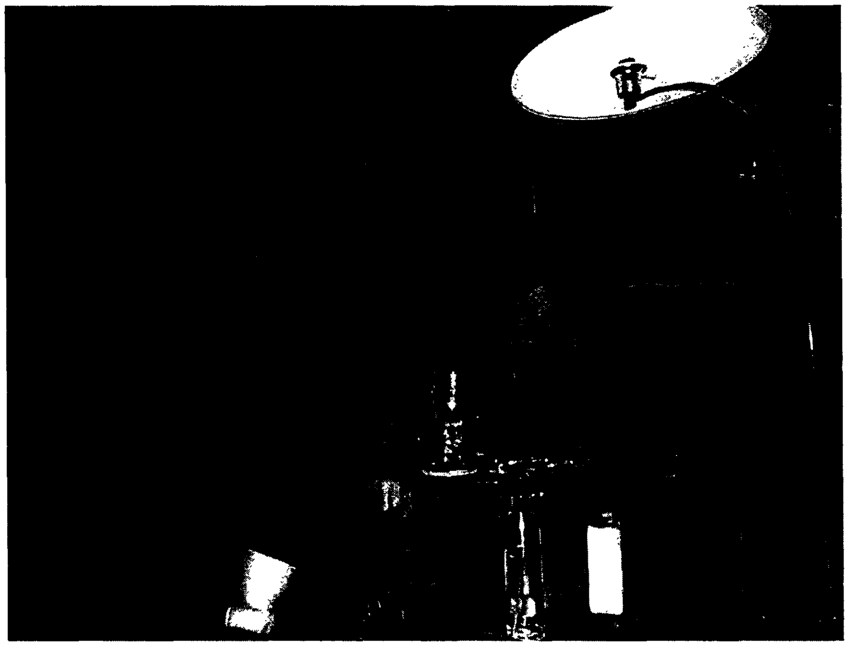

Figure 5.7: Photograph of Stafford Beer taken by the author in 2001, one year before his death.

Figure 5.8: Photograph of Fernando Flores taken in 1973 (Image used with permission from COPESA, Santiago.)

Chapter 6

Symbolic Computing

TOWARD THE end of his life, Stafford Beer donated a large portion of his private papers to the School of Business Information at Liverpool John Moores University in England. The collection, which the university archivists refer to as "ninety-two boxes of Beer," includes seventeen boxes of materials that document Beer's activities in Chile. Within these boxes, neatly labeled folders contain written correspondence, telex transmissions, project reports, software documentation, photographs, computer printouts, and press accounts, sorted by date and topic. Together, these documents paint a vivid picture of the design and implementation process for Cybersyn as well as the range of reactions to the project expressed by Chilean and international actors. In box 63 the curious researcher will find a folder labeled "Papers Santiago January 1973 Still Current" that contains a document entitled "Inauguration Speech for the Operations Room." The document, written in both English and Spanish, was to be President Allende's speech welcoming visitors to the Cybersyn Operations Room. It reads in part:

> My friends – I wish to welcome you personally to this place, because I have taken a keen personal interest in its development, and because I want to ask

you to take an interest in its personal use. What you see around you is the result of eighteen months hard work by a strong team of our very own Chilean engineers, who have devoted themselves to problems of industrial management. They have created for us a totally new set of tools to help us in our task of controlling the economy.

Modern science, and particularly the electronic computer, offers government a new chance to deal with its increasingly complex problems. But we have found that in the so-called advanced countries the power of science to help has not been widely used.

The speech concluded with the following observation:

> We set out courageously to build our own system in our own spirit. What you will hear about today is revolutionary – not simply because this is the first time it has been done anywhere in the world. It is revolutionary because we are making a deliberate effort to hand to the people the power that science commands, in a form in which the people can themselves use it.[1]

The inauguration speech provides a good example of the political framing of the project and an attempt to position the Cybersyn system within the ideological goals of the Popular Unity platform. Furthermore, the speech shows that the government planned to present Cybersyn as a technology of both administrative and symbolic value. Politics merged with technology to create a different idea of revolution, one that was grounded not only in social change but also in scientific prowess. The tone of the speech is both nationalist and populist, rhetorical strategies that Allende often used when speaking before the public, and the text emphasizes the contributions of Chilean engineers while obscuring the contributions made by their foreign collaborators. In contrast to Chile's earlier scientific and technological endeavors,

[1] Stafford Beer, "Welcome to the Operations Room," box 63, Stafford Beer Collection, Liverpool John Moores University, Liverpool, England. The archives also contain a Spanish translation of the speech, "Presentación de la Sala de Operaciones." Judging from the editorial notes made on the English copy, it appears that Beer drafted the original and had it translated into Spanish for Allende. A number of project participants saw this document while being interviewed for this dissertation project. While many could remember Allende's visit to the room, none could recall whether he had delivered or recorded this message. Several recalled discussing the idea of having Allende record a greeting to welcome workers who visited the room for the first time. Project participants also remembered that the first time Allende sat in one of the Opsroom chairs and pushed a button, the whole electrical system shorted -- a moment of great embarrassment for the team.

which had been the almost exclusive domain of Chile's small technical elite, Cybersyn proposed to bring technology to the common people. For the first time Chileans from working-class backgrounds and with limited education would have access to one of the most exclusive and costly technologies: the computer. Factory workers *(obreros)* would not be programming or maintaining these costly machines, tasks handled by the white-collar employees (*empleados*) working for ECOM, the state computer agency, or perhaps the factory's own "IBM division," but factory workers could assist in modeling their factories and determining the desired values for key production indices that would form the backbone of the Cybersyn's customized software programs. Just as it sponsored the IRT Antú television and the Citroën-designed Yagán automobile (see chapter 4), the government attempted to redesign computer systems for popular use and the benefit of the general public. Due to the expense of importing mainframes, the government could not facilitate popular access to this technology as it had with smaller microelectronic devices such as televisions, record players, and calculators. However, it could expand the social network surrounding the computer to include those who had not been part of these socio-technical networks in the past. The term "computer system" does not simply refer to a configuration of hardware and software, but rather the entire web of social and technical actors required to make the system function. Regarding Cybersyn, the computer system included the software programs, their programmers, and the government administrators who benefited from their results; the expanding communications network that linked the mainframe to the outside world as well as the telex operators who sent and received messages across these lines; and the factory managers and workers who provided the requisite production data. The

Operations Room and its occupants also functioned as part of this system, providing what was then heralded as a democratic space for viewing the data output by the system.[2] Once completed, the room would expand the reach of Cybersyn system to include high-level government administrators and, eventually, workers who would use low-tech versions of the Operations Room on the factory floor. Both stood to benefit from the realization of this system. The social networks formed by this new computer system reflected the ideological beliefs of the Chilean government and echoed the UP commitment to worker empowerment and state economic control.

Cybersyn represented a new form of socialist modernity, one that was technologically innovative yet socially just. In this new vision of modernity, enlightened Chilean scientists and engineers leapfrogged over the state-of-the-art technologies produced in the developed, capitalist world and created "revolutionary" technologies "in our own spirit." The welcome speech illustrates the ideological framing of the Cybersyn project, which was not so different from the government's parallel efforts to direct science and technology toward achieving the social, economic, and political goals of the Chilean revolution.

Just as relics and artifacts inform archeologists about the beliefs and practices of societies past, studying the traces left by more recent technologies can provide information about the hopes, fears, values, and priorities of the women and men responsible for their design and construction, as well as those who put these technologies to use. Cybersyn is more than a configuration of hardware, software, and telex terminals. It is a historical text that documents the goals, contradictions,

[2] A recent exhibition at the ZKM Center for Digital Art and Media entitled "Making Things Public: Atmospheres of Democracy" has further explored the idea of the Cybersyn Operations Room as a democratic space. See Eden Miller Medina, "Democratic Socialism, Cybernetic Socialism: Making the Chilean Economy Public," in *Making Things Public: Atmospheres of Democracy*, ed. Bruno Latour and Peter Weibel (Cambridge, Mass.: MIT Press, forthcoming 2005).

and strategies employed by the Chilean government and its detractors. The project inspired political speeches, folk songs, brochures, training programs, and paintings, all of which framed the project as a socialist technology capable of transforming the Chilean economy and correcting class inequalities. The inauguration speech provides a particularly vivid example of the type of ideologically driven propaganda that accompanied the system's construction.

However, the system also provided another arena for world actors to duke out the ideological tensions of the Cold War. While members of the project team equated Cybersyn with socialist liberation, press accounts from the United States and Britain described it as a technological "Big Brother" that would sacrifice individual rights for a more powerful state apparatus. Chilean opposition parties and the Rightist press generated similar critiques aimed at arousing public feelings of uncertainty and fear with regard to the project. These hostile readings of the Cybersyn project reflected anxieties of the Cold War and the all-out struggle between capitalism and communism in Chile, as well as in other nations of the developing world.

Like their predecessors and successors in governments around the world, Chilean officials viewed innovations in science and technology as symbolic of political success. The significance of Cybersyn was its successful mirroring of the revolutionary beliefs of the Chilean state. The project also stands as a concrete example of how the state planned to nurture those beliefs within Chilean society. Constructing the technological network required that new social networks be formed and that old networks be dismantled; although it was less certain that these new social configurations would overcome the old relations of domination, exploitation, and oppression within Chilean factories.

Technological systems can contribute to the exercise of state hegemonic power and have been used historically to engineer ideological change. Through Cybersyn, ideology and technology became linked through concepts of and plans for worker participation and the necessity of managing changes in property ownership. However, the act of writing social theory into technological design highlights the difference between theory and practice and demonstrates the ambivalences, ambiguities, and shortcomings of the UP program for socialist change. Allende never wavered in his faith that socialism would solve the needs of the Chilean people and create a more just society. Beer professed a similar faith in the abilities of management cybernetics to implement the ideological changes outlined by the Chilean revolution. Whether history agreed with either man will be discussed in the pages that follow.

Cybernetic Socialism

From its early stages the Cybersyn project operated under the joint leadership of a scientific director, Beer, and a political director, Flores. Beer, however, recognized the utility of combining the rhetoric of Marxism and modernization to create a "powerful political instrument" able to garner widespread support, and he often stepped outside the bounds of his scientific duties.[3] His use of the phrase "the people's science" stressed the antitechnocratic nature of the Cybersyn project, and he often removed himself and his British colleagues from the picture when discussing the accomplishments of Chilean scientists and engineers in the area of management cybernetics. At Beer's request the famous Chilean folksinger Angel Parra composed

[3] Stafford Beer, "The Extension of Cybernetic Management Systems to the Enterprises: A Reconsideration of the Political Context," 14 October 1972, box 57, Beer Collection.

an original song entitled "Litany for a Computer and a Baby About to Be Born" to help rally worker support for the project. The "baby" in the title refers to the rebirth of the Chilean people through socialist transformation. The chorus of the song similarly conveyed the political intentions of the project:

Hay que parar al que no quiera
que el pueblo gane esta pelea
Hay que juntar toda la ciencia
antes que acabe la paciencia.[4]

Let us stop those who do not want
the people to win this fight
Let us bring together all of science
Before we exhaust our patience.

As a whole, the song demonstrated the importance of technology in bringing about social change and its potential for eliminating political corruption. The lyrics issued a rallying cry as well as a prophetic warning. Parra's folk song was one of several attempts to link Cybersyn and the interests of the Chilean public. Project notes suggested that Cybersyn engineers distribute empanadas or *huesillos con mote* (a popular Chilean dessert) to workers when making presentations about the project in order to gain their attention, and their support, for the project. And team members, including Beer, drew up plans for worker training programs designed to teach Chileans to use the tools that the government developed for them.

The politics of the project extended beyond propaganda or rhetoric. It shaped the very design of the system. Understanding the correlation between Cybersyn's design and Allende's politics requires a closer examination of the president's plan to transform Chile into a socialist state. Allende's interpretation of Marx's writings emphasized the importance of respecting Chile's existing democratic processes in

[4] Lyrics "Letanía para una computadora y para un niño que va a nacer," box 64, Beer Collection.

bringing about socialist reform, a possibility that Marx alluded to but never realized.[5] Unlike earlier socialist revolutions, such as those in Cuba and the Soviet Union, Chile's transition to socialism was to be democratic, including respect for election results, individual freedoms (such as the freedoms of thought, speech, press, and assembly, and respect for the rule of law), and public participation in government decision making through elected representatives. At one point Allende promised to augment existing freedoms, stating, "We would not be revolutionaries if we were to limit ourselves to maintaining political freedom. The government of the Unidad Popular will extend political freedom."[6] However, it is crucial to note that Allende's notion of individual or political freedoms were not the same as individualism, which he associated with capitalist selfishness. Individualism therefore detracted from the collective wellbeing of the Chilean nation.[7] In contrast to the centralized planning found in the Soviet Union, Allende's articulation of socialism stressed a commitment to decentralized governance with worker participation in management, reinforcing his professed belief in individual freedoms. He even credited his government with putting "an end to centralism and bureaucracy."[8] Yet he also admitted that if forced to take sides the government would favor the "interest of those who made their living by their own work" and that revolution should be fomented from above, using a "firm guiding hand."[9]

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[5] Karl Marx, "The Possibility of Non-Violent Revolution," in Karl Marx, Friedrich Engels, and Robert C. Tucker, *The Marx-Engels Reader* (New York: W. W. Norton, 1972), 522-24.

[6] Salvador Allende, "The Chilean Road to Socialism: First Annual Message to Congress, May 21,1971," in Salvador Allende Gossens, *Chile's Road to Socialism*, ed. Joan E. Garces, trans. J. Darling (Baltimore: Penguin, 1973), 149.

[7] Régis Debray and Salvador Allende Gossens, *The Chilean Revolution: Conversations with Allende*, 1st American ed. (New York: Pantheon, 1972), 87.

[8] Salvador Allende, "First Anniversary of the Popular Government, National Stadium, Santiago, November 4, 1971," in James D. Cockcroft, ed., *Salvador Allende Reader* (Hoboken, N.J.: Ocean Press, 2000), 124.

[9] Allende, "Chilean Road to Socialism," 150; Peter Winn, *Weavers of Revolution: The Yarur Workers and Chile's Road to Socialism* (New York: Oxford University Press, 1986), 185.

The tension inherent in Beer's model, between individual autonomy and the welfare of the collective organism (described in chapter 5), mirrors the struggle between competing ideologies in Allende's democratic socialism. Just as Allende promised to preserve individual freedoms while directing the revolution from above, Beer's "viable system model" allowed the individual components of system 1 to maintain their autonomy unless an emergency threatened the stability of the overall organism, government, or firm. In this instance the "chief executive" (system 5) could intervene in the activities of the lower levels and restore coherence to the system. Thus the design of the Cybersyn system permitted the nationalized firms to maintain control of factory operations while allowing the government to intervene and assist in resolving economic emergencies. This commitment to liberty and autonomy, as well as the government's willingness to construct a technological system for decentralized control, set Cybersyn apart from the computer-based tools that the Soviet Union developed for economic management.[10]

In the late 1950s Soviet scientists and mathematicians began applying cybernetic principles and computer technology to the optimization of national economy activity. In contrast to the situation in Chile, the initial push in the Soviet Union came from cyberneticians working for the military who hoped to create a national, centralized network of computing centers that could be used primarily for national defense while dedicating excess processing time to problems of economic planning. Military cyberneticians encountered strong resistance from the Soviet state bureaucracy--the bureaucrats feared that the introduction of computer technology would leave them unemployed. The proposed computer system also left

[10] Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge, Mass.: MIT Press, 2002).

no room for the ideological leadership of the Communist Party and motivated at least one official within the Chief Political Directorate of the Army to ask, "Where is the leading role of the Party in your [computing] machine?"[11]

In the 1960s the desire to optimize the Soviet economy by using computers was known as "economic cybernetics." Gerovitch reports that by 1967, the Soviet Council on Cybernetics was coordinating research activities at five hundred institutions, half of which were investigating how to apply cybernetic ideas to economic management.[12] Soviet mathematicians, including Viktor Glushkov and Mstislav Keldysh, envisioned the construction of a technological system that could optimize production and replace the market by monitoring all labor, production, and retail activities. Glushkov later teamed with the director of the Central Economic Mathematical Institute, Nikolai Fedorenko, and together they detailed a complex three-tiered computer network that would use thousands of local computer centers to collect "primary information." These local centers would be linked to thirty to fifty computer centers in major Soviet cities. All the information collected at the midlevel centers would eventually flow to one central computer in Moscow, dedicated to government use. The tiered computer network proposed by Glushkov and Fedorenko represented a system of tremendous complexity. Researchers later realized that this scheme would require the manipulation of about fifty million variables, vastly more than the three thousand variables required to manage the Chilean economy with Cybersyn.[13] Soviet economists tried to simplify the problem of economic optimization

[11] Ibid., 267.
[12] Ibid.,269.
[13] At the time of the coup against Allende, the Chilean government had incorporated 420 firms in the public and mixed property areas. If the Cybersyn system required five to seven index values from each firm to monitor factory performance, we arrive at a figure of slightly less than three thousand variables in all. This

by using "indirect centralization," whereby the state set optimal prices and efficiency levels but otherwise allowed firms to make their own decisions. This approach bears a striking similarity to the process of decentralized control articulated by Beer's viable system model and the subsequent design of the Cybersyn system. Yet the differences in the practice of Soviet communism and that of Chilean socialism were far greater than any intellectual similarity to their cybernetics. Chilean state planning, particularly at the level of managing a national economy, was in its infancy. As a result, administrators like Flores remained open to new ideas for managing the public sector. The same could be said of Chilean state planning agencies. In 1971 CORFO, the state development agency, willingly underwent a series of structural changes that allowed it to grow alongside the public and mixed property areas and expand its management capabilities. This included creating the Dirección Industrial (Industrial Directorate) and introducing of new layers of bureaucracy to the preexisting administrative hierarchy.[14] In the Soviet context, however, the idea of preserving factory autonomy contradicted Soviet economic theory and threatened to undermine the absolute power of the State Planning Committee. In the end the centralist hierarchies of the Soviet bureaucracy proved stronger than the interventions proposed by economic cyberneticians. Far from being instruments of change, or even improvement, in the Soviet Union computer technology and the language of cybernetics emerged as new tools for reinforcing the existing administrative hierarchies and the politics of centralized control. As

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does not account for subsequent levels of recursion, although it does illustrate the tremendous difference in complexity between the Soviet version of economic cybernetics and the work undertaken in Chile.

[14] Luis Ortega Martínez, *Corporación de Fomento de la Producción: 50 años de realizaciones, 1939-1989* (Santiago de Chile: Universidad de Santiago Facultad de Humanidades Departamento de Historia, 1989), 229.

Gerovitch writes, "cybernetics turned into a flexible ideological tool, another newspeak, only now filled with cybernetic terminology."[15]

Chilean cybernetics also proved incapable of transforming the Chilean bureaucracy, as will become evident later in this chapter. However, the system never sought to automate managerial tasks, entirely replace the market, or completely centralize Chilean industrial activities by eliminating factory autonomy. To the contrary, Cybersyn sought to improve the efficacy of human interventions in economic management rather than fully automate the process. Similarly, Cybersyn's ability to promote factory autonomy and encourage worker participation further conflated the technology and the goals of the Chilean revolution. Beer recalled that during his first meeting with Allende, the only "snaggy" part of their conversation concerned the Soviets and their application of computer technology to running the economy. According to Beer, Allende asked, "Are you going to use the Communist Party and all the apparatus that the communists have developed in Moscow? And I said, 'I'm sorry it's all rubbish.' And [Allende] grinned broadly. He was very amused, because he didn't like them either."[16]

Despite this shared disdain for the Soviet model, neither Allende's political beliefs nor Beer's viable system model could resolve the fundamental tension between individual freedom and centralized control. Both men recognized situations when "the needs of one division must be sacrificed . . . explicitly to the needs of other divisions."[17] Thus the collective welfare of the state or the homeostasis of the system superseded the mechanisms devised to ensure autonomy, freedom, and liberty.

[15] Gerovitch, *From Newspeak to Cyberspeak,* 288.
[16] Beer interview.
[17] Stafford Beer, *Brain of the Firm: The Managerial Cybernetics of Organization*, 2nd ed. (New York: J. Wiley, 1981), 161.

According to Beer, this conflict of values can be resolved only at the top, a belief supported by Allende's acknowledgment that the Chilean government would favor policies protecting the rights and interests of the workers despite the legislative provisions that granted equal rights to the opposition.[18] The similarity between Allende's articulation of socialism and the cybernetic model guiding Cybersyn's construction caught Flores's attention from the outset. Flores said:

> For me, what socialism meant is how do you combine autonomy of individuals with community? The classical Marxist idea, they call democratic centralism. But my impression at the beginning was that this was pure lip service and nothing concrete. That's what brought Beer to me. He found this relationship between autonomy of the unit with the intelligence of the whole. And in that sense there was a connection. I never found anything [like it] in any other place.[19]

The similarity of Cybersyn's design and Chilean socialism was deliberate. Marxist thinking influenced the selection of Beer's cybernetic model and ultimately the design of the system. Marxism also provided the essential hegemonic force needed for Cybersyn to function as it was originally envisioned.

The Marxist slant in Cybersyn's design appears with little subtlety in two system diagrams drawn by Herman Schwember, a member of the team. Both illustrate the centrality of worker participation to Cybersyn's operation (figure 6.1). The first image depicts the nation, the central government, industry (CORFO), and the individual firms as nested viable systems, each located recursively inside the other. The figure of a worker appears at the heart of these systems, reinforcing their

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[18] This tension between centralized and decentralized control also appeared in the practice of oriented research at the University of Chile. Although the government directed the overall goals of Chile's oriented scientific endeavors, the individual scientists maintained the freedom to select the questions that they were interested in pursuing and the appropriate methodologies. Eugenio Yunis Ahués, *Asignación de recursos y política de investigación para la ciencia y la tecnología: El caso de la Universidad de Chile* (Santiago, Chile: Ediciones C. P. U., 1972).

[19] Flores interview.

perceived importance to the Chilean nation. The second diagram in figure 6.1 shows a modified rendering of Beer's five-tier viable system model with the figure of a worker inserted in the structures of both system 1 and system 5. Here the worker contributes both physically *and* mentally to the production process, an illustrated response to Marx's critique of alienated labor in capitalist societies, where the worker "does not develop freely his mental and physical energies but is physically exhausted and mentally debased."[20] The idea of alienated labor appeared frequently in Cybersyn team discussions and, in Beer's opinion, constituted one of Marx's most influential ideas.[21]

The correlation of Allende's Marxism and Beer's cybernetics is intentional, but it would be wrong to classify cybernetics as a Marxist science, just as it would be wrong to call Cybersyn an inherently Marxist technology. According to Beer, cybernetics provided a scientific method for uncovering natural laws and remained neutral in its conclusions. "Proper use of science," Beer wrote, "is really the world's brightest hope for a stable government . . . with cybernetics, we seek to lift the problems of organizational structure out of the ruck of prejudice—by studying them scientifically."[22] The strength of cybernetics, therefore, is that it "provides a language sufficiently rich and perceptive to make it possible to discuss the problem objectively, without heat."[23] As a neutral language, cybernetics "should not develop its own ideology; but it should attest to one."[24] This is an important point: Beer recognized that his cybernetic toolbox could create a computer system capable of

[20] Herman Schwember, "Cybernetics in Government: Experience with New Tools for Management in Chile, 1971-1973," in *Concepts and Tools of Computer-Assisted Policy Analysis*, ed. Hartmut Bossel, *Interdisciplinary Systems Research* (Basel, Germany: Birkhäuser, 1977), 86, 135; Karl Marx, *Economic and Philosophic Manuscripts of 1844* (New York: International Publishers, 1964), 125.
[21] Beer interview.
[22] Stafford Beer, *Platform for Change: A Message from Stafford Beer* (New York: J Wiley, 1975), 425.
[23] Beer, *Brain of the Firm,* 180.
[24] Ibid., 260.

increasing capitalist wealth or enforcing fascist control, a moral dilemma that would later plague the project team. In Beer's opinion cybernetics made Marxism more efficient through its ability to regulate social, political, and economic structures. Marxism, in turn, gave cybernetics a purpose for regulating social action.

From 1971 to 1973 Beer expanded the project's goal from one of economic regulation to one of political structural transformation. However, the success of the project depended upon acceptance of the system in its entirety by members of the industrial sector and the Chilean government. As Beer himself acknowledged, adopting individual components could prove disastrous and result in "an old system of government with some new tools. . . . For if the invention is dismantled, and the tools used are not the tools we made, they could become instruments of oppression."[25] Nonetheless, observers from within Chile, around the world, and even within the project team tended to view Cybersyn as an accumulation of its technological components rather than a synergistic whole—in effect, separating the technology from the ideology behind its creation. According to Beer, members of Chile's opposition parties wrote congratulatory letters embracing the Cybersyn design—minus, of course, its emphasis on worker participation. The centrist Chilean newsmagazine *Ercilla* also separated the project from its socialist objectives and published an article in January 1973 entitled "The Big Brother of Mr. Beer"—an obvious allusion to the totalitarian world depicted in George Orwell's *1984*.[26] More sinister commentary appeared in the Rightist magazine *Qué Pasa* under the headline "The UP Controls Us by Computation."[27]

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[25] Stafford Beer, "On Decybernation: A Contribution to Current Debates," 27 April 1973, box 64, Beer Collection.
[26] "El 'hermano mayor' de Mr. Beer," *Ercilla*, 23-30 January 1973, 11.
[27] "Plan secreto 'cyberstride': la UP nos controla por computación," *Qué Pasa*, 15 March 1973, 7.

Internationally, the separation of the technology from the ideology provoked criticism from the British publications *New Scientist* and *Science for People*, both of which faulted Cybersyn for being overly centralized and abusive of the Chilean population.[28] Similar criticism came from the United States, particularly from the mainframe computing guru Herb Grosch of the National Bureau of Standards, who refused to believe that "Beer and his team could put together a major new model, in a strange and primitive hardware and software environment, in a few months." In a scathing letter to the editor of *New Scientist* Grosch wrote, "I call the whole concept beastly. It is a good thing for humanity, and for Chile in particular, that it is only a bad dream."[29] Throughout 1973 Beer received invitations from the repressive governments in Brazil and South Africa to build comparable systems. Considering the political context of each of these nations during the early 1970s, it is easy to sympathize with Beer's lament: "You can see what a false position I am in."[30]

According to Beer, the success of the system hinged on its acceptance as a *system*, a network of people as well as machines, a revolution in behavior as well as in instrumental capability. However, in practice quite the opposite occurred. Not only were the tools not accepted for the uses for which they were designed, but members of the Cybersyn team failed to fully understand the cybernetic principles behind their development. Nor were team members able to convey the rationale behind the system to members of the industrial sector. From the perspective of many

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[28] John Adams, "Everything Under Control," *Science for People*, April-May 1973, 4-6. Joseph Hanlon, "Chile Leaps into Cybernetic Future," *New Scientist*, 15 February 1973, 363-64.
[29] Herb Grosch, "Chilean Economic Controls," *New Scientist*, 15 March 1973, 626-27. Grosch is a rather interesting character in the history of computing, known first for his self-coined "Grosch's Law," which governed the mainframe computing industry during the 1960s and 1970s, and also for his notoriously cantankerous personality. While the harshness of his commentary in *New Scientist* may be attributed to the latter, Grosch had traveled to Santiago during the late 1960s to advise the government of Eduardo Frei Montalva on ways to improve Chile's computer capabilities. His comments, therefore, cannot be dismissed.
[30] Stafford Beer to Raúl Espejo, telex, 1 March 1973, box 66, Beer Collection.

Chilean engineers involved with the project, mastering cybernetic theories took a backseat to possibly ordering the increasing chaos of the Chilean economy. Contrary to Beer's view of the project, a number of the engineers described their work as primarily technical, rather than political, with the end goal of creating a new tool for economic management. One member of the Chilean team, who was charged with creating factory models of the textile sector, poignantly summarized the situation:

> The final objective, "the revolution in management" is not accepted, nor even understood. . . . I haven't seen a single manager really motivated by the central concept, and what is worse . . . [of] the team that has developed the work only a very few present the concepts involved. . . . Ultimately your work is accepted as long as it provides tools to achieve a more effective traditional management. It is not even a halfway revolution, it is a mixture, which if not adequately cared for might end up meaning a new increase in bureaucracy.[31]

To put it another way, instead of bringing about revolutionary change, these new technologies served to further entrench many of the management practices that had disempowered workers before Allende's presidency.

Engineering Participation

Both Beer and Allende sought to change the Chilean system of economic governance. Allende believed that transforming Chile from a capitalist to a socialist country required structural transformation and a systematic dismantling of former production practices. Beer's work was designed to provide the tools for transforming Chile's system of factory control by restructuring the industrial sector to adhere to his five-tier model, eliminating what he perceived as unnecessary bureaucracy and granting factory workers a new means of participating in factory regulation. In a report dated October 1972, Beer wrote, "The target is to transform the whole of

[31] Tomás Kohn to Stafford Beer, 19 April 1973, box 63, Stafford Beer Collection. When shown this letter thirty years later, Kohn exclaimed, "My God, was I an arrogant bastard!" Kohn interview.

industrial management, and to make Chilean industry fully effective in one year."[32] Beer wrote these lines around the same time of the October strike, a watershed moment that many consider the beginning of the end for the UP government and Allende's presidency. Given this context, Beer's remark seems naively optimistic and impossible to achieve. The cybernetician's ambitious ideas commanded the respect of his fellow Chilean team members—they often referred to him as a genius—but he frequently met resistance from those who claimed that his goals were politically unrealistic.

This was particularly true with respect to worker participation. Allende and Beer verbally committed to increasing the levels of worker participation within Chile's nationalized industries. Allende's presidential platform promised Chilean workers that they would participate in the management of their factories. While he refrained from providing an exact plan for worker management, he succeeded in pushing the long-deferred issue to the forefront of Chilean politics.

Chileans had discussed worker participation as early as the mid-1920s when President Arturo Alessandri (1920-1925) legalized unions and strike activity. Members of the FRAP, the Leftist coalition that preceded the UP and that ran Salvador Allende as its presidential candidate, called for the inclusion of labor in state planning activities as part of their 1964 election platform. However, after Allende's opponent, Eduardo Frei's election Montalva, was elected president, the national labor federation (CUT) pushed for higher wages and economic reforms rather than for worker participation. According to Espinosa and Zimbalist, the Frei government supported the idea of worker participation but did nothing to bring

[32] Beer, "Extension of Cybernetic Management Systems," 3.

about changes within the factories, deferring to more immediate concerns such as the "Chileanization" of copper or the agrarian reform.[33]

Allende made worker participation a central pillar of the Chilean revolution.[34] The UP made a clear commitment to participation as part of its platform, but members of the coalition had radically different ideas about how to achieve this goal. Some preferred strengthening the existing union representation within the factories, while others proposed creating a new infrastructure of worker committees, councils, and assemblies. Members of the MIR, the most radical Leftist party of the UP, pushed for a direct democracy within the factories that would include workers and consumer interests.[35] Members of the MAPU argued against both the centralization found in the Soviet Union and the ideas of direct democracy promoted by the MIR. Instead, MAPU members supported new hierarchies of well-trained workers and managers, each capable of performing the tasks assigned to them. In the Center, the Christian Democrats advocated the creation of "worker's enterprises" (*empresas de trabajadores*) inspired by the Yugoslavian experience: workers would share ownership of their firms and split the profits—an approach that provoked disdain from Allende. According to the president, making the workers "shareholders would be to convert them into pseudo-capitalists and this cannot be

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[33] Juan G. Espinosa and Andrew S. Zimbalist, *Economic Democracy: Workers' Participation in Chilean Industry, 1970-1973*, *Studies in Social Discontinuity* (New York: Academic Press, 1978). Juan Guillermo Espinosa played a role in drafting the Christian Left's initiative on worker participation put forward in mid-1973 to bridge the UP and the PDC programs and help form a Left-Center coalition. In spite of the initial support shown from both sides, the proposal did not receive congressional approval.

[34] This raises the related question of why Chilean interpretations of Marxism emphasized worker participation while other Marxist revolutions did not. According to James Wilson, Chilean Marxism drew upon parallel currents in thought, including the humanist tradition of the Christian Democrats and the sympathies toward workers expressed by the Roman Catholic Church. The addition of the MAPU and the Christian Left to the UP coalition further illustrates the ideological similarity between Marxist thought and that of the PDC. James W. Wilson, "Freedom and Control: Workers' Participation in Management in Chile, 1967-1975" (Ph.D. diss., Cornell University, 1979)

[35] The MIR's base of support--poor slum dwellers, intellectuals, students, and middle-class youth, all of whom were outside the industrial sector--explains this unorthodox position.

conceived of as a means of transformation in a process such as the one in which we are living."[36] Allende, however, lacked a clear position of his own. Wilson describes the UP program as sketchy with respect to participation and claims that Allende attempted "to conceal this sketchiness with rhetoric and betray a greater interest in participation as a means to an end."[37] The lack of a clear approach inspired numerous organizational reshufflings within the public sector enterprises, all with varying degrees of clarity and efficacy.

In June 1971 a collaboraton between the government and the CUT resulted in the "Normas Básicas de Producción," a first attempt at resolving the issue of participation. The document proposed a rather complicated hierarchy of committees at levels ranging from the shop floor to the top management of an enterprise and included representatives from the blue- and white-collar workforces as well as union leaders. The "Normas" called for three channels of worker participation in factory management. At the top level of the management hierarchy, they envisioned an administrative council with decision-making power similar to that held by a board of directors. This council would consist of five workers (three from production, one administrator, and one professional) and six government representatives, including the state-appointed interventor.[38] The report also called for the creation of production committees at the section, department, and division levels, all consisting of worker representatives elected from general assemblies of their peers. Members of these worker committees would be able to offer suggestions for improving working conditions and increasing production but would not exert decision-making power.

[36] Wilson, "Freedom and Control", 352.
[37] Ibid., 347.
[38] By 1973 them ratio of five workers for six government representatives had changed to 5:5 in practice. Before 1973 workers often enjoyed a majority presence in administrative council meetings. Government representatives frequently had other commitments and could not attend meetings.

Worker representatives from both the production committees and the administrative council would form the coordinating committee, a body that was to serve as liaison between these two participatory channels. According to the "Normas," labor unions would maintain their independence. Union delegates would continue to serve as representatives of working-class interests but would not hold positions within the production committees or the administrative council. The government made the "Normas" public on September 1, 1971, but had already applied the plan to managing the nationalized textile mills Yarur, Progreso, Hirmas, and Fabrilana. By June 1972 the organizational structure outlined by the "Normas" existed in modified or complete form within 76% of the public enterprises.[39]

In the 1960s, the International Labor Organization (ILO) of the United Nations identified three areas of worker participation.[40] These categories provide a better understanding of the levels of worker participation achieved within the nationalized firms during Allende's presidency. Chilean workers had considerable experience in the first area—solving social, administrative, and personnel problems—through years of union representation. They had considerably less experience in the second area, which the ILO defined as resolving technical and production problems. However, the plan outlined by the Normas provided opportunities for workers to participate in these areas through their elected representatives to the production committees and the administrative council. The Normas did not provide a outlet for worker participation beyond the factory level. As such, workers contributed very little to the third area, which the ILO defined as participation in the economic and financial management of the firm. Workers

[39] Espinosa and Zimbalist, *Economic Democracy,* 53.
[40] Organizaci6n Internacional del Trabajo, La participaci6n de los trabajadores en las decisiones que se adoptan en las empresas. Geneva: Oficina Internacional del Trabajo, 1969. Cited in Ibid.

pushed for representation within the sector committees of CORFO but received little support from the government. While Espinosa and Zimbalist attribute the lack of worker representation in state planning to the failure of Chilean economic planning efforts, Pedro Guglielmetti, head of the CUT-government participation committee until late 1972, offered a more direct explanation. High-ranking members of the government "from Allende down," including the state-appointed interventors, did not view participation as a vital issue.[41]

From the outset the creators of Cybersyn considered it a tool for worker participation. Beer claimed Allende emphasized the importance of participation during their first meeting in November 1971 as well as during their last meeting in July 1973. In their July conversation the cybernetician asked the beleaguered president, "in view of the confusion being generated around the project" what was the "extent to which [Allende] expected worker control of the social economy?" "El maximo," the president replied.[42] The pages of the 1973 CORFO report "Proyecto Synco," the Spanish name of the Cybersyn project, further confirm Beer's account. According to the report, the system's "true results" were derived from "the construction of a more just society, with effective worker participation, that organizes itself, operates, and develops itself coherently with the higher politics of the country."[43] The connection between the UP's ideological commitment to worker participation and the design of the system seems clear. However, like the UP platform itself, ambiguity arose not in the system's overarching goals but in its implementation. Beer's project reports about the system contain several suggestions

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[41] Pedro Guglielmetti, interview by James Wilson, 18 October 1973 and 25 October 1973. Cited in Wilson, "Freedom and Control", 371-72.
[42] Beer, *Brain of the Firm*, 346.
[43] CORFO, "Proyecto Synco conceptos y práctica del control; una experiencia concreta: la dirección industrial en Chile," ed. Corporación de Fomento de la Producción (Santiago de Chile: 1973), 3..

for how to insert workers into Cybersyn's operation and expand their role in the revolutionary process. In a report dated December 1972, one month after the October strike, Beer wrote:

> We have wrestled with the problem of technocracy in Cybersyn. The answer seems to be that the workers themselves must man the team – with the help of scientists. I see this relationship in exactly the same light as the relationship should be between workers and technicians on the shop-floor. The Operations Room is the shop floor of Total Industry. It is a place for the workers.[44]

Beer's reports also include plans to build simplified versions of the Operations Room within the nationalized industries, creating a space for workers to meet, monitor production, and contribute to the decisions affecting their factory.[45] These simplified rooms used nothing more sophisticated than chalk on a blackboard but would incorporate the methods of collecting and presenting information developed by the Cybersyn team. Beer called for workers to contribute their intimate, even tacit, knowledge of production activities to the process of modeling their factories. In this plan workers would assist operations research scientists and engineers at INTEC, an agency affiliated with CORFO, in selecting the key indicators of production as well as their appropriate threshold values. Beer later urged workers to take an even greater role in this process. "There is no-one better qualified to model a plant, than the man whose life is spent working in it," Beer concluded. "He knows."[46] Beer had confidence in workers' ability to master the tools designed by his team-- software, simulators, flowcharts, and production indices associated with the system. He compared these tools to automated machinery. Workers did not need to understand

[44] Stafford Beer, "One Year of (Relative) Solitude," p. 4, December 1972, box 61, Beer Collection.
[45] This proposal did not specify whether the administrative council, coordinating committee, or any of the production committees would use the room.
[46] Beer, "One Year of Relative Solitude," p. 5.

the complicated inner workings of the system, only how to use the tools it provided and their benefits to production.[47] Once workers understood and recognized the value of the tools, Beer reasoned, they would demand them. Workers, not an upper-level bureaucrat, would provide the impetus for the system's use. CORFO also identified workers as key contributors to Cybersyn's operation. Their experience in dealing with factory bottlenecks and equipment limitations would provide vital information for assessing the levels of production that a factory could achieve. By quantifying shop-floor knowledge in factory flowcharts and models, each worker:

> knows their interaction with the rest of the parts of the system, and of their system in relation to other systems. This effort would permit the workers to understand problems of investment . . . as well as problems of production and its fluctuations through comparisons of what <u>is</u> with what <u>can be</u>.[48]

CORFO cited promising results within the firms INSA and Muebles Easton, where the process of defining production indices initiated "a process of general participation of executives and workers" as well as studies of "organization, information and participation." From this experience the report concluded that workers were perfectly able to understand the system but that "there is much more to do in this area."[49]

How, then, do we determine the value of the Cybersyn Project with respect to worker participation? According to Patricia Cornejo, a socialist who helped draft the "Normas," participation not only orients, disciplines, and commits the working

[47] Beer's reasoning is questionable here given that automation had led to the deskilling of the workforce, increased the power of managers over workers, alienated workers from their labor, and in some cases raised levels of unemployment. From the early 19th century onward, workers vented their frustrations stemming from the changing nature of their work by attacking the new mechanical technologies arriving in their factories. In this context, it seems unlikely workers would demand new forms of automation. Studies of worker resistance to automation can be found in David F. Noble, *Forces of Production: A Social History of Industrial Automation*, 1st ed. (New York: Knopf, 1984) and Shoshana Zuboff, *In the Age of the Smart Machine: The Future of Work and Power* (New York: Basic Books, 1988).
[48] CORFO, "Proyecto Synco conceptos y práctica del control; una experiencia concreta: la dirección industrial en Chile," 40..
[49] Ibid., 47.

classes but also consolidates the changes brought by the revolution in Chilean economic, political, and social structures.[50] Therefore, judging the efficacy of Cybersyn requires evaluating its ability to organize worker participation in a substantive manner as well as its ability to formalize the goals of the Chilean revolution within the structure and practice of factory management. To further explore these aspects of the system, let me now turn to a case example.

Participation in Ex-Yarur

On April 28, 1971, the Yarur cotton textile mill entered the Chilean history books as the first enterprise to be seized by its workers for incorporation in the public sector.[51] It was the largest and oldest textile mill in the country, with approximately three thousand workers, but it had not been on the government's original list for public requisition. The government's decision to acquire the mill illustrated the strength of the revolution from below that Allende's presidency had unleashed, and it accelerated the pace of the nationalization process. As 1971 unfolded, workers at other factories followed the example set by the workers at Yarur and tried to take control of their destiny. "Ex-Yarur," as the mill was known after its nationalization, served as the government's test case for requisitioning a firm by using emergency decree powers rather than offering to purchase the enterprise from its original owners. Use of this legislation facilitated the nationalization process but provoked criticism from both the Christian Democrats and the Right.

Yarur provided one of the most suitable test cases for Cybersyn's early introduction into factory management practices. Allende had identified enterprises

[50] Wilson, "Freedom and Control", 350.
[51] Winn, *Weavers of Revolution*

within the textile sector as priorities for requisition. A CORFO report on the Cybersyn system similarly pointed to factories within the textile and forestry sectors as among the first to be modeled and connected to the telex network. Because the mill was the test case for government intervention and requisition, Ex-Yarur received the best of everything, including the most qualified state-appointed interventors and the attention of high-ranking government officials. It seems logical that the mill would be among the first enterprises considered for an experimental computer system that improved industrial management.

Ex-Yarur also was among the first to set up the series of participatory bodies described in the "Normas Básicas de Producción," albeit in modified form. Within a year workers at the mill had made significant gains in leadership and in expanding the scope of their participatory powers. Winn describes a General Assembly meeting at Ex-Yarur at which workers rejected the mill's annual financial report because it was "incomprehensibly technical in some parts, inappropriately political in others, and delivered orally." They insisted that the report be "drawn up in a form they could understand" so that they could determine its merit and use the information to contribute to future decisions at the factory.[52] By the time the Cybersyn project truly got underway in March 1972, the workers at Ex-Yarur had already made significant strides toward self-organization, increasing worker confidence, and raising the level of participation in management. Members of the Ex-Yarur workforce in particular seemed poised to demand the tools of the Cybersyn system if they believed that they would add to the gains that the workers had already achieved.

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[52] Peter Winn, "Workers into Managers: Worker Participation in the Chilean Textile Industry," in *Popular Participation in Social Change: Cooperatives, Collectives, and Nationalized Industry*, ed. June Nash, Jorge Dandler, and Nicholas Hopkins (Chicago: Mouton, 1976), 588.

Ex-Yarur possessed other distinguishing features that made it suitable for introducing Cybersyn. Union leaders at the mill represented both blue-collar workers and white-collar employees. For years the technical professionals in particular, especially those from the data-processing division known informally as IBM, played a significant role in the mill's history of labor resistance. In 1966 five employees of the IBM division incited a work stoppage to protest their working conditions, the first employee-driven stoppage in Yarur's then thirty-four year history.[53] By the end of 1970 the organized members of the IBM division had found additional support among the industrial engineers who were working in Yarur's Division of Production Control and Planning. Together they formed an official employee union in early 1971. Although workers and employees continued to feel resentment toward one another and their respective roles in Chile's revolutionary process, both white-collar employees and blue-collar workers had a history of organization and resistance at Ex-Yarur. Both groups had drawn strength from Allende's presidency. If the government wished to unite technical prowess with greater participation among the rank-and-file, which was necessary for the Cybersyn system to function properly, it would be hard pressed to find a more suitable factory than Ex-Yarur. The expropriation of the mill had also attracted the attention of high-ranking members of the MAPU, including Oscar Guillermo Garretón, deputy minister of the economy. The application of computer technology to economic management had been the brainchild of another MAPU party member, Fernando Flores. Finally, the owners, the Yarur family, had made significant efforts to modernize factory production and management during the 1950s and 1960s and owned one of the few factories that possessed telex machinery and its own computer

[53] Winn, *Weavers of Revolution*, 183.

system. Technically and politically, Ex-Yarur appeared to offer an ideal setting for testing the ideological aspects of the Cybersyn system, including its mechanisms for worker participation.

However, Ex-Yarur managers and INTEC engineers shared a very different story. Ex-Yarur was one of the first factories connected to the Cybersyn system, but it does not appear that Ex-Yarur's workforce knew about the system. In bringing the system to Ex-Yarur, the INTEC engineers responsible for modeling factory operations hid the system's participatory facets and promoted its technological benefits. Workers could not demand the tools offered by Cybersyn, as Beer claimed they would, because workers did not know that the tools existed.

After the government requisitioned the Yarur mill in April 1971, Juan Francisco Sánchez was appointed to serve as one of the mill's three interventors, charged specifically with managing finances. Like many of the government administrators working for the Allende government, Sánchez was young. He was also a recent graduate of the Catholic University in Santiago and a member of the MAPU – a profile remarkably similar to that of Flores. The two men knew one another from their time together in the Catholic University and had continued to travel in the same academic and political circles. Both had played an active role in the university reform movement of the late 1960s and had contributed to modernizing the administration of the Catholic University, Flores in the role of academic director and Sánchez as the subdirector of administration and finances. In addition, they shared an interest in modernizing the form of management found in the Chilean industrial sector. "In the School of Engineering," Sánchez recalled, "we wanted to modernize production, to make this country, that was so traditional, be able to advance."[54] Referring to the technical inclinations of his MAPU colleagues, Sánchez added that "making a structure of management and modernizing the management of the [nationalized] enterprises attracted our attention, not only for its political side but also because it interested us." Through his connections with the MAPU, Sánchez learned of Beer's cybernetic model and even applied material from several of Beer's publications in his work as a management consultant after the 1973 military coup.

Sánchez never encountered the Cybersyn system during his time at Ex-Yarur, although he did become involved with the project once he left the textile mill and assumed a position within the Division of Finances and Planning of the Textile Sector Committee at CORFO.[55] In Sanchez's opinion the cybernetic underpinnings of the system "generated certain conditions of autonomy and a balance among different positions or interests. For me it was very satisfactory." However, he described Cybersyn as "a technological structure" or set of "technological tools." "I separated all of Project Cybersyn from Beer's model," Sánchez said, a statement that concisely illustrates the slippage between the model and its implementation. Even the desire to increase Chilean efficiency by creating new technologies took a backseat to the daily emergencies that CORFO employees faced. "Our urgencies were brutal," Sánchez recalled, describing the everyday struggles to maintain national production. In this context, he warned, "don't come to me to send papers"-- a statement he made

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[54] Juan Francisco Sánchez, interview by Peter Winn and Eden Medina, 27 July 2003.

[55] Due to his connections with Flores and the MAPU, it seems logical Sánchez would have known of the project if it had been implemented in Ex-Yarur during his time as the mill's financial interventor. The fact that he did not encounter the project could be a result of his leaving the factory to work for the CORFO Textile Committee before the INTEC factory modelers arrived at the mill, or because the project maintained a low profile in its early stages that made it unknown even to other members of the MAPU. The first state appointed general manager of the mill, Andrés Van Lancker, would have been the most likely person to know of the Cybersyn project within Ex-Yarur. However, he died before the research for this dissertation project began.

referring to the daily telex transmissions of factory data demanded by Cybersyn engineers.[56]

When Sánchez left Ex-Yarur for his position at CORFO, Patricio Taulis took over as interventor of finances. Taulis confirmed Ex-Yarur's involvement in the Cybersyn project and maintained that the system "was absolutely unknown" among the workers.[57] Taulis claimed to have sent all of Ex-Yarur's production indices to CORFO himself, without the intervention, participation, or aid of anyone else, with the possible exception of his assistant, Jaime Betancourt. "There was no democracy . . . there was no human evaluation, there was no participation. The data were the most important, period." Later in our conversation he remarked, "Project Cybersyn, this project of the social property area, was not realized—not for a lack of desire but because it was not prioritized." The government, he concluded, "was worried with other things." Vicente Poblete, the second general manager of Ex-Yarur, also did not remember the system or its component parts. However, he did describe a number of other measures that he implemented within Ex-Yarur to encourage worker equality and participation.[58]

Conversations with INTEC engineers further confirmed the limited political scope of the project's implementation. Tomás Kohn began working for INTEC in March 1972 after completing his master's degree in mechanical engineering at Louisiana State University in the United States. He listed his primary interests as operations research, optimization theory, and modeling. When he returned to Chile, he wanted to gain practical experience and accepted an offer to work at INTEC for

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56 Sánchez interview.
57 Patricio Taulis, interview by Peter Winn and Eden Medina, 28 July 2003.
58 Vincente Poblete, interview by author, 31 July 2003. One of Poblete's favorite accomplishments was knocking down the wall that separated workers from employees in the mill's cafeteria.

José Valenzuela, the vice director. Kohn was assigned to the INTEC Cybersyn team headed by INTEC engineer Jorge Barrientos. "When this project started rolling," Kohn said, "my initial responsibility was modeling one particular sector and identifying the indices, according to Stafford's model, in the textile industry. . . . We focused on production indices, not so much on the financial side. More on the physical side, production capabilities. We also had some indices that reflected the man-hour input, absenteeism."[59] During 1972 Kohn visited Ex-Yarur, as well as other textile plants, such as Sumar and Bellavista. He began the modeling process by contacting the interventor and then approaching people within "the engineering side of the company." When asked to describe the reaction of the interventors and plant engineers to the goals of the Cybersyn project, Kohn replied:

> Looking back, they must have been really pissed off. We were fairly young at the time. For most of us it was probably our first job. We were pretty arrogant, not because of any political position but because we thought we had a good model, and we firmly believed in this approach to looking at a company and what it could help in managing a company. We were convinced that this was a model that really shed new light and gave new tools for managing. . . . I remember one particular guy at, I think it was, the Yarur plant who was an engineer who had spent a couple of years already reaching the level of plant manager, and he was obviously not fond of the changes that were taking place in the country. He was difficult to deal with. When it came to more technical aspects he could work quite openly.

Kohn described the process of modeling the factory as "a fairly technocratic approach," one that was "top down" and did not involve "speaking to the guy who was actually working on the mill or the spinning machine or whatever." When asked about the system's implementing the forms of worker participation described by Beer, Kohn replied, "Well, I can understand [Beer's] statement, especially given the

[59] Tomás Kohn, interview by author, 5 September 2003.

political circumstances. I don't recall any instance in which one would say that was actually happening."

Eugenio Balmaceda, the INTEC engineer responsible for modeling enterprises within the forestry and construction sector, also reported working exclusively with the directors of the firm, not the workers. Like Kohn, he found it easier to avoid the political aspects of the project and concentrate solely on the technical aspects. "We did not get into political themes that much," Balmaceda said. "We tried to make [our presentations] as technical as possible." Unlike Kohn, Balmaceda remembered giving a general description of the project to assembled groups of workers and that "they were totally in favor of the ideas we wanted to implement." Later in our conversation he added, "the workers could not have many doubts [about the system] because it was a highly technical subject."[60]

A Participative Technology?

From the experience at Ex-Yarur we can draw two central conclusions regarding worker participation. First, the councils and committees outlined in the "Normas Básicas de Producción" and adopted in modified form by Ex-Yarur created a series of structural changes within the mill's management practices. These succeeded at directing worker participation and broadened the channels through which they could participate. The introduction of these advisory and decision-making bodies led to real advances in workers' leadership capabilities and levels of worker awareness, until the strike of October 1972 changed the Chilean political climate. Afterward, the severity of the nation's economic and political crisis deflected attention from the

[60] Eugenio Balmaceda, interview by author, 28 January 2003.

issue of participation. Instead, workers, managers, and administrators struggled to maintain production despite work stoppages, labor strikes, and shortages of spare parts and raw materials.

Second, it does not appear that Cybersyn contributed to the organizational changes laid out in the "Normas" or succeeded in implementing parallel mechanisms for worker participation. In the Ex-Yarur context workers remained unaware that the Cybersyn system existed. Elsewhere, INTEC engineers used only the most general terms when explaining the system's functionality to the rank-and-file of the shop floor. From the perspective of the cybernetic modelers, technocracy regularly eclipsed ideology on the factory floor. Although INTEC engineers received explicit instructions to work with worker committees in developing the quantifiable models that detailed factory production capabilities, often the converse occurred, and the engineer treated the worker with condescension, or he would ignore the workers altogether and deal directly with management. Moreover, the engineers frequently hid or overlooked the political facets of the project in favor of emphasizing its technological sweetness, thereby avoiding potential labor conflicts. Although the project team drew up training programs for educating workers about the use these new management tools, these efforts never came to fruition. We can only speculate how the Cybersyn system might have functioned within the nationalized factories if it had been completed. However, these initial experiences suggest that the social and technical networks of communication created by the system would have further solidified the channels of communication between the CORFO sector committees and the upper level of factory management. In their study of worker participation in Chile, Espinosa and Zimbalist concluded that "effective participation requires both cooperation from administrators and extensive information dissemination regarding the operation of the enterprise."[61] Cybersyn might have physically increased the flow of information within the factory, but it could not change the attitudes toward worker participation held by white-collar engineers, factory managers, and government bureaucrats.

Within the Cybersyn team factory modelers were not alone in their preference for technical solutions. In response to one of Beer's later reports, Raúl Espejo, the Cybersyn project director, wrote, "Within the government in the short term, I think the ideological problems are in a second place. . . . We can do models for effective problems of the economy. . . . Through them we can dismantle the bureaucracy."[62] Throughout 1973 Beer grew increasingly frustrated with Espejo's technocratic leanings; this statement is a perfect illustration of Espejo's affinity for technical, rather than ideological, problems.[63] The perceived importance of technology to the Cybersyn project is perhaps best illustrated in figure 6.2, a drawing made by the state computer agency ECOM that was used to describe the Cybersyn's operation during a government-sponsored data processing conference. Instead of making Chilean workers the central figures of Cybersyn's operation, as in figure 6.1, the image shows a mainframe computer occupying the place of privilege at the heart of the system.

Workers recognized the CORFO preference for top-down, technocratic management and criticized the state agency for not creating participatory channels for workers within the upper echelons of economic planning. This became especially clear in July 1972 during the *Encuentro Textil*, a three-day meeting between the government and workers' representatives from across the textile industry, where

[61] Espinosa and Zimbalist, *Economic Democracy*, 183.
[62] Raúxl Espejo to Stafford Beer, 22 May 1973, box 66, Beer Collection.
[63] Beer interview.

both parties assessed the first year of nationalization. During the meeting workers called for increased representation in CORFO and openly condemned the technocratic leanings of the CORFO Textile Committee, which the workers regarded as ruling from above and failing to invite the participation of the rank-and-file. As most workers did not know of the Cybersyn project, these criticisms were not leveled at the system explicitly. However, the frustrations expressed by these textile workers agree with the observed lack of worker contributions to the development of this CORFO-sponsored technological system. Worker representatives further argued that the sector committee's reliance on bureaucrats and technicians limited the scope of workers' influence and created a system of management that they described as bureaucratic, undemocratic, bourgeois, and incompetent.[64] Given the reported absence of worker participation in the process of creating factory models, and the willingness of factory managers and CORFO employees to sacrifice ideological goals for technical solutions, we can easily imagine similar critiques directed at the Cybersyn project.

Outside the textile industry, workers remained mostly ignorant of the Cybersyn system and the management tools that it offered, with one notable exception.[65] Raimundo Beca, an interventor assigned to MADEMSA, a maker of

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[64] These comments were made at the Encuentro Textile, a three-day meeting held in July 1972 between government officials and worker representatives from the nationalized textile mills. In general, worker complaints against the government were minimal, except for the criticism about the lack of worker participation in the Textile Committee (Comité Textile) and other upper-level administrative bodies. Winn, "Workers into Managers," 596.

[65] I made several attempts to locate workers who either used or remembered hearing about the Cybersyn project in their factories. Toward this end, I attended meetings at the National Labor Confederation (CUT), advertised in Chilean periodicals, and contacted labor leaders from the UP era. In the end, not a single worker could recall hearing of Project Cybersyn, Proyecto Synco, an operations room, a telex network of communication, or a computerized system of economic management. Of the workers I interviewed, none knew of government attempts to create cybernetic factory models or participated in their creation. However, my efforts to locate workers did turn up additional CORFO employees who contributed to the project in its final months and whose names did not appear in the archive of Stafford Beer's papers.

electrical appliances, recalled that mapping the vital indices of production provided a source of motivation for workers, who used the figures as a basis for rewards and as a means of promoting collective production instead of individual output.[66] However, Beca also served as the director of the state computer agency, ECOM. His leadership roles at both MADEMSA and ECOM during Allende's presidency may explain why the Cybersyn system was more visible to MADEMSA workers and why Beca perceived the system as a noteworthy component of factory production and participation. But Beca could not address how workers perceived their use of the system or its significance. Generally speaking, it seems safe to conclude that the system failed to increase worker participation within the nationalized enterprises. The experiences recounted by Ex-Yarur interventors and INTEC cybernetic modelers raise additional questions about the level of government commitment to implementing the ideological facets of Cybersyn's design.

Instead of promoting social transformation and augmenting worker participation at every level of government, a principle upheld on paper by Beer and CORFO, the interactions between Cybersyn engineers and workers in the nationalized sector reflected Chilean social and cultural hierarchies in general and reinforced the project's technocratic image. The priority given to technical expertise within the nationalized factories was later summarized in a paper written by a member of the project team. According to the author, "The individual [workers] should have effective and organic feedback channels to all niveaus [levels] of the system" but at the same time should learn to accept expert advice and even demand

[66] Beca interview. Beca, who was both director of ECOM and interventor for MADEMSA during the government of the UP, noted that the use of the system depended strongly on interventor support. For example, MADEMSA discontinued all work on Cybersyn's implementation after Beca left the factory.

it when necessary. This would help them "avoid confusion of their role."[67] However, as the case of Ex-Yarur illustrates, within a year workers had learned to demand information in a form that they could understand, which allowed them to contribute to factory planning and management. As the workers saw it, CORFO's reliance on technical expertise constituted one of the greatest obstacles to their real participation within the higher levels of government administration.

With regard to participation, the theoretical underpinnings of the system differed significantly from its implementation. Moreover, the proposed channels for worker participation that were incorporated in Cybersyn's design were overlooked in favor of giving factory managers tools for better top-down management. In this sense the project gave additional power to the upper levels of factory management, CORFO administrators, and technical experts. Workers criticized this exclusionary concentration of power and argued that the technocratic and bureaucratic approach employed by the CORFO sector committees limited workers' opportunities to participate at the level of national economic planning. Following the October strike, the telex network became crucial to the government's survival and changed the project's focus from a means of transforming society to a tool for helping the bureaucracy to survive. The strike also had a dramatic effect on the nature of worker participation. Workers from different factories banded together in *cordones industriales* (industrial belts) and geographically coordinated their efforts in support of the government. Within the factory, however, surviving the daily crises of production siphoned attention away from worker participation efforts and stalled

[67] Schwember, "Cybernetics in Government," 88. It is interesting to note that Beer went in another direction as the project progressed and eventually drafted both a report and a letter to President Allende emphasizing the importance of the workers' learning to create the models themselves rather than looking to the advice of technocratic experts.

the gains that workers had made previously. Ironically, Allende expressed his greatest commitment to worker participation during his last year in office, perhaps as a last attempt to maintain his popular base of support. However, as 1973 progressed, the Cybersyn system and the UP government lost their ability to implement change. Instead, both struggled simply to maintain the status quo.

Gendered Technology

Just as the system's implementation in the factory setting highlighted the government's ambivalence toward worker participation, the design of the Operations Room illustrates how gender influenced ideas of participation and the access to political power. The design positioned seven chairs in an inward-facing circle. Once seated in these chairs, the occupants of the room could change the information presented on the various wall displays to suit the topic under discussion. Beer recognized that the men sitting in the chairs would not possess skills as typists—an occupation typically performed by female secretaries. Therefore, in lieu of the now-traditional keyboard, the Operations Room team designed a series of large "big-hand" buttons that participants could "thump" if they wished to emphasize their point. Beer felt that this design decision facilitated communication by eliminating "the girl between themselves and the machinery."[68] He was referring to a literal woman, a typist who would navigate the keyboard interface on behalf of the bureaucrats or factory workers occupying the seven Operations Room chairs. The large buttons made this additional operator superfluous and created a more intimate relationship between the humans and the machine. I argue, however, that this

[68] Beer, *Platform for Change,* 449.

design decision reflects the gendered history of Chile, as well as of the Left, and illustrates how technology can embody the politicization of gender.

There is no question that the room was designed, consciously or unconsciously, as a masculine space.[69] Another participant equated the act of banging on the armrest with "an ejaculation." Most would surely agree that this form of communication bears a closer resemblance to masculine aggression than to a form of gender-neutral or feminine expression. See figure 6.3[70] for a close-up image of the chair. The ashtray and the space for a drink on the let armrest further convey the type of environment for control envisioned by the room's designers. Many project participants cited Winston Churchill's underground cabinet war room as the inspiration for the Opsroom. It is easy to imagine Churchill smoking a cigar with his generals while seated in the Chilean reinterpretation of his command center.

The characteristics ascribed to the room's future occupants reveal assumptions of who would hold power within the Chilean revolution. Generally speaking, workers and bureaucrats would have the ability to make decisions affecting the direction of the country; clerical workers, those operating outside the formal economy, and women would not. As several historians of gender in Chile have noted, the vast majority of industrial workers and government officials were male. Most Chilean women held jobs in the service sector or stayed at home.

In interviews project participants described the room as a democratic and equalizing space, and project notes back these recollections. The designers of the

[69] When asked, several participants interviewed did not remember the room as being designed as a male space. This, however, does not eliminate the importance of gender perceptions in the resulting design, especially in assigning characteristics to the room's users. In an interview Beer said the decision to "eliminate the girl" reflected the existing structure of power in the Chilean government and therefore represented a realistic acknowledgment of the room's likely inhabitants. This raises the question of why the government did not feel a need to change the gendered structure of power and make gender part of the Chilean revolution.

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Opsroom aimed to create an environment for government decision making as well as a new channel for working-class power. Its design reflected these commitments. Recognizing the low-level of formal education completed by many Chilean workers, Beer claimed the big-hand design made the room suitable for workers instead of a "*sanctum sanctorum* for a government elite."[71] Yet Cybersyn scientists focused their attention to equality and empowerment exclusively on overcoming the injustices caused by class difference. Why did the designers not direct a similar level of attention to the inequalities of gender? Instead of creating a truly democratic space, the gendered assumptions reveal systematic sexism within the Chilean revolution and the unequal opportunities made available to Chilean men and Chilean women.[72]

Historians of gender have criticized the UP for its ambivalent attitude toward women, as well as the Left's focus on the largely male groups of industrial workers and, to a lesser extent, rural peasants.[73] Traditional Marxist narratives and labor histories have similarly marginalized the experiences of women and the urban poor. In the pages of the Leftist *Cuadernos de la Realidad Nacional,* the Chilean social scientist Ribeiro criticized existing bodies of social theory for failing to address the experiences of Chilean women and privileging production outside the home over reproduction and related domestic activities.[74] She was not alone in her critique. Years later the historian McGee Deutsch wrote, "Existing studies have stressed the Left's inability—of which there are numerous examples—to conceive of female

[71] Beer, *Brain of the Firm,* 270..
[72] This is especially curious, given the UP's need to grow its base of support among Chilean women. Although Allende won the 1970 election by popular vote, the majority of his supporters were overwhelmingly male.
[73] This critique has also been leveled at social and labor historians.
[74] Lucía Ribeiro, "La mujer obrera chilena. Una aproximación a su estudio," *Cuadernos de la realidad nacional*, no. 16 (1973).

participation in the struggle for socialism."[75] Chilean organized labor and the beginnings of the Socialist Party both emerged from the almost all-male environment of the nitrate mines during the latter part of the nineteenth and early twentieth centuries. The Socialist Party, created in 1933, looked to the labor unions as a stronghold of its support and thus prioritized workers' needs over those of others. Moreover, the wage structure supported by the Left and the Center-Left popular front (1936-48) reaffirmed an ideology of gender that positioned men as productive and relegated women to dependent and subordinate positions within the home. As Rosemblatt as shown in her study of gender during the popular front period, modernization projects educated and disciplined the Chilean popular classes and promoted "the value of cleanliness, temperance, hard work, sexual restraint, and, above all, love of the family."[76] These state programs produced and enforced gendered identities for Chilean men and women, transforming working-class men into productive breadwinners and working-class women into attentive wives and mothers.[77] Klubock, confirming Rosemblatt's analysis, writes, "The popular fronts, with the support of labor and the Left, built their political hegemony on the foundation of a gendered political ideology that defined the rights and benefits of national citizenship in terms of the male worker and head of household and the female housewife."[78]

In the political sphere women gained the right to vote in municipal elections as early as 1934. However, they had to wait another fifteen years (1949) to be

[75]Sandra McGee Deutsch, "Gender and Sociopolitical Change in 20th Century Latin America," *Hispanic American Historical Review* 71, no. 2 (1991): 297-98.
[76] Karin Alejandra Rosemblatt, *Gendered Compromises: Political Cultures and the State in Chile, 1920-1950* (Chapel Hill: University of North Carolina Press, 2000), 3-4.
[77] See also Ibid. ; Karin Alejandra Rosemblatt, "Charity, Rights, and Entitlement: Gender, Labor, and Welfare in Early Twentieth-Century Chile," *Hispanic American Historical Review* 81, no. 3-4 (2001)
[78] Thomas Miller Klubock, "Writing the History of Women and Gender in Twentieth Century Chile," *Hispanic American Historical Review* 81, no. 3-4 (2001): 507.

allowed to participate in national elections. Although the popular front period permitted the mobilization of Chilean women, support for these gains also came from the Right, which felt that women would support its conservative platform. Even before Allende became president, early Chilean feminists such as Felicitas Klimpel lamented the lack of commitment shown by the Left toward the promotion of gender equality.[79]

Given this history, it is not surprising that women occupied a marginalized position with the UP and that the UP had difficulty articulating the role of women in a consistent manner. This does not mean that the UP did not vocally commit to improving the living conditions of Chilean women and that some of these promises materialized. The National Milk Program distributed rations of milk to Chilean mothers and children. The government also passed laws requiring businesses of a certain size to provide day-care programs for working mothers. Under Allende the *Centros de Madres* (Mother's Centers), a collection of community organizations begun in the late 1940s and promoted by the Frei administration as a space for educating women about how to be better wives and mothers, increased their membership to more than one million and expanded to offer vocational training. Women became eligible for membership in agrarian cooperatives, and free medical care in the slums gave poor women greater opportunities to care for their families. Apart from these gains, the UP platform called for a new Ministry of the Family, greater pay equity, equal educational opportunities for Chilean men and women, legalized divorce, and equal rights for legitimate and illegitimate children. The government even named 1972 the "Year of the Woman." However, the UP never

[79] Felicitas Klimpel, *La mujer Chilena: el aporte feminino al progreso de Chile, 1910-1960* (Santiago: Editorial Andres Bello, 1962).

implemented the majority of promises directed at its female constituency, a failure that some attributed to the strength of the opposition parties and others to the lukewarm support shown by the UP to issues affecting Chilean women.

Since the 1930s workers supported the Socialist Party and served as protagonists of Chile's proletarian revolution. However, there were very few women among their ranks. According to the 1970 census, only 20% of all Chilean women worked outside the home. Of these, only one-fifth worked in the factories – approximately 4% of Chile's female population of working age.[80] Protective legislation for female workers supported by the Left--such as labor laws that prohibited women from working nights, legalized maternity leave, and required employers to provide day-care facilities--often had the opposite effect. Factory managers frequently regarded female employees as less desirable than their male counterparts, who could work any one of the plant's three 8-hour shifts without restriction. Managers often hired women as a last resort or when there was no union that could force managers to adhere to these labor laws.[81] Of the small percentage of women employed by the Chilean factories, most did not have union representation or access to the participatory mechanisms being implemented elsewhere. The UP rhetorically encouraged more Chilean women to enter the industrial sector, yet the Leftist coalition did not provide them with the union support that they needed to

[80] Cited in Camilla Townsend, "Refusing to Travel *La Via Chilena:* Working-Class Women in Allende's Chile," *Journal of Women's History* 4, no. 3 (1993), and Ribeiro, "La mujer obrera chilena," Ribeiro notes that women working outside the home had relatively small roles in industrial production but had a greater, albeit limited, presence in the service industry, which included the distribution and circulation of goods.

[81] At the Yarur mill women constituted the majority of machine operators until the mid-1950s. With the introduction of protective legislation, the Yarurs refrained from hiring women because hiring them had become more expensive. By the time Allende became president in 1970, only 10% of the mill's workforce was female. Winn, "Workers into Managers," 579.

become part of the workforce. In fact, the majority of programs for women supported by the UP aimed to create better mothers and family caretakers.[82]

Citing another set of statistics from the 1970 census, Ribeiro notes that the National Statistics Institute classified only 12.87% of Chilean women as "economically active," a category that refers to those employed in the formal economic sector. Of these, only 2.95% contributed to agriculture production, or about 0.38% of the total working female population.[83] Economically, women received minimal benefit from the agrarian reform begun by the Christian Democrats and continued by the UP. Tinsman's study of gender relations in the Chilean countryside during the 1960s and 1970s illustrates how, far from increasing women's rights, agrarian reform deepened the inequality of the sexes.[84] Changes in property ownership expanded the rights and freedoms afforded men and reaffirmed their role as master of the house. However, these changes also subordinated women, financially and sexually, and increased their dependence on their husbands. Thus the two main sites of Chile's socialist transformation --factories and the countryside--offered limited benefits to Chilean women and marginalized their opportunities to participate in the revolutionary process.

The UP commitment to Chilean democracy required growing its base of electoral support in order to get the changes outlined in its platform written into law. Allende had won the popular vote, barely, but the vast majority of his

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[82] The UP publication *La mujer en el gobierno de la Unidad Popula* (Santiago: 1970) criticized capitalism for forcing women to work outside the home and abandon their families, while it credited socialism for liberating women from housework and increasing their integration into activities of national production. Cited in Deutsch, "Gender and Sociopolitical Change,"

[83] Ribeiro, "La mujer obrera chilena," 174.

[84] Heidi Tinsman, "Good Wives and Unfaithful Men: Gender Negotiations and Sexual Conflicts in the Chilean Agrarian Reform, 1964-1973," *Hispanic American Historical Review* 81, no. 3-4 (2001). Also Heidi Tinsman, *Partners in Conflict: The Politics of Gender, Sexuality, and Labor in the Chilean Agrarian Reform, 1950-1973, Next Wave* (Durham, N.C.: Duke University Press, 2002).

supporters were male. Strategically, the government needed to gain the support of Chilean women in order to implement the economic and social changes delineated by the UP. To this end, Allende encouraged his male supporters "to conquer" *(conquistar)* their female family members and convince them to follow the Chilean road to socialism. In a speech celebrating the anniversary of his first year in office, Allende announced:

> Forward, we shall win. We shall win by strengthening our unity. We shall win by broadening the political and social bases of the Chilean revolutionary movement. To the youth: we shall win by studying more. To the workers, technicians, professionals, peasants, and employees: We shall win by producing more. We shall win when the Chilean woman learns of our appeal and joins the struggle of her man, her father, her son, and her brother. . . . Forward, comrades, we must win so that we can live as brothers and without hate in our homeland, improving the morality with the constructive revolutionary force of the people. Forward, Chileans, we shall win again for the homeland and the people.[85]

This passage clearly demonstrates the centrality of female support to the success of the Chilean revolution. However, Allende's phrasing does not position Chilean women as the central protagonists or beneficiaries of socialist change. Instead, the president urges them to support the struggle of their husbands, fathers, sons, and brothers. The UP did little to change the access of Chilean women to real political power. In March 1973 the UP supported seventeen female candidates for the Chamber of Deputies and two for the Senate, resulting in the successful election of one female senator and ten female deputies.[86] Allende also appointed the communist Mireya Baltra as his minister of labor, but such high-ranking women constituted the exception rather than the rule. Furthermore, most senior government women directed their energies toward issues in health or food areas viewed as traditionally

[85] Allende, "First Anniversary of the Popular Government, National Stadium, Santiago, November 4, 1971," in Cockcroft, ed., *Salvador Allende Reader*, 124-25.
[86] There are 120 members of the Chilean Chamber of Deputies and forty-eight senators.

female.[87] This should not imply that the government sought to degrade, devalue, subordinate, or ignore the contributions of Chilean women. Rather, it illustrates the legacy of sexism within Chilean society and the inattention of the Chilean revolution to resolving this problem. As Townsend writes, "[members of the UP] could not help but shape their ideas at least partially within the molds handed down for generations."[88]

Other events shaped the construction of gender in Chile during the UP era. The international attention given to Chile's Marxist government encouraged the inflow of progressive ideas from all over the world, including those generated by the struggles of the women's movement in the United States and elsewhere. This, in turn, brought new levels of attention to the lives of Chilean women. Historians have also suggested that more of the government reforms proposed for the benefit Chilean women might have become law had the government completed its full six-year term.

The UP failed to attract widespread female support for its program of socialist change. In contrast, the Right proved very effective at mobilizing women from all social classes against the government.[89] The Right conveyed a simple but consistent message that honored women for their superior virtue and their role as wives, mothers, and protectors of family values. Women from bourgeois Chilean families formed movements such as *Poder Feminino* (Feminine Power) and filled the streets, banging empty pots in protest of the consumer shortages that they had helped to create by hoarding consumer goods and foodstuffs. Many working-class

[87] Deutsch, "Gender and Sociopolitical Change,"
[88] Townsend, "Refusing to Travel *La Via Chilena:* Working-Class Women in Allende's Chile," 55-56.
[89] Margaret Power, *Right Wing Women in Chile: Feminine Power and the Struggle Against Allende* (University Park: Pennsylvania State University Press, 2002); Maria de los Angeles Crummet, "El Poder Feminino: The Mobilization of Women Against Socialism in Chile," *Latin American Perspectives* 4, no. 4 (1977).

and poor women, who experienced the daily frustrations of waiting in long lines to purchase basic necessities, also threw their lot in with the Right. Rather than sympathize with their situation, members of the Left viewed these women as class traitors and saw their actions as proof of female passivity, traditionalism, and ignorance.[90]

The radical Leftist party *Movimiento de Izquierda Revolucionaria* (Movement of the Revolutionary Left, or MIR) also succeeded in mobilizing members of the urban poor and encouraged them to improve their communities. Pulling themselves up by their bootstraps, the men and women living in shantytowns such as Nueva Habana rebuilt their neighborhoods physically, through the construction of new homes of better quality, and socially, with programs such as those to combat alcoholism. These efforts allowed Chilean women to participate in the socialist revolution and accelerated the pace of social reform. The government, however, did not view these shantytowns as the primary site of the revolution, nor did it endorse the radical activities of the MIR. Women succeeded in increasing their activity in the public sphere from 1970 to 1973. However, as these two examples suggest, women's greater participation did not equal direct support of the government, nor did it result from government policies that supported women's rights. While Allende continued to express an idealistic conviction that socialism would solve all of Chile's problems, including the oppression of women, the government repeatedly demonstrated a limited understanding of how its plan for revolution and self-liberation inadequately

[90] The Chilean feminist Julietta Kirkwood argues that working-class and poor women joined the opposition against Allende not from a natural tendency toward political conservatism but from the conditions of authoritarianism that most women experienced within their households. Klubock agrees, writing that "the lack of gender democracy within the Left and the labor movement as well as the Left's inability to speak to women's everyday experiences of patriarchy made women receptive to the Right's efforts to mobilize them against the UP." Julietta Kirkwood, *Ser política en Chile: los nudos de la sabiduría feminista*, 2nd ed. (Santiago de Chile: Editorial Cuarto Propio, 1990); Klubock, "Writing the History of Women and Gender in Twentieth Century Chile," 499.

addressed the patriarchy that women faced in their homes and workplaces. The government, moreover, did not treat gender with the same consideration as class in discussions of inequality and exploitation.

Scott has famously argued that gender behaves as an organizing category that gives knowledge and meaning to sexual difference. By exploring how gender constructs politics and how politics constructs gender, women's history transcends the cataloging of great deeds performed by women, what Scott refers to as "her-story," and exposes "the often silent and hidden operations of gender that are nonetheless present and defining in the organization of most societies."[91] Applying Scott's observation to the context of Chilean history, we see how gender constructed politics through the many ways that men contributed to Allende's victory and women to his downfall. Moreover, the gender roles described by the government and the opposition appealed to differing factions within Chile's fractured political landscape and attracted supporters. Politics also constructed gender. The Chilean government defined the characteristics appropriate to men and women through labor legislation, welfare programs, and channels available for accessing power. The bidirectional relationship between gender and politics, as defined by Scott, has been explored in greater depth by several historians cited here.

Scott's argument, with a slight modification, can allow us to theorize the design and function of the Cybersyn Opsroom from a gendered standpoint. Here we see how gender constructed a political technology and how technology constructs gender politics. In the case of the Operations Room, gendered perceptions of communication, style of work, and level of clerical skill shaped the resultant form of

[91] Joan Scott, *Gender and the Politics of History*, rev. ed. (New York: Columbia University Press, 1999), 27.

a political space designed for economic control. However, we also see that the resulting design of the room reflected an existing politics that marginalized women's access to political power and privileged achieving class equality among Chilean men over other possible power configurations, such as achieving greater equality between men and women within industry and government. Far from being revolutionary, the Operations Room represents the limits of Chile's social revolution and the complicit acceptance that the existing patriarchal power structure would not and did not need to change.

By deciding to remove the keyboard and "eliminate the girl" between the user and the machine, as well as by designing the system to reflect and encourage masculine forms of communication, the Cybersyn team demonstrated a complicit understanding that state power would remain largely in the hands of Chile's male population. Through this technological design we see the limits of Chilean socialism and a concrete expression of abstract concepts such as democracy, worker, and revolution. The room was designed as a democratic space but only for those who fit a particular profile, namely, the predominantly male political elite and industrial workforce that constituted the government's primary base of support. Furthermore, the category "worker" would continue to refer exclusively to those employed in factories and would not expand to include those performing clerical tasks, those working within the home, those working in the factories without union support, or those employed within the informal sector. Finally, "revolution" would refer to the restructuring of Chilean society to eliminate inequalities grounded in class difference while ignoring or deprioritizing other sources of inequality and exploitation such as those illuminated by gender analysis.

In the history of technology we see many examples of women using technologies in ways that are equated with unskilled labor. Here we see an opposite, but no less interesting, phenomenon. In the Operations Room male workers and government administrators maintained a privileged, albeit technologically unskilled, position within this space for control. In contrast, women, defined by their skills, were asked to leave the room.

Conclusion

When asked about the significance of the Operations Room, Flores remarked, "What was going on [inside the Allende government] had nothing to do with the room. In my opinion the emphasis [is] too much on the room [and] hides the real story. [It] invents a lot of lies or dreams."[92] Flores's point is well taken. Apart from the contributions made by the telex network, the other components of the project never reached a point where they could assist with the daily challenges faced by the UP government. As an experimental undertaking, the project was regarded as marginal within CORFO, and even top members of the administration did not know of its development. Several project participants reported that they refocused their energies elsewhere for much of 1973 in order to tackle more pressing concerns that threatened to topple the democratically elected government.

As work on the project slowed, Beer became even more convinced that the system played a vital role in continuing Chile's revolutionary process. On August 2, 1973, he drafted a letter to the president in which he pushed for worker training programs so that workers might use "the general cybernetic approach that was prepared for them" rather than invent "their own approach as they go along." Beer

[92] Flores interview.

worried that "unless some of the solutions to these questions [of worker participation] are adopted fairly soon I think that all that we have achieved may well be wasted." Not achieving the full political scope of the project, Beer concluded, "would be a grievous loss for the Chilean process."[93] Flores took a different position: "I believe the last year, there were a couple of guys who tried to convince Stafford and Raúl that they needed to speak to Allende and show how important [the project] is. I believe in that moment Allende saw us as marginal."[94] Project participant Herman Schwember, who was also a close confidante to Flores and Beer, noted that "Stafford, no matter how clever he is, or how knowledgeable of people he has [*sic*], could not have a full understanding of all the political elements in Chile. I think that he was also very optimistic about Chile, [that] he would not accept that there was the level of corruption [and] that there was the level of incompetence."[95] Other Chilean participants expressed the view that while Beer possessed a firm grasp of the Chilean situation, he was nonetheless an outsider who could not fully perceive the many nuances and delicacies of the national state of affairs.

In spite of Beer's attempts to implement the political goals of the project, in practice, except for its telex network, Cybersyn contributed minimally to the revolutionary process. However, this is not to say that documenting the history of the project conflicts with or obscures the "real story" of the UP era. To the contrary, in this chapter I have shown how this technological experiment generated the same fears, uncertainties, and dreams as those surrounding Chile's political experiment. On one hand, critics from Chilean opposition parties or from nations such as the

[93] Stafford Beer to Salvador Allende, 2 August 1973, box 55, Beer Collection.
[94] Flores interview.
[95] Herman Schwember, Inteview by author, 22 June 2002.. According to Schwember, Flores resented Beer for "interfering with his relationships with Allende and the upper political groups," while Beer believed that he understood the political situation better than many of his Chilean colleagues.

United States or Britain painted the system as a form of control akin to Big Brother. On the other, prepared government speeches, folk songs, pamphlets, and government reports positioned the project as a populist experiment and catalyst for a new form of socialist modernity. This examination of the system's design and implementation further highlights the unique nature of the Chilean revolution while still allowing us to discern its limitations and contradictions, as we have seen in regard to the role of women and the scope of worker participation. This research has also demonstrated the difficulty of separating the lived experiences and genuine convictions of those who contributed to or observed the construction of this system into the categories of lies, dreams, and realities, as Flores suggests.[96]

However, Flores' s comment is perceptive in singling out the seductive power of the room. As a modernist dream, it presented a clean, colorful, and controllable vision of the future that obscured the work of disciplining a chaotic, continually changing, and highly unstable economy. Like Allende's "revolution of empanadas and red wine," a turn of phrase that the president used to emphasize the effortlessness of Chile's socialist transformation, the room promised complete economic control with the push of a button. Creating this impression, however, required the intense dedication of Chile's best designers and technical experts, as well as a creative configuration of Chile's limited resources. A series of slide projectors located behind the far wall created the high-tech simulation of display monitors. Each armrest button sent a signal to one projector and controlled the position of the slide carrousel (see figure 6.4). Chilean industrial designers drew each production flowchart by hand, and then converted the drawings into slide

[96] However, Flores' suggestion of such a classification illustrates the contentiousness nature of this moment in Chilean history.

images that were projected in the room. Only through this painstaking process could the room create the illusion of freedom and control that impressed all who entered. Simplification offered a new form of visibility, captured in only five to seven production indices and displayed in a series of colorful graphs, flowcharts, and photographs. However, the wondrous simplicity of "seeing" the economy in this manner obscured the complex negotiations occurring daily within the industrial sector and rendered the social aspects of Chile's economic dislocations invisible. Like the smoke and mirrors used by the Wizard of Oz to mask his human identity, the Operations Room presented an illusion of socialist modernity and control that masked the difficulties of Chile's economic transition and the precariousness of national order. Similarly, Allende's faith in the Chilean road to socialism did not account for the actual complexity that the process entailed. Like Allende's platform for change, the clean, futuristic appearance of the room obscured the vast network of individuals, materials, expertise, and information required to make economic management appear so simple.

Cybersyn's success, as described by Beer, hinged on creating a new structure of economic management that fundamentally altered the relations between workers, managers, engineers, and public-sector employees. However, reaching a state of homeostasis, or stability, depended on controlling the number of variables central to Chile's economic transition. This premise created two immediate problems. First, making Beer's model a functional reality meant transforming the existing political, economic, and social structure, a nearly impossible task in Chile's fractured political context. Revolution through democracy, rather than through violence, restricted the potential avenues for change and after much frustration caused Beer to wonder, "Does it take more courage to be a cybernetician than to be a gunman?"[97] Second, although members of the project team designed the factory models with a degree of structural flexibility at the industry level, Cybersyn as a whole did not possess the capabilities needed to move Chile's economy from a capitalist to a socialist system or to control the unforeseen events that marked Chile's unprecedented path toward revolution. Rather than regulate transformation, Cybersyn fell victim to the onslaught of instability that accompanied Allende's program for socialist reform. Similarly, project engineers found themselves attempting the impossible: modeling an economic system that refused to remain constant using only a subset of the variables needed to understand the system. Production, as gauged by flows of raw materials and finished goods, constituted only one aspect of the Chilean economy—one that increasingly paled in comparison to the economic dislocations of inflation, consumer shortages, political infighting, U.S. foreign policy, black market hoarding, labor strikes, and increased social unrest. Labor, in particular, did not behave as just another factor of production but rather as a body of self-conscious individuals able to criticize and resist state operations. In hindsight Beer wrote, "The model we were using . . . could not adequately represent changes that had come about during Allende's term . . . because these were changes in economic management that had nothing to do with ownership in the legal sense."[98] Rather than transforming Chile's economy through the massive social restructuring that Beer envisioned, Cybersyn struggled merely to regulate the status quo, a task that became increasingly difficult by 1973.

[97] Beer, "On Decybernation," 6.
[98] Beer, *Brain of the Firm,* 323.

However, this is not to say that the system was a complete failure, just as the ideological congruence of the system and Allende's plan for reform does not qualify it as a success. Regulation, like transformation, played an important role in keeping the Allende government afloat and, as Chile's socioeconomic situation slid into chaos, the necessity for social and political regulation gradually eclipsed the earlier priority of structural transformation. Although Beer maintained that the system would function properly only in its entirety, the telex network contributed significantly to the government's ability to counteract and manage strike activity as well as its capacity to map complex economic fluctuations using recently generated data. By May 1973, 26.7% of the 420 industries in the social or mixed property area, responsible for 50% of the sector's revenue, had been incorporated to some degree within the Cybersyn system.[99]

In one of his final reports on the project, Beer summarized his views on the importance of regulation to Chile's democratic road to socialism:

> . . . envisage our invention as an instrument of revolution. I mean that "The Way of Production" is still a necessary feature of the Chilean revolution, but that "The Way of Regulation" is an extra requirement of a complex world not experienced by Marx or Lenin.[100]

[99] *Mensaje Presidente Allende ante congreso pleno, 21/Mayo '73*, (Santiago, Chile: Departamento de Publicaciones de la Presidencia de la Republica - Chile, 1973), 412-13; Espinosa and Zimbalist, *Economic Democracy*, 47.

[100] Beer, "On Decybernation," 5. Beer spent a considerable amount of time rethinking how Marxist theory would work in the age of automation. "Allende and I always saw the whole process as the reinvention of Marxist-Leninist [thought] in the light of modern thinking, whereas what the Russians were doing was thought of one hundred years ago. And so I still think there is a lot of work there--Marx, and particularly Engels, was spot on if you adjust it for the times. I mean, Marx was completely absorbed by the proletariat, meaning the productive workers. And he didn't see it coming that most workers wouldn't be in production because of automation and that most of them are in the advertising industry now [laughs]. I was trying to allow for that." During his time in Chile, Beer drafted an unpublished manuscript for Allende titled "Status Quo" that updated many of Marx's ideas. "'Status Quo' I named because of Das Kapital. I said, well, Marx called the enemy Das Kapital, so he named his book after the enemy. So I said I would name my book after the enemy, which is Status Quo. That's the real enemy." Beer interview.

In light of Beer's experience applying cybernetic principles to the Chilean political situation, his new interpretation of revolution is understandable. However, it seems more plausible that this newfound emphasis on regulation did not stem from a change in world complexity or from an oversight in Marx's philosophy. Rather, it embodies how science and technology can influence and redefine our conceptualizations of political order and the tools available for orchestrating social change. The history of the Cybersyn system further illustrates that political ideologies not only articulate a worldview but also can contribute to the design and application of new technologies that politicians, engineers, and scientists subsequently use to create and maintain these new configurations of state power. Disagreements about implementation (e.g., the level of worker involvement), contradictory readings of the system's potential for control, and the politics of everyday design decisions (e.g., such as whether to use a keyboard in the Operations Room) did not simply reflect ideas about technological feasibility and soundness. Instead, they revealed class resistance to economic and social change, the scope of Cold War ideology, and the limitations of power redistribution within Chile's socialist revolution. Furthermore, the system provides a concrete articulation of the UP ideological program for economic transformation.

The history presented in chapters 4, 5, and 6 demonstrates the singular nature of Chile's socialist experiment. Not only was this project unique in its manner of applying cybernetic science to economic regulation and state governance, but its emphasis on decentralized control also resulted in a technology that reflected the distinguishing features of the UP government. Although we may question the magnitude of the contribution made by this system in staving off Chile's mounting political, social, and economic upheavals, the history of Cybersyn does offer a new perspective on the Chilean experience. In contrast to the chaotic images of shortages, strikes, and protests that have come to characterize the era, Cybersyn presents an alternative history. Here we see members of CORFO, INTEC, ECOM, and their British collaborators struggling to realize a different dream of socialist modernity, technological capability, and regulated order. It would be a dream some Cybersyn team members continued to pursue until the day the military imposed a very different form of order on the Chilean people and members the project team fled CORFO headquarters with project documents tucked innocuously under their arms.[101]

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On the morning of September 11, 1973, the Chilean military launched a coup against the Allende government. It began in the city of Valparaíso and continued to gather strength as the military traveled south toward Santiago. By 2 p.m. Allende was dead, his dream incinerated by the flames engulfing the presidential palace.

After the coup the military made several failed attempts to understand the theoretical and technological aspects of the Cybersyn Project and afterward decided to dismantle the Operations Room. The neoliberal economic policies of General Augusto Pinochet left no room for state economic control or worker empowerment.

Almost every project participant who contributed to this study has claimed that the project changed his or her life. Most have continued to use knowledge acquired from the project to this very day, and most now hold high positions in

[101] Guillermo Toro, e-mail correspondence with author, 5 June 2004. Toro, who began working as the Cybersyn Project coordinator in June 1973, vividly recalls risking his life by leaving CORFO headquarters with Project Director Raúl Espejo the day of the coup in order to save four packages of photocopied Cybersyn documents that Espejo still holds in his possession. In Toro's words, the documents "must be saved to tell the tale."
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either universities or tech-related industries. However, despite Cybersyn's contribution to Chile's technological history, as well as to the political history of this well-studied moment, until very recently it had all but vanished from wider Chilean memory. Like the many other casualties of the Pinochet dictatorship, Cybersyn disappeared.

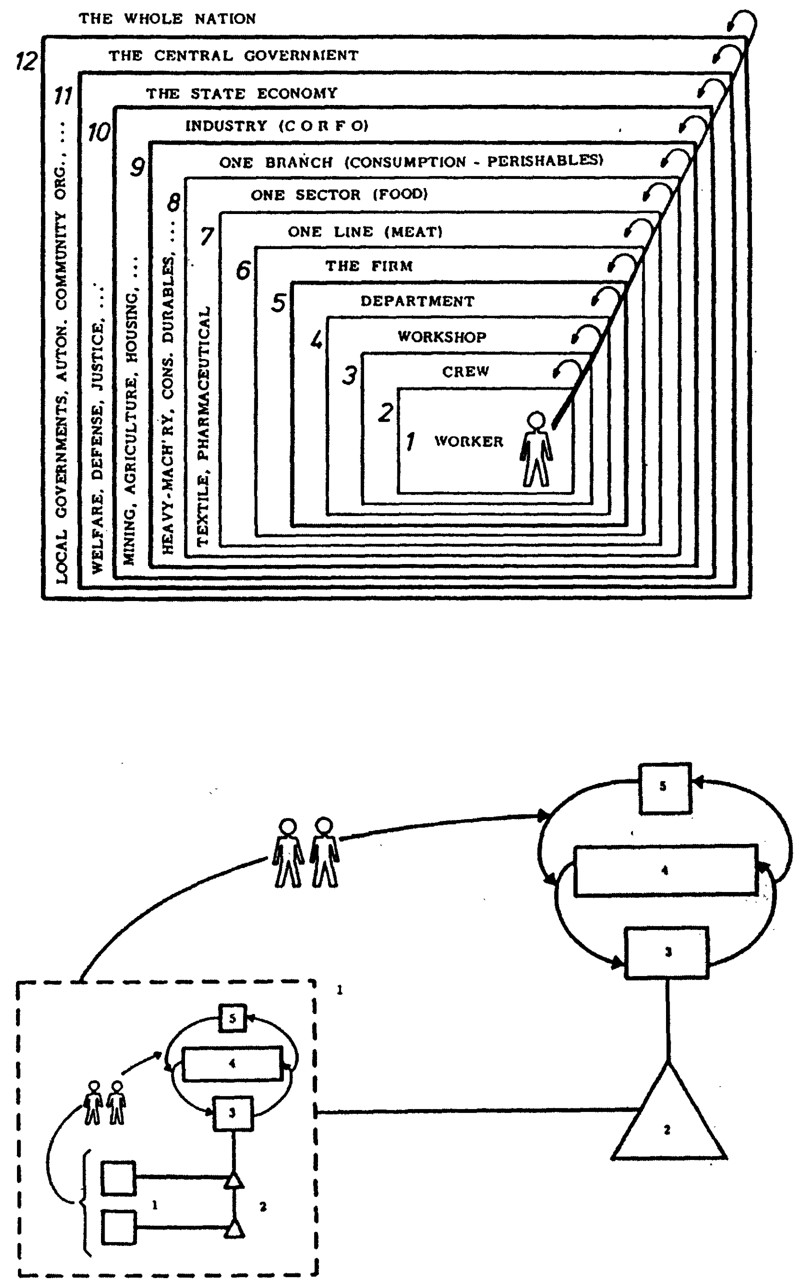

Figure 6.1: Worker participation drawn as a system diagram. (Herman Schwember, "Cybernetics in Government: Experience with New Tools for Management in Chile 1971-1973," In Hartmut Bossel, ed., Concepts and Tools of Computer-Assisted Policy Analysis, 79-138. Basel, Switzerland: Birkhäuser, 1977. 1977. Images used with permission from Birkhäuser Verlag, Basel, Switzerland.)

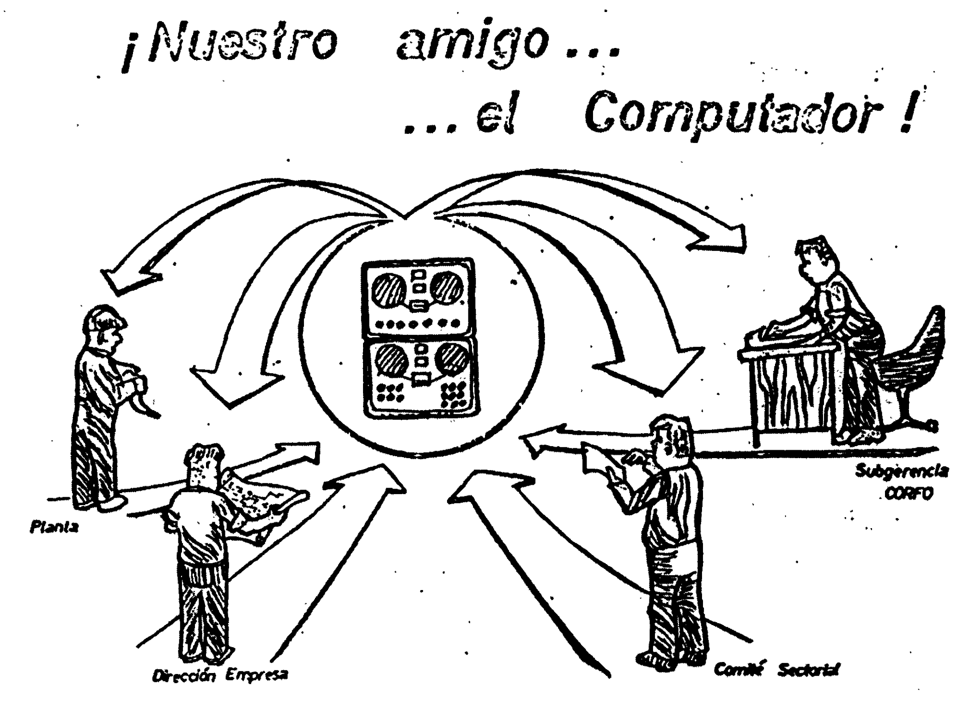

Figure 6.2: "Our friend ... the computer!" (Image used with permission from the Corporación de Fomento de la Producción, Santiago.)

Figure 6.3: Close-up of the chair from the Cybersyn Operations Room. (Image used with permission from Rodrigo Walker.)

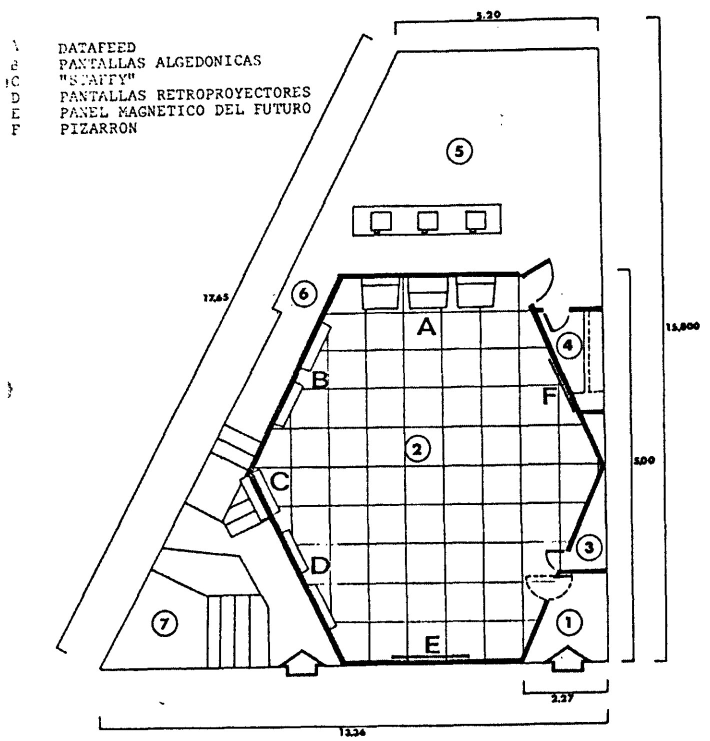

Figure 6.4: Floor plan of the Operations Room. Notice the slide projectors situated behind the top wall, a configuration that simulated a series of monitors or projection screen. (© JMU. Reproduced by permission of Liverpool John Moores University Learning and Information Services and The School of Business Information. Originals kept at Liverpool John Moores University, Learning and Information Services, Special Collections and Archives.)

Chapter 7

The Neoliberal Machine

WALKING UP Teatinos Street in the center of downtown Santiago, it is difficult to miss the large glass building that houses Chile's largest computer company, SONDA (Sociedad Nacional de Procesamiento de Datos). Like a new kid on the block ostentatiously flaunting his wealth, the modern corporate building rises above the dingy concrete buildings that flank it on either side (figure 7.1). Inside, the building offers a refuge from the hubbub of the busy Santiago streets. Light streams through the glass into a large atrium. Caged birds converse with one another on an upper floor, although the echoes of their chirps and twitters make it impossible to discern their exact location. Were it not for the guard who told me to put away my camera, one could easily mistake Chile's most successful computer corporation for a posh hotel.

SONDA, which claims $300 million in sales for 2001 and has offices throughout Latin America, stands as a model for Chilean success in the private sector, as does its founder, Andres Navarro Hauessler--a man often referred to as the Bill Gates of Chile (figure 7.2).[1] In a large conference room overlooking the city, Navarro shared his memories of the company that he started in 1974. "When I started with SONDA," he recounted, "I thought two things: I love technology and I [thought] that technology [was] the one thing that can make this country progress and change many things."[2] He recalled traveling to the United States while still in high school and being impressed with the widespread incorporation of technology in everyday life. "I always believed that technology was needed," Navarro added. "We needed to put much more technology into our government, into our businesses, into all the processes in this country. I had no doubt that it was feasible. But I never had a vision that the thing would grow as it did later on."

SONDA's origins have become the stuff of corporate legend. While an engineering student at the Catholic University, Navarro discovered the world of informatics and used computer technology to complete his thesis for the industrial engineering department. In a 1998 interview for a publication put out by Catholic University's school of engineering, he said, "I arrived at this area by accident, but [computation] was a lot of fun, it was dynamic, it kept me active."[3] After graduation, the then twenty-five-year-old Navarro convinced his brothers to invest their $150,000 inheritance check to found one of Chile's first data-processing enterprises.[4] He secured additional funds by negotiating a partnership with the Compañía de Petróleos de Chile, a private gasoline company, which invested $500,000 and

[1] The SONDA public relations representative with whom I spoke quoted the $300 million figure for 2001, then told me on the sly that the company's revenues had declined since 2001, something it has avoided publicizing.
[2] Andrés Navarro Hauessler, interview by author, 15 January 2004.
[3] "Andrés Navarro, presidente de Sonda y de la Teletón: en la escuela descubrí el mundo de la informática," *Vía directa: boletín de la Escuela de Ingeniería de la Pontificia Universidad Católica de Chile y la Fundación de Ingenieros de la Universidad Católica*, December 1998.
[4] According to Navarro, PROCESSAC was Chile's first private computer enterprise, but it went out of business.

received a 55% ownership stake in the company in return.[5] SONDA's first computer was a small NCR 315 machine that bore a closer resemblance to the previous generation of IBM United Records machines than to a modern mainframe, but SONDA soon purchased a Burroughs 3700 and grew from twelve employees initially to 176 in 1981 and 350 employees in 1984, an impressive rate of growth.[6] "I must say my main purpose was to build a company that would be the opposite of IBM," Navarro said, referring to the controlling form of management practiced by Big Blue. "IBM would recruit fifty guys and put them in this training for three months. Half of them would quit. That [first] half would stay [at IBM] forever, and we'd recruit all those guys who did not like IBM. They were more informal. They would work hard with less [direction]." SONDA became the sole Chilean representative for Digital Equipment Corporation (DEC) just as minicomputers replaced mainframes and the dominant technology of the computer market. The shift in technology from large, expensive mainframes to smaller, less expensive minicomputers bolstered SONDA's business and allowed the company to boast in a 1981 DEC advertisement: "SONDA, the largest and most reliable private computer company in the country."[7]

SONDA also survived the political and economic upheavals of the 1970s and 1980s, which included political witch hunts—more than 3,000 Chileans were disappeared or murdered under the repressive Pinochet dictatorship—as well as periods of extreme boom and bust. In 1986, the Chilean trade publication *Informática* quoted Navarro saying, "Businesses last longer than governments and

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[5] Reported figures vary on the initial amount invested by the gas company. The $500,000 figure appears in Patricio Donoso I., "SONDA: Impetu, Innovación y Emprendimiento," in Matko Koljatic M. , ed., *La nueva empresa chilena: un estudio de casos* (Santiago: Eds. Universidad Católica de Chile, 1999)

[6] Mr. Chips, "Registros de 15 años," *Sondauta*, November 1989; Sonia Cano, "SONDA: una empresa de servicios que sirve servicialmente," *Informática*, December 1984. According to *Sondauta*, ("SONDA Por 22 Veces 22," October-November 1996), SONDA originally had eleven employees.

[7] "Minicomputadores Digital PDP-11," *Informática*, September 1981, 7.

their politics," and indeed SONDA flourished during the military dictatorship and during the successive governments following Chile's return to democracy in 1990.[8] According to press reports, Navarro's long-standing affiliation with the Christian Democracy Party--he had even run as the PDC candidate for student president of the Catholic University in 1971--was not "completely accepted" by the military government. "Everybody will tell you, and it's true, that I [opposed] the military government," Navarro said, but "I wasn't trying [to make] revolution. . . . I devoted all of my time . . . [to] selling and servicing the private sector." SONDA avoided contracts with the armed forces, and during the 1970s almost all government business fell to ECOM, the state computer enterprise.[9] However, by the late 1970s and early 1980s, government enterprises such as the railroads and the state mining agency had started looking to SONDA's technical expertise. The privatization of government services such as social security also added to SONDA's client base.[10] In 1983, SONDA President Efrain Friedmann announced in an interview with a reporter for *Informática* that "SONDA wants to compete head to head with ECOM."[11] Friedmann, ECOM's first director and the original champion of a centralized state computer agency, remarked, "Today ECOM is . . . an enterprise without the special function of organizing computation in the public sector. In no way are we [SONDA] against [ECOM's] continued existence. What we want is that when [ECOM] competes with the private-sector enterprises, it does so without any

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[8] Soledad Amenábar, "Andrés Navarro: 'las empresas duran más que los gobiernos y sus políticas,'" *Informática*, October 1986, 32.
[9] Andrés Azócar, "Recuerdos de plata," *Qué Pasa*, 11 October 1999.
[10] Andrés Navarro Haeussler, "Sondauta: 25 años de vocación de servicio," *Sondauta*, October-November 1999.
[11] Sergio Prenafeta Jenkin, "Efraín Friedman, presidente de SONDA 'queremos competir de igual a igual con ECOM'," *Informática*, August 1983.

special privilege."[12] As the state computer enterprise continued to lose money, the Pinochet government decided in 1985 to privatize ECOM. Private entrepreneurship won out over decades of state protectionism. SONDA got its wish; it would be able to compete with the former state enterprise on a supposed level playing field.[13] However, Navarro felt SONDA had a clear advantage, stating, "It is difficult for an industry created with government assistance to become a reliable business in time."[14] By "in time" he meant the accelerated pace of change demanded by Chile's market-driven economy.

SONDA's success represents a culmination of Chile's neoliberal trajectory that began after the military coup on September 11, 1973.[15] The military junta that came to power was clear in its desire to rid Chile of Marxism, the political force

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[12] Sergio Prenafeta Jenkin, "Efraín Friedman, presidente de SONDA 'queremos competir de igual a igual con ECOM,'" *Informática*, August 1983.
[13] Soledad Amenábar, "Nueva cara de ECOM: casa de software y representaciones de equipos," *Informática*, November 1985.
[14] Amenábar, "Andrés Navarro," 32.
[15] The literature on the Pinochet dictatorship rivals that of the Allende period in volume and ideological bent. For a critical overview of the Pinochet period see chap. 2 of Peter Winn, *Victims of the Chilean Miracle: Workers and Neoliberalism in the Pinochet Era, 1973-2002* (Durham, N.C.: Duke University Press, 2004), and chap. 10 of Brian Loveman, *Chile: The Legacy of Hispanic Capitalism*, 3rd ed. (New York: Oxford University Press, 2001). An economic perspective appears in Patricio Meller, *Un Siglo de Economía Política Chilena (1890-1990)* (Santiago: Editorial Andrés Bello, 1996); Ricardo Ffrench-Davis, *Entre el neoliberalismo y el crecimiento con equidad: tres décadas de política económica en Chile* (Santiago: Dolmen Ediciones, 1999); Juan Gabriel Valdés, *Pinochet's Economists: The Chicago School of Economics in Chile* (New York: Cambridge University Press, 1995); Eduardo Silva, *The State and Capital in Chile: Business Elites, Technocrats, and Market Economics* (Boulder, Colo.: Westview, 1996); and chap. 9 of Ascanio Cavallo, Manuel Salazar, and Oscar Sepúlveda, *La historia oculta del régimen militar: memoria de una época 1973-1988* (Santiago: Grijalbo Mondadori, 1997). The neoliberal program promoted by the "Chicago Boys" appears in Centro de Estudios Públicos, *"El ladrillo": bases de la política económica del gobierno militar chileno* (Santiago: Centro de Estudios Públicos, 1992). Joaquín Lavin, *Chile: A Quiet Revolution*, trans. Clara Iriberry and Elena Soloduchim (Santiago: Zig-Zag, 1988), contains progovernment propaganda about the neoliberal "economic miracle." An interview with "Chicago Boy" Carlos Paut Ugarte appears in Patricia Politzer, *Fear in Chile: Lives Under Pinochet* (New York: Pantheon, 1989).Firsthand or human centered accounts of the dictatorship, including its human rights abuses, appear in Sergio Bitar, *Isla 10*, 3rd ed. (Santiago: Pehuén, 1988); Pamela Constable and Arturo Valenzuela, *A Nation of Enemies: Chile Under Pinochet*, 1st ed. (New York: W. W. Norton, 1991); and Mary Helen Spooner, *Soldiers in a Narrow Land: The Pinochet Regime in Chile* (Berkeley: University of California Press, 1994). See also Peter Kornbluh, *The Pinochet File: A Declassified Dossier on Atrocity and Accountability* (New York: New Press, 2003), for an archive-based account of the clandestine activities of the Pinochet dictatorship and the role of the United States.

armed forces held responsible for destroying the country. Apart from a shared contempt for Marxism, members of the junta, led by Augusto Pinochet, had a common disdain for politics but lacked a plan for reversing the consumer shortages and rampant inflation caused by the economic policies of Popular Unity. By 1975, Pinochet had decided to back the neoliberal "shock treatments" proposed by the Chicago Boys, a group of economists who had studied either with Milton Friedman at the University of Chicago or with professors at the Catholic University in Santiago who were well versed in Friedman's monetarist economic theories. The plan for the economy called for continuing cuts to public spending, now by an additional 15% to 25%; freezing wages; privatizing the majority of the firms nationalized by CORFO; reversing the agrarian reform carried out during the Allende and Frei administrations; raising income taxes by 10%; and laying off eighty thousand government employees.

However, which path to take for Chile's economic recovery had been less certain a year earlier. While the Chicago Boys argued against the inefficiencies of public spending, protectionism, overregulation, and nationalization, others--including Fernando Léniz, Pinochet's minister of finance, and Raul Sáez, an economic adviser to the junta--argued for a developmentalist approach similar to that adopted by the Christian Democrats in the 1960s. They thought that the state should continue to play an influential role in a mixed Chilean economy and should protect domestic industries. As the junta debated the benefits and costs of removing state economic protections, it decided to carry out a short-term experiment. On July 19, 1974, the junta approved Law 1130, which lowered tariffs for approximately 150 imported goods--including computers--to a mere 10% of their purchase price. The smaller tariff applied to listed goods with "with importation records dated before

December 31, 1974."[16] Law 1130 represented the "government's economic fear," said Juan Ignacio Cahís, the founder of the Center of Computation at the Catholic University and a manager at ECOM from 1973 to 1979. According to Cahís, government officials "realized that they had to do it [lower tariffs], but they were not completely sure. There was a debate among the ministers who wanted to make it [lower tariffs] permanent and those who were not yet ready. In the end, they reached an agreement and said ok, we'll do it for a short period."[17] Tariffs for imported computers dropped from 120% to 10%, and the number of computers purchased by Chilean businesses grew to unprecedented levels.[18] These new machines began to arrive in 1975. Members of the Chilean computer community estimated that Chileans ordered 120 machines during the four-month window opened by Law 1130, a tremendous increase, given that there were fewer than fifty machines in Chile in 1974. Estimates placed spending between $20 million and $40 million. "I would say that what we [IBM] brought [to Chile] from 1962 to 1974 corresponded to what we imported in 1975," observed Hernán Cavallo, general director of IBM Chile.[19] As a result of Law 1130, "We [IBM Chile] tripled our computing capacity."[20] On January 1, 1975, the tariffs levied on imported computing machinery returned to 100%. But Law 1130 proved that Chileans wanted to invest

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[16] Ministerio de Hacienda, Rebaja derecho ad valorem a bienes de capital que indica, Decreto 1130, 19 July 1974.

[17] Juan Ignacio Cahís, interview by author, 2 January 2004.

[18] Several individuals whom I interviewed put tariffs at 200% or 300% of purchase price before the junta instituted Law 1130. The 120% figure stated in the text comes from a letter sent to Jorge Cauas, minister of finance, describing the effects of Law 1130 and signed by Chile's top computer professionals in government, industry, and academia nearly a year after the law took effect. Regardless of the exact figure, the change to 10% was a considerable difference. Letter to Jorge Cauas Lima, 28 May 1975, Box 754 08R-0101 SECICO 1973 a 1983, Folder "Correspendencia recibida y despachada, memorandos e informes. CECICO 1974-1979," Archive of the Pontificia Universidad Católica de Chile, Santiago.

[19] This comment reflects the one year lag between when Chilean customers placed orders for computer machinery (1974) and when these machines actually arrived (1975).

[20] Sergio Prenafeta Jenkin, "IBM, bastante más que computación," *Informática*, April 1979, 17.

in computing technologies. Unfortunately, the need to buy machines within the four-month period resulted in hasty purchases of inappropriate machines that businesses were stuck with and created a shortage of those trained to operate the new machines (members of the computer community put the shortage at about fifteen hundred computer specialists).[21]

Shutting the window opened by Law 1130 hindered the private sector's ability to purchase computers but not for long. The more gradual neoliberal program that the junta practiced at first--it devalued the currency, removed price controls, canceled scheduled wage increases, freed interest rates, altered the tax structures to encourage foreign investment, reduced government expenditures, and lowered tariffs--did not bring the desired results. In mid-1975 Sergio de Castro, a leader of the Chicago Boys, replaced Fernando Léniz as the minister of economics, and, with Pinochet's support, the government began pushing the neoliberal program even further. Tariffs fell once again and Chilean markets opened even wider. The junta's encouragement of short-term foreign investment led new computer companies to establish Chilean branch offices for selling machines to the growing private sector. Competition swelled as IBM, NCR, and Burroughs were forced to share the market with newcomers such as Digital, Wang, and Honeywell, among others. Computers became smaller and cheaper, shrinking from the enormous mainframes of the 1960s to the minicomputers of the 1970s and, finally, to the desktop personal computer epitomized by the IBM PC, which was introduced in 1981.

As computing machines flooded Chilean markets without government controls, they also served the repressive politics of the Pinochet dictatorship. On November 26, 1975, top intelligence representatives from Chile, Argentina,

[21] Letter to Jorge Cauas Lima.

Uruguay, Paraguay, and Bolivia convened in Santiago for the First Inter American Working Meeting on National Intelligence. Paid for and organized by the Chilean secret police, DINA, the meeting allowed the region's most powerful intelligence and police officers to discuss coordinating their intelligence efforts and eliminating their political enemies. In an eleven-page agenda for the meeting, Col. Manuel Contreras, the DINA director, wrote:

> Subversion . . . is present in our continent. . . . The situation described does not know borders, or countries, and the infiltration penetrates all levels of national life. Subversion has developed a leadership structure that is intercontinental, continental, regional, and subregional.[22]

In other words, intelligence agents had to eliminate not only the Marxist subversives and political enemies hiding within their own borders but also those who had sought refuge or support in other countries. If the enemy could travel from continent to continent, then members of the intelligence community had to be ready to do the same. The meeting was slated to conclude on December 1, but on November 28 representatives from the five participating countries signed a resolution in which they agreed to construct an intelligence-sharing network known as Condor for the Chilean national bird. Operation Condor was born.[23]

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[22] Cited in Nilson Mariano, *Operación Cóndor: terrorismo de estado en el Cono Sur* (Buenos Aires: Ed. Lohlé Lumen, 1998), 16, and John Dinges, *The Condor Years: How Pinochet and His Allies Brought Terrorism to Three Continents* (New York: New Press, 2004), 119, 261. The document was part of the infamous Paraguayan "Archives of Horror" discovered by accident in December 1992. The archives included an extensive set of documents kept by the Paraguayan secret police. Among its holdings were records of 8,369 detainees and more than ten thousand photographs, as well as the agenda for the first Condor meeting. Dinges cites this document as Primera Reunion de Trabajo de Inteligencia Nacional, Secret, Santiago, October 29, 1975, Paraguay Archive 22:0155-0165.

[23] Chile began collaborating with other intelligence apparatuses in the Southern Cone before the creation of Operation Condor in 1975. As early as September 1973, five Brazilians were captured and killed in Santiago. Members of the Brazilian police not only taught the Chilean police methods of interrogation and torture, they also dealt directly with the prisoners detained in Chile's National Stadium. In 1974, DINA agents executed Allende's former minister of defense, Carlos Prats González, in Buenos Aires. In 1975, DINA agents tried to kill Bernardo Leighton, a leader of the Chilean Christian Democratic Party who was living in Italy with his wife. The following year Orlando Letelier, Allende's former minister of foreign relations, was killed in Washington D.C. by a car bomb explosion that also killed one of his companions

Operation Condor, which had three phases, sought to eliminate subversive threats to national security. The first phase called for the creation of a central intelligence-sharing data bank. The second phase targeted subversives living in member countries. According to an FBI Intelligence Report dated September 28, 1976, the last and most sinister phase called for the "formation of special teams from member countries who are to travel anywhere in the world to non-member countries to carry out sanctions up to assassination against terrorists or supporters of terrorist organizations."[24] Of the three phases, we have the most documentary evidence for the data bank, which Contreras envisioned as a South American Interpol. Member countries would contribute intelligence information to a central data repository housed in a "Condor Coordinating Center" in Santiago. In a statement before the Chilean Supreme Court in 1979, Contreras said that the FBI and CIA participated in the creation of this data bank.[25] Moreover, an FBI attaché in Argentina, Robert Scherrer, confirmed for the journalist John Dinges that the CIA provided the DINA

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and severely injured another. All three incidents were later tied to Michael Townley, an explosives expert working for the DINA who arrived in the United States under a false Paraguayan passport obtained from Paraguayan intelligence services. U.S. intelligence agencies have subsequently linked the Letelier case to Operation Condor. In all, nearly eighty Chileans were murdered in neighboring Southern Cone countries; thirty-three of them were slain in Paraguay and Argentina between 1975 and 1976. Of all Southern Cone nations, Chile exhibited the greatest tenacity in locating and eliminating its enemies abroad, using sophisticated assassination techniques. Although it is obvious that the DINA played a large role in coordinating and implementing the Chilean part of Condor, it is unclear whether the agency formed special Condor teams or simply hired experts such as Townley. Although the scope of Condor had diminished considerably by the 1980s, many people believe that the last Condor-related mission occurred in 1992 with the assassination of the Chilean biochemist Eugenio Berríos Sagredo in Uruguay. For more on Operation Condor see Dinges, *The Condor Years,* 121-22; Mariano, *Operación Cóndor*; Francisco Martorell, *Operación Cóndor, el vuelo de la muerte: la coordinación represiva en el Cono Sur*, 1st ed., *Colección Septiembre* (Santiago: Lom Ediciones, 1999); Stella Calloni, *Los años del lobo: Operación Condor* (Buenos Aires: Ediciones Continente, 1999); and chap. 6 of Kornbluh, *The Pinochet File.* A journalistic analysis of the Letelier assassination appears in John Dinges and Saul Landau, *Assassination on Embassy Row*, 1st ed. (New York: Pantheon, 1980).

[24] FBI Intelligence Report from Attaché Robert Scherrer, September 28, 1976. Cited in Kornbluh, *The Pinochet File*, 377.

[25] Cited in Dinges, *The Condor Years.* René Peralta, director of ECOM in 1974 and 1976, told the author that ECOM had nothing to do with the Condor data bank. In Peralta's words, "The intelligence community had their own computer systems; they would not process data in a firm [ECOM] that did not have any type of security. We never dealt with matters of security. Never." Peralta interview.

with the computer systems and training that Scherrer believes were used to construct the Condor database.[26] Condor also linked intelligence operations among member nations by using a telex network known as Condortel.[27] Member countries received code names--Chile, as operation headquarters, became Condor One, Argentina was Condor Two, Uruguay Condor Three, and on through to Peru as Condor Eight--that were used in Condortel messages. Telex messages were encrypted using an automatic encryption device that was attached to the telex terminals and reportedly also provided by the CIA.[28] A radio network provided by the U.S. military also made it possible for military leaders throughout the continent to communicate with one another. A diagram found along with the agenda for the November 1975 meeting maps the data-sharing project in four components: a data bank, police records, microfilm, and computers. The resolution signed by the member countries at the conclusion of the meeting also calls for intelligence use of telex, microfilm, computer, and cryptographic technologies.[29]

In his book *The Condor Years* Dinges writes, "Computers were almost nonexistent in South America in the mid-1970s, and Contreras's promise that the data bank would be computerized was itself a revolutionary step forward."[30] Given that in 1975 the Chilean police still used paper filing systems that relied on nothing more complicated than carbon paper, Dinges's observation holds a degree truth. But

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[26] Ibid., 121.
[27] This raises the question: did the Popular Unity Cybernet network, the telex component of the Cybersyn project, serve as a precursor for Condortel? I asked John Dinges this at a conference in 2005, and he did not know the answer. Given the paucity of source materials for Operation Condor and the reticence of those involved to speak openly, we may never know.
[28] Dignes cites Gerardo Irustra, *Espionaje y servicios secretos en Boliva* (La Paz: n.p., 1995), 280, 301. Information about the existence and origin of the encryption machines was given to Irustra by a Bolivian security agent, Juan Carlos Fortun.
[29] Acta de Clausura de la primera reunion interamericana de inteligencia nacional, November 28, 1975, personal Condor archive of John Dinges, New York. This document, often referred to as the Condor Act, is reprinted in Kornbluh, *The Pinochet File*, 357-360.
[30] Dinges, *The Condor Years,* 121.

the Chilean government also had a long history of state computing, which began in the 1920s and became an increasingly entrenched part of the state machinery during the 1960s and 1970s. The military's decision to apply computers to intelligence activities and national security was a logical extension of Chile's technological history rather than a point of revolutionary change. Mainframe computers had been serving the ideological goals of the Chilean government for close to ten years by the time Contreras proposed the Condor data bank. From the perspective of a military dictatorship, it made sense to provide an instrument for the identification and elimination of those labeled subversives or terrorists, those with the potential to threaten Chile's new national order. The Condortel network bears a remarkable similarity to the Cybernet system, the telex component of the Cybersyn project constructed during the Allende period and may be a perverse reinterpretation of the technological system originally designed for the daily survival of a Marxist government. Given the dearth of source materials, drawing a connection between the two is pure speculation, but it is certainly within the realm of possibility.

Most treatments of Operation Condor have paid particular attention to the third phase, wherein intelligence operatives assassinated their political enemies on foreign soil, but the first phase of Condor also warrants close attention. The creation of the Condor data bank is not as reprehensible or controversial as the activities outlined for the second and third phases of Condor, but it constituted more than a technical system. From the perspective of the member countries, eliminating the threat of subversion required a network of humans as well as machines and positioned both in new socio-technical configurations. According to Dinges, documents from the Condor meeting obliged each country to provide technical staff to maintain the Chilean Condor Coordinating Center and its data bank. Furthermore, the network depended on the collaboration of top military officers and intelligence agents within member countries, as well as the exchange of information about subversive activities from intelligence agencies outside of South America. According to the minutes of the first Condor meeting, member countries decided to "recommend facilitating the presence of National Intelligence personnel or similar agents in the Embassies of our countries for direct and personal liaisons."[31] These personal liaisons played a vital role in the creation of the network and were necessary for obtaining content for the data bank and its continued operation. However, this is only half the story. Just as the network of relationships, the human liaisons, was necessary for the functioning of the technological network, documents such as the Condor Act suggest that the military governments in South America needed the data bank in order to pursue a violent agenda of disappearance and assassination in the name of national security. Technology furthered the government goals directed toward these ends. The technology used in the Condor data bank is significant in another way, too. Like declassified government documents or participant interviews, machines may serve as the smoking guns of history. As we learn more about these computer systems, encryption devices, telex machines, and the radio network provided by the U.S. military, we come closer to understanding what the U.S. government knew about Operation Condor and to shedding light on other facets of this clandestine history.[32] Chile used the Condor network to extend the scope of its power and to provide an additional layer of secrecy to the junta's activities of disappearance, torture, and murder while creating

[31] Condor Act; translated in Kornbluh, *The Pinochet File*, 359-60.
[32] Studies of technology may also provide a less controversial route for collecting information about U.S. involvement in the activities of these South American military governments.

mechanisms for distributing blame and facilitating denial. Perhaps the computer systems and telex machines used for Condortel and the Condor data bank will one day help to make these denials impossible.

The End of the State Machine

While the private sector and the military were quick in adapting their uses of technology to changes in Chile's political and economic landscape, the path of the public sector was less clear. Patricio Léniz, the brother of Fernando Léniz, the minister of finance, assumed the helm of ECOM in 1975, following a short tenure by Italo Bossi and René Peralta. ECOM, according to Léniz, desperately needed to be reorganized to reflect the economic and political changes taking place around it. For starters, the state enterprise no longer enjoyed the monopolistic position of the Allende years. But it still did not think of itself as needing to cater to its constituents or as in competition with the private sector. "When I took over as general director, we did not have a sales office," Léniz said. "It didn't exist, no one sold . . . because everyone was obligated to buy [from ECOM in the past]."[33] Moreover, ECOM, still a state enterprise, had yet to adjust to the idea of customer service. According to Léniz, "The big problem . . . was that everyone wanted to buy from anywhere but ECOM, because of our bad service and our bad attitude in general, which was characteristic of all government service." He added, "It was hard to change the spirit of the people [ECOM's employees] so that they would understand we were a service business, and what it meant to have the vocation of serving and being pleasant with our clients."

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[33] Patricio Léniz, interview by author, 23 December 2003.

Like all of Chile's state agencies and enterprises, ECOM had grown substantially under Allende as part of government efforts to increase employment and redistribute wealth. As the government cut public spending, ECOM could no longer retain all its employees. Layoffs were required. When Léniz took over ECOM, he recalled, it had five hundred employees. Some decided to leave on their own, especially given the low wages offered by ECOM--Léniz said he made only $600 per month as the director. Moreover, new opportunities were opening within the growing private sector. Some of ECOM's best employees were among the first to go. Of those who preferred to stay, many turned to teaching as a means of supplementing their income.

ECOM also made changes to accommodate military intelligence, including firing employees deemed politically dangerous and undesirable. Léniz said:

> I had to talk with various communist leaders and tell them, "Look, Don Pedro, I am going to ask that you leave the enterprise and I'm going to be very frank. I am going to ask that you leave to protect yourself, because the whole world knows that you are a communist and because the whole world knows that you are a politically important person from the Left who works here. If something happens to you tomorrow, they are going to imprison you, torture you, I don't know what will happen. You are a good person and I cannot protect you because the security people who work here do not report to me."[34]

Léniz recalled having such conversations with two or three individuals who were "highly visible in politics." However, most lost their jobs simply to downsizing. By the time Léniz left ECOM in 1976, he had reduced the workforce by two hundred employees, shrinking the company to approximately 60% of its former workforce.

The simultaneous demand for security and cost efficiency affected the design of ECOM's new headquarters building. During Allende's presidency the company

[34] Léniz interview. Neither René Peralta or Juan Ignacio Cahís could confirm that ECOM dismissed people for their political orientation.

had been housed in several office buildings. Now the agency began drawing up plans for a new office building on Santa María Avenue that would be large enough to house ECOM's machines, technical staff, and administration under one roof. But construction was stalled because Chile didn't have the money to build it. However, as Léniz tells it, he was able to make several design changes that cut costs. For example, he decided to place the agency's computing machinery in the basement and capture the heat that they generated to save on heating costs during the winter months. "Moreover," Léniz said, in the basement "the computers were more protected from sabotage. You need to think of the conditions of civil war that we were living in. Sabotage continued in Chile, guerilla activity continued, these types of things happened," although he acknowledged that ECOM was never the victim of any guerrilla activity or sabotage. Putting all of ECOM's computers in the basement of the new headquarters building solved an immediate problem, but it proved disastrous in the long term.

In July 1982 heavy rains swelled the Mapocho, a river that cuts through the center of Santiago, to levels far beyond what its banks could contain. The city flooded. The ECOM building, which sat along the river, sustained heavy flood damage. Because almost all its machines were located in the basement, the agency lost nearly everything. An article for *Informática,* headlined "ECOM: After the Mud Comes Change," described the situation this way:

> It is difficult to describe the spectacle that the employees of ECOM found the Monday after the flood. The two underground levels of their installation at 6700 Avenue Santa María, where not even a speck of dust entered before, now had a layer of wet mud reaching the ceiling. Obviously, the computers installed there had disappeared under the stones and mud. The machines were diagnosed as unrecoverable.[35]

[35] Sonia Cano, "ECOM: después del lodo viene el cambio," *Informática*, July 1982, 4.

It was the beginning of the end for the state computer enterprise. Chile had been dealt a series of blows since the initial economic gains that accompanied Minister of Finance Sergio de Castro's neoliberal "shock treatments." These policies had succeeded in lowering inflation, increasing foreign investment, and creating a boom in consumer spending through the late 1970s. However, by 1982 the Chilean economy had changed dramatically. Chile sunk into its worst financial crisis since the Great Depression. The reasons for the crisis were multiple, but most fingers pointed at the failed economic policies of de Castro and the Chicago Boys. Their decision to fix the exchange rate from 1979 to 1982 had encouraged foreign speculation but hid the declining real value of the Chilean peso. Moreover, the absence of government regulations had increased Chile's vulnerability to international market fluctuations, which were exacerbated by the rising price of oil, the falling price of copper, and the mobility of foreign capital. As interest rates began to rise and the economy showed signs of instability, spooked foreign investors withdrew their capital from Chilean markets. This, in turn, further swelled Chile's national debt, which reached $17 billion by 1983—13% more than the GNP.[36] In this context, the magnitude of the loss that ECOM faced was even more devastating. The agency was never able to recover. In 1982 it reported net losses of 171 million pesos, a trend that continued in 1983 with reported net losses of 333 million pesos.[37] ECOM's net worth slipped into the red by more than 100 million pesos.

[36] Winn, *Victims of the Chilean Miracle*, 39.
[37] "En 1983: $466 millones perdió ECOM," *El Mercurio*, 11 March 1984.

Saddled with a losing investment at a time of extreme economic crisis, CORFO decided to privatize ECOM in 1985.[38] The government sold shares in the company to its employees, an investment that these Chileans willingly made in order to save their jobs. National unemployment rates had exceeded 30% at the height of the crisis, and the value of real wages continued to fall. One employee recorded the situation in a poem entitled "Memories of ECOM" that was published in the ECOM magazine *Nosotros*. The final two stanzas read:

"Mamá CORFO" sold one hundred per cent of its shares
And what happens to us? Once again we grin and bear it, yes sirs.
Some take less, others take more from their pockets
A substantial sum, buy at least one share!

In my case, I had to go into debt
Buying a few shares, perhaps you bought more
And if we total these and however many more
It does not matter how many, the debt had to be paid.[39]

However, these efforts were not enough. The company had been losing its focus and its raison d'être since 1973. By 1985, when the government turned ECOM into a private sector venture, companies such as SONDA had attracted a significant chunk of available market business and had more than a decade of experience in catering to the private sector. After losing its monopoly over state computing needs, ECOM lacked a clear market and area of expertise that would give it an edge in an increasingly competitive industry. Navarro blamed ECOM's failure on poor management and the inefficient use of resources, summed up by his observation that the new company was "doing stupid things."[40] Moreover, colleges and universities had long since assumed ECOM's mission of training computer professionals. By the

[38] The decision to cut ECOM loose was probably reinforced by the massive government bailouts that occurred throughout 1983 and depleted half the internal reserves of the Central Bank, causing some to joke about the "Chicago road to socialism."
[39] "Recuerdos de ECOM," *Nosotros*, February 1989.
[40] Navarro interview.

mid-1980s, new computer science programs at Chilean universities were steadily churning out the workforce of computer professionals that the new economy required. Computer technology had also changed dramatically since ECOM's inception in 1968. Computers were now smaller, less expensive, and easier to obtain. Juan Ignacio Cahís, ECOM's former director of development, said that while many blamed the failure of ECOM on the flood of 1982, "I believe that ECOM died because of the PC [and] the minicomputer . . . a central state mainframe office no longer made sense."[41] Or, as René Peralta, a former director of ECOM, said, in this new Chilean landscape "ECOM never found its destiny."[42]

In 1991, two years after democratic elections returned to Chile, ECOM closed its doors for good. The firm had been decimated by the economic changes that transformed the Chilean nation and the technological changes that made a central computer center irrelevant. Their history in Chile as state-controlled and state-supported technologies notwithstanding, computers now symbolized a new form of Chilean modernity driven by the private sector. Separated from their past, computers became yet another commodity acquired by government agencies and businesses alike in Chile's open markets.

Conclusion

From the 1920s to the 1980s, Chile's history of computing shared a close relationship with the history of the Chilean state. The state played a vital role in the early adoption of computing technologies, which required large sums of foreign credit and an educated workforce capable of effectively applying these machines to state

[41] Cahís interview.
[42] Peralta interview.

activities. And as government técnicos entered Chile's public administration in increasing numbers, they used imported tabulating machines and later mainframe computers to grow the state administration, coordinate government activities, and map national resources and populations with increasing detail -- actions that fell in line with the stated political goals of the administration in power. New data-processing capabilities made the increasing state intervention outlined by Ibañez, Frei, and Allende possible and supported policies of economic planning that characterized the development discourse of the post-World War II era.

The nature of these computer applications changed over time and supported different ideological visions of the Chilean nation. In the 1920s and 1930s, the use of tabulating machines paralleled Ibañez's abhorrence for liberal politics and his faith in the rational order offered by scientific methods and technological advancements. His ideas of modernization extended beyond public works projects and industrial growth to the creation of a new state apparatus capable of mapping and managing the Chilean nation and its populations with greater accuracy, detail, and sophistication. Improved statistical and data collection techniques helped the state rearticulate the underlying causes of poverty and translate them into manageable factors such as education, nutrition, unemployment, and, later, development. The introduction of new techniques and technologies, combined with the greater employment of engineers and technocrats in Chile's public administration throughout the 1930s and 1940s, helped create a new form of legitimacy grounded in a strong state administration that could care for its citizenry and direct Chile's economic recovery from the Depression.

The Christian Democrats built upon the administrative "tecnificación" begun by Ibañez and his successors and continued to expand the size and scope of Chile's public administration throughout the 1960s. Christian Democracy's technocratic vision of state organization and the party's desire to emulate the administrative techniques used by the industrialized nations of France, Britain, and the United States motivated the government's purchase of mainframe computers and the training of Chile's first generation of computer programmers and systems analysts. The centralized, interventionist state created by the Christian Democrats led to the centralized use of large, costly mainframe machines; the most visible example of this parallel was the government's decision to create EMCO. Computers, in turn, advanced Frei's programs for improving administrative management, using imported technologies, and securing foreign aid. However, as the 1960s progressed, Frei's developmentalist approach to Chilean economic policy came under increasing attack as members of political parties from the Left and Center condemned Chile's mounting dependence on foreign capital and the government's inability to implement the social changes outlined in the revolution in liberty. In this increasingly fraught context, computers and foreign companies such as IBM elicited feelings of desire as well as resentment and served as conflicting symbols of modernization and dependency.

Following the election of Salvador Allende, the discourse of development changed, as did Chile's stance toward the purchase and application of computer technology. Instead of trying to encourage foreign investment, Chilean economists and Left-leaning policy makers pushed for Chile to become more autonomous by decreasing its reliance on foreign capital and by applying science and technology to meet Chile's specific needs. The nationalization program of the Unidad Popular vested more power and responsibility in EMCO and led to its transformation into the state computer monopoly known as ECOM, a maneuver that reflected the new role of the state in Chile's directed socialist economy. The U.S.-led decision to deny foreign credit to Chile and the U.S. trade barriers that prohibited Chile from obtaining most U.S.-made machinery and spare parts forced ECOM to look beyond U.S. multinationals for their computing needs and to consider new sources, including the French company CII. Government nationalization efforts also motivated new applications for computer technology, such as the Cybersyn system, which was an instrument for economic regulation as well as a symbol of Chile's political success and technological might. Instead of simply adopting the technological systems of the developed, capitalist world, Chile created computer systems that reflected the goals and constraints of its socialist project and that helped bring the political aims of the Popular Unity to fruition. However, despite the coalition's desire to create national technologies, the government continued to rely on foreign expertise and, in the case of computers, foreign technology. Moreover, the stated political goals of these technological systems often differed from their actual manner of operation.

After the military coup in 1973 the Pinochet government used computer technology in the service of its political repression, surveillance, and disappearance, policies that were part of Operation Condor. Although we are still uncovering information on Operation Condor and do not know the full extent of this cooperative intelligence network, available documents from U.S. and Latin American archives describe the Condor data bank -- modeled after the police network Interpol, without its judicial safeguards -- and the encrypted Condortel telex network. According to recent estimates, close to eighty Chileans were killed in neighboring Southern Cone countries. Many more were tortured or detained. We may never know the exact relationship between the Chilean military's use of computers and the acts of violence linked to Condor, but given what we know now there is strong reason to believe that such a connection existed.

At the same time, neoliberal "shock treatments" to the economy lowered tariff barriers and opened Chilean markets to foreign investors and a wider range of imported goods. Foreign-made technologies, including computers, entered Chile in unprecedented quantities. Moreover, technological advances reduced computers from hefty mainframes to smaller minicomputers and finally to desktop personal computers, which reached Chilean markets in the early 1980s. The changes -- technological, economic, and political -- upset ECOM's former monopoly in the public sector and removed the government protection that the enterprise had enjoyed in the past. By 1991, ECOM's economic losses and undefined market niche closed the former state computer enterprise for good. Although ECOM had been run as a private company for its final six years, its demise signified the inability of state computing to adjust successfully to Chile's free market economy.

The Chilean state played an important role in Chile's early history of computing. Its contributions included, but were not limited to, acquiring many of Chile's first computers and tabulating machines, training a computer literate workforce almost from scratch, and providing opportunities and resources for incorporating this technology in the running of the country. Through ECOM the state helped to establish jobs for Chilean engineers interested in computing, giving them an alternative to employment in foreign multinationals such as IBM. This move helped to counteract the brain drain of Chilean scientists and engineers who were leaving Chile to work with advanced technologies in other countries. Many of ECOM's early employees now hold top positions in Chilean companies, banks, and universities and shape the policies of these influential organizations. The same holds true for the original participants in the Cybersyn project, who have gone on to distinguished careers in politics, high-tech consulting firms, and education. Thus we can say that Chile's flourishing information technology industry has its roots in the educational programs, technological acquisitions, and administrative policies of the Chilean state. In Chile, as in the rest of the world, computers have become widely used tools in the past twenty years and have consequently been linked to Chile's recent economic changes. However, the widely admired technical prowess of Chilean computer professionals and the success of Chile's private computer industry is connected to a history that goes back far longer than twenty years, well beyond the Pinochet dictatorship and the economic policies of the Chicago Boys.

Computers supported, reflected, and embodied many different approaches to Chilean modernization, not just the neoliberal restructuring of the 1970s and 1980s. This practice continues: the Chilean government still frames national computer capabilities as proof of the country's modernization and a marker that separates it from other countries in the region. Politicians trumpet policies that require computer resources in every Chilean school so that all Chilean children have the opportunity to become computer literate. When Chilean economists and politicians cast Chile as the "Asian tiger of Latin America," they unconsciously echo the efforts of Efrain Friedmann almost forty years ago to make Chile a technological center within Latin America. At the same time, their rhetoric strives to place Chile in the same league as the United States, Europe, and now Southeast Asia -- the nations of the developed world -- not that of their South American neighbors. Computers may have ceased to become state machines, but they retain their power as instruments of nationalism.

This study is but a starting point for other examinations of the history of technology in Latin America. Computers are but one of many technologies whose early adoption benefited from state support and whose use and/or manufacture overlapped with ideas of modernity, economic development, or social justice. For example, histories of automobiles, telephones, televisions, or other consumer technologies promise to yield new perspectives on Chilean economic policies and the changing lives and cultural practices of the Chilean men and women who used them. The same can be said for industrial technologies, particularly in the context of automation and the subsequent changes to factory work.

Writing the history of technology is a way of documenting history from above as a well as history from below. Such study contributes to understanding the history of institutions and elites by shining a light on certain aspects of trade agreements, the international flow of expertise, and the political and economic policies pursued by various government administrations and political leaders. Technological history can also provide a means for understanding the relationship between the state and its citizenry as well as how policies from above affected the lived experience of Chileans from all walks of life. New histories of technology could shed light on how women, members of Chilean popular classes, workers, and even indigenous populations encountered and incorporated technologies in their lives and used them to construct new identities and relations with their government. In this light, technology offers a means for writing a broader and more inclusive range of histories. Indeed, studies of technology in the Latin American region could prove relevant to research in a variety of subfields of history, such as those of interest to labor, social, economic, business, and cultural historians as well as to those studying political science, economics and development. The wealth of research waiting to be done with respect to technology in Latin America, and its potential for enriching our knowledge in a range of disciplines, warrants the attention of other scholars.

This dissertation focuses on the role of computer technology in Chilean public administration rather than in the Chilean armed forces because access to military archives is quite limited. But we have no reason to think that the Chilean armed forces did not have an equally interesting and important history of computing, especially given the number of early computer professionals who emerged from Chile's military academies and given IBM's habit of recruiting members of the Chilean navy. A general history of Chilean computing should address the contributions of the military academies in training Chilean technical experts. It also should address the changing nature of Chilean military education and its relationship to the technological and political changes that occurred during the twentieth century. Historical studies in this vein should also address the changing relationship of military technical experts, government technocrats, academics, and multinational companies. One avenue of study might be to compare the international exchanges of machines and expertise that occurred within Chile's public administration and those that occurred between members of foreign governments and the Chilean armed forces. Documenting these relationships will enrich our understandings of technological development within Latin America and the influence of foreign nations in Chile's technological and political development.

Scholars within the history of science and technology may wish to pursue projects that document in greater depth the currents of scientific and intellectual thought that have been discussed here, including cybernetics, operations research, systems dynamics, and autopoiesis. Their investigations might examine the origins of these theoretical framings and methodological approaches in the Chilean context;

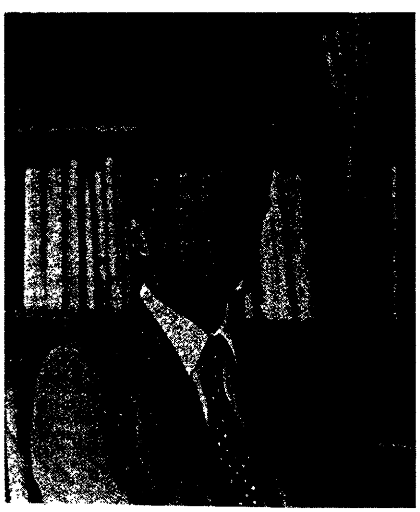
their influence in Chilean scientific, business, and academic communities; and their adoption elsewhere in South America. While many of these ideas originated outside South America and arrived in Chile through academic collaborations with the United States and Europe, others, such as autopoiesis originated in Chile and subsequently spread throughout the world. It would be valuable to learn more about both paths of intellectual diffusion.

Many themes addressed by historians of computing in other geographical contexts may be valuable guides to future work on computing history in Chile, specifically an examination of the formation of Chile's first university computer science programs during the 1970s. The emergence of computer science as a recognized academic discipline paralleled the neoliberal economic changes put in place by the Pinochet dictatorship that expanded the private sector and demanded a computer-literate workforce. Preliminary work shows that the government channeled money to Chile's universities and spurred the creation of a number of private universities that could assist in creating the technically literate workforce that the new economy demanded. Documenting this academic history, its tie to Chile's national economic policies, and its role in creating Chile's successful software and data processing industries remains a rich vein for future scholarship.

An area of great potential for future work addresses the role that information technologies have played in violations of civil and human rights. Many of today's databases, such as those belonging to credit bureaus, health insurance companies, or even telephone companies, have made headlines and sparked controversy for their violations of their customers' right to privacy. However, as Operation Condor suggests, without the proper restraints and safeguards, these same database and communications technologies can transform a widely accepted technological system for law enforcement, namely, Interpol, into a tool for illegal surveillance and international terrorism. In recent years, legislation such as the U.S. Patriot Act has come under fire for privileging national security interests at the expense of civil liberties. The U.S. government is currently waging a war on terrorism against an omnipresent but unidentifiable threat, a subversive enemy with the ability to cross national boundaries and the potential to destroy the U.S. way of life. While one can hardly deny the threat to the United States posed by al Qaeda and other terrorist organizations, the rhetoric of the Bush administration offers uncomfortable echoes of the discourse employed by the Pinochet government as it sought to ferret out and destroy the threat of Marxism thirty years ago. We need to know more about how governments have used technologies in ways that violated the civil and human rights of their citizenry and the citizens of other nations. Only then will we learn how to safeguard our fundamental rights and liberties in the future and better define the line between freedom and security.

And finally, if technologies serve as symbols of Chilean national success or national pride, in the past as well as in the present, then technological histories must play a role of importance within the general history of the Chilean nation. This dissertation is but a first step toward creating this larger literature and aims to raise not only academic awareness of Chile's technological contributions but also a general awareness of the accomplishments of Chilean engineers, scientists, designers, and their technological systems. In 2003, Chile's aging Museum on Science and Technology in Santiago's Quinta Normal Park offered a small display on the history of computing that charted the accomplishments of the pioneering men and machines that marked the milestones of U.S. and British computing history. Absent were the names of Chile's computing pioneers and any mention of their accomplishments. As knowledge of Chile's technological history begins to reach a broader public, perhaps some of the people and events that I have discussed will receive recognition, not only in Chile but also in the Western-dominated narratives of computer history.

Figure 7.1: The SONDA headquarters building rises above the older architecture of downtown Santiago. (Photo by author.)



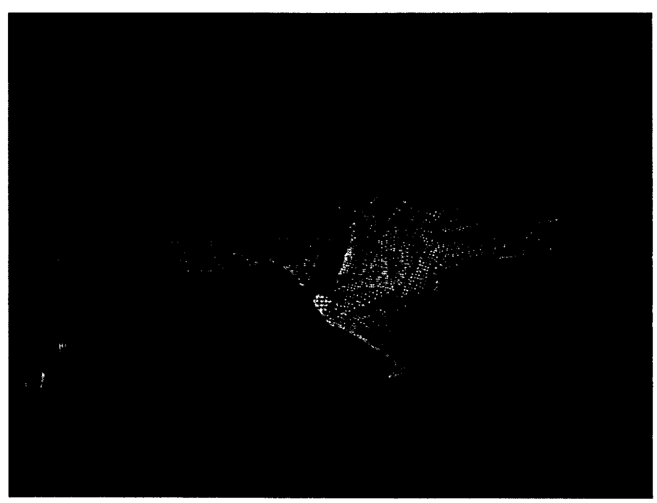


Figure 7.2: Andres Navarro, general director of SONDA. The first was published in 1984; the second was taken in 2004. (Left: Photo used with permission from the National Library, Santiago. Right: Photo by author.)

Figure 7.3: Today, ECOM's former headquarters on Avenue Santa María houses the Santiago private school Colegio Huelén. Photograph taken by the author.

Bibliography

Archival Collections and Document Repositories

Archive of the Fundación Eduardo Frei, Santiago.

Archive, INTEC, Santiago.

Centro de Ciencias de la Computación (CECICO) Papers, Archives of the Pontificia Universidad Católica de Chile, Santiago.

Library of the Dirección de Presupuestos, Ministerio de Hacienda, Santiago.

Library of the Instituto de Ingenieros de Chile, Santiago.

Library of the Instituto Nacional de Estadística, Santiago.

Nettie Benson Collection, University of Texas, Austin.

Records of the U.S. Bureau of Foreign and Domestic Commerce, Government Documents Repository, Harvard University, Cambridge.

Stafford Beer Collection, Liverpool John Moores University.

Newspapers and Magazines

Chile

The Clinic

El Diario Oficial

Ercilla

Estadística chilena

IBM diálogo

Industria: órgano oficial de la Sociedad de Fomento Fabril

Informática

Ingenieros: boletín oficial del Colegio de Ingenieros de Chile

El Mensaje

El Mercurio

Mundo NCR

La Nación

Patrimonio Cultural

Qué Pasa

Revista chilena de ingeniería y anales del Instituto de Ingenieros

Señal

Sondauta

United States and Britain

Daily Telegraph

Datamation

Data Systems

New Scientist

Science for People

Technology Review

Interviews

Acle, Alfredo. Interviews by Eden Medina. Tape recording. Santiago, 18 and 23 December 2004.

Balmeceda, Eugenio. Interview by Eden Medina. Tape recording. Santiago, 28 January 2003.

Beca, Raimundo. Interview by Eden Medina. Tape recording. Santiago, 9 September 2003.

Beer, Stafford. Interviews by Eden Medina. Tape recording. Toronto, 15 and 16 March 2000.

Benadof, Isaquino. Interview by Eden Medina. Tape recording. Santiago, 10 April 2002.

Cahís, Juan Ignacio. Interview by Eden Medina. Tape recording. Santiago, 2 January, 2004.

Cañete, Roberto. Interview by Eden Medina. Tape recording. Santiago, 15 January 2003.

Energici, Mauricio. Interview by Eden Medina. Tape recording. Santiago, 17 December 2003.

Flores, Fernando. Interviews by Eden Medina. Tape recording. Santiago, 30 July and 18 August 2003.

Garcia, Osvaldo. Interviews by Eden Medina. Tape recording. Santiago, 25 September and 6 October, 2003.

Garretón, Oscar Guillermo. Interview by Eden Medina. Tape recording. Santiago, 4 August, 2003.

Kohn, Tomás. Interview by Eden Medina. Tape recording. Santiago, 5 September 2003.

Lawson, Barrie. Interview by Eden Medina. Telephone interview. Liverpool, 18 January 2001.

Léniz, Patricio. Interview by Eden Medina. Tape recording. Santiago, 23 December 2003.

Leon, Carmen Gloria. Interview by Eden Medina. Tape recording. Santiago, 4 February 2004.

Martínez, Alberto. Interview by Eden Medina. Telephone interview. Santiago,7 October 2003.

Maturana, Humberto. Interview by Eden Medina. Tape recording. Santiago, 8 September 2003.

Medina, Pedro. Interview by Cristian Medina and Eden Medina. Tape recording. Santiago, 20 December 2004.

Mendoza, Jaime. Interview by Eden Medina. Tape recording. Santiago, 26 August, 2003.

Molina, Sergio. Interview by Eden Medina. Tape recording. Santiago, 15 January 2004.

Morales, Jorge. Interview by Eden Medina. Tape recording. Santiago, 9 August 2002.

Mordojovich, Sonia. Interview by Eden Medina. Tape recording. Santiago, 16 July 2002.

Navarro Hauessler, Andrés. Interview by Eden Medina. Tape recording. Santiago, 15 January 2004.

Olmos, Virginia. Interview by Eden Medina. Tape recording. Santiago, 4 February 2004.

Peralta, René. Interview by Eden Medina. Tape recording. Santiago, 12 January 2004.

Poblete, Vicente. Interview by Eden Medina. Tape recording. Santiago, 31 July 2003.

Ríos, Guillermo. Interview by Eden Medina. Tape recording. Santiago, 6 October 2003.

Salazar, Luis. Interview by Eden Medina. Tape recording. Santiago, 19 August, 2003.

Sánchez, Juan Francisco. Interview by Peter Winn and Eden Medina. Tape recording. Santiago, 23 July 2003.

Schwember, Herman. Interview by Eden Medina. Tape recording. Santiago, 22 June 2002.

Silva, Gustavo. Interview by Eden Medina. Tape recording. Santiago, 5 September 2003.

Taulis, Patricio. Interview by Peter Winn and Eden Medina. Tape recording, Santiago, 28 July 2003.

Toro, Guillermo. Interview by Eden Medina. E-mail correspondence. 5 June 2004.

Vidal, Eduardo. Interview by Eden Medina. Tape recording, Santiago, 9 February 2004.

Villanueva, Fernando. Interviews by Eden Medina. Tape recording. Santiago, 9 and 16 December 2003

Books, Articles, and Government Documents

Abbate, Janet. *Inventing the Internet.* Cambridge, Mass: MIT Press, 1999.

"El acceso a la tecnología." *El Mercurio,* 2 December 1970, 3."El aporte de la alianza para el progreso en 1969." *La Nación*, 1 January 1969, 3.

Acosta, Uldaricio. "Datos sobre el Instituto Tecnológico/CORFO." *INTEC* 1 (1971): 7-9.

Acuña Fernández, Miguel. "Aplicación del computador (APL/360) a estudios de costos en ENAMI." *Ingenieros: Boletín Oficial del Colegio de Ingenieros de Chile*, no. 51 (1970): 24-25.

Adams, John. "Everything Under Control." *Science for People*, April-May 1973.

"Adaptación del Sistema ICES a Ingeniería Civil Chilena." *El Mercurio*, 19 July 1967, 24.

Adas, Michael. *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance.* Ithaca, N.Y.: Cornell University Press, 1989.

Adler, Emanuel. "Ideological Guerrillas and the Quest for Technological Autonomy: Brazil's Domestic Computer Industry." *International Organization* 40, no. 3 (1986): 673-705.

———. *The Power of Ideology: The Quest for Technological Autonomy in Argentina and Brazil.* Studies in International Political Economy, no. 16. Berkeley: University of California Press, 1987.

———. "State Institutions, Ideology, and Autonomous Technological Development Computers and Nuclear Energy in Argentina and Brazil." *Latin American Research Review* 23, no. 2 (1988): 59-90.

"Afirma experto norteamericano: la computación transforma una biblioteca en banco de datos." *El Mercurio*, 10 August 1970, 39.

Agar, Jon. *The Government Machine: A Revolutionary History of the Computer.* Cambridge, Mass.: MIT Press, 2003

Aguirre Tupper, Fernando. "La planificación y su importancia en las obras públicas." *Ingenieros: Boletín Oficial del Colegio de Ingenieros de Chile*, no. 39 (1968): 4-6.

———. "Significación de las inversiones en la infraestructura (análisis de ODEPLAN)." *Revista Chilena de Ingeniería y Anales del Instituto de Ingenieros*, September 1967, 14-18.

Aldunate Phillips, Arturo. "Materia gris electrónica." *La Nación*, 28 March 1967, 2.

"Allende Inaugura Hoy Red Troncal de ENTEL." *El Mercurio*, 23 August 1971, 27.

Allende Gossens, Salvador. *Chile's Road to Socialism*. Translated by J. Darling. Edited by Joan E. Garces. Baltimore: Penguin, 1973.

———. *Nuestro camino al socialismo: la vía chilena*. 2a ed. Buenos Aires: Ediciones Papiro, 1971.

———. *La revolución chilena*. 1. ed. Buenos Aires: Editorial Universitaria de Buenos Aires, 1973.

———. *Salvador Allende. Obras escogidas, 1908-1973, Colección Chile en el siglo XX.* Santiago de Chile: Editorial Antártica S.A., 1992.

Althusser, Louis. "Ideology and Ideological State Apparatuses." In *Essays on Ideology*. London: Verso, 1976.

Aludante Phillips, Arturo. "Materia gris electrónica." *Revista Chilena de Ingeniería*, no. 318 (1967): 17-22.

Alvial, Aldolfo. "Una moderna tiranía: el automatismo." *Industria: Órgano Oficial de la Sociedad de Fomento Fabril*, no. 7 (1962): 61-63.

Amenábar, Soledad. "Andrés Navarro: 'las empresas duran más que los gobiernos y sus políticas.'" *Informática*, October 1986, 32-34.

———. "Nueva cara de ECOM: casa de software y representaciones de equipos." *Informática*, November 1985, 22-26.

———. "Waldo Muñoz, gerente general de ECOM." *Informática*, June 1984, 10-12.

"Un amigo silencioso: ER-56.1." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 22 (1964): 4-7.

"Amplio intercambio de docente entre U. de La Habana -- U. de Chile." *La Nación*, 26 November 1970, 6.

Anderson, Benedict R. *Imagined Communities: Reflections on the Origin and Spread of Nationalism*. Rev. and extended ed. New York: Verso, 1991

"Andrés Navarro, presidente de Sonda y de la Teletón: en la escuela descubrí el mundo de la informática." *Vía directa: boletín de la Escuela de Ingeniería de la Pontificia Universidad Católica de Chile y la Fundación de Ingenieros de la Universidad Católica*, December 1998.

Angeles Crummett, Maria de los. "El Poder Feminino: The Mobilization of Women Against Socialism in Chile." *Latin American Perspectives* 4, no. 4 (1977): 103-13.

Angélica Alvarez, María. "Base tecnológica: requisito de desarrollo económico social." *La Nación*, 26 December 1969, 5.

"Aplicación de las técnicas y la tecnología al desarrollo de los pueblos latinoamericanos." *El Mercurio*, 26 August 1965, 23.

"Aplicación de técnicas modernas para mejorar la producción industrial." *El Mercurio*, 18 December 1964, 41.

"Apoyo a la investigación científica y tecnológica." *La Nación*, 25 April 1967, 3.

"Apoyo científico y tecnológico a planes de desarrollo del país." *La Nación*, 16 March 1971, 3.

Ashby, W. Ross. *Introduction to Cybernetics*. London: Chapman and Hall, 1956.

"Asistencia técnica de Francia a Chile." *La Nación*, 5 December 1970, 8.

"Asombroso Computador Inaugura la Universidad." *El Mercurio*, 17 January 1967, 17.

Aspray, William. *Computing Before Computers*. 1st ed. Ames: Iowa State University Press, 1990.

———. "International Diffusion of Computer Technology, 1945-1955." *Annals of the History of Computing* 8, no. 4 (1986): 351-60.

———. "Literature and Institutions in the History of Computing." *Isis* 75, no. 276 (1984): 162-70.

———. "The Problems and Virtues of Oral History." *IEEE Annals of the History of Computing* 15, no. 1 (1993): 5-6.

Astrín Castro, Santiago. "Las telecomunicaciones en Chile." *Revista Chilena de Ingeniería y Anales del Instituto de Ingenieros*, May-June 1966, 18-30.

"Automación y desarrollo." *La Nación*, 30 December 1970, 14.

"Avanza 'cyberstride,' plan UP de control por computación." *Qué Pasa*, 6 September 1973, 8-10.

Azócar, Andrés. "Recuerdos de plata." *Qué Pasa*, 11 October 1999.

Baeza-Yates, R. A., D. A. Fuller, J. A. Pino, and S. E. Goodman. "Computing in Chile: The Jaguar of the Pacific Rim?" *Communications of the ACM*, September 1995, 23-28.

"El Banco del Estado de Chile recibe un valioso equipo IBM de computación electrónica." *El Mercurio*, 30 June 1969, 34.

"Banco del Estado inauguró sistema de computación." *El Mercurio*, 3 September 1969, 26.

"El Banco del Estado se incorpora a la era de la computación electrónica." *La Nación*, 4 September 1969, 3.

Barquín, R. C. "Computation in Latin-America." *Datamation* 20, no. 3 (1974): 73.

———. "State of Computation in Cuba." *Datamation* 19, no. 12 (1973): 69-72.

———. "Survey of Computer Education in Latin-America." *Computer* 8, no. 12 (1975): 66-72.

Barquín, Ramón C. "A Categorization of the Latin American Nations According to their Potential for Development of a Computer Industry." In *M.I.T. Alfred P. Sloan School of Management Working Paper no. 678-73*. Cambridge, Mass.: MIT Alfred P. Sloan School of Management, 1973.

———. "Computation in Latin America – Annotated Bibliography and Other Sources of Information." *Latin American Research Review* 11, no. 1 (1976): 75-102.

———. "The Degree of Penetration of Computer Technology in Latin America: A Survey." In *M.I.T. Alfred P. Sloan School of Management Working Paper no. 702-74*. Cambridge, Mass.: MIT Alfred P. Sloan School of Management, 1974.

———. "Development of the Computer Industry in the Latin American Nations: An Evaluation of Strategies and Policy." Master's thesis, Massachusetts Institute of Technology, Boston, 1972.

———. "Some Political Effects of Computation in Latin America." In *M.I.T. Alfred P. Sloan School of Management Working Paper no. 655-73*. Cambridge, Mass.: M.I.T. Alfred P. Sloan School of Management, 1973.

———. "The Transfer of Computer Technology: A Framework for Policy in the Latin American Nations." Ph.D. diss., Massachusetts Institute of Technology, Boston, 1974.

Barrientos, Jorge, and Raúl Espejo. "Un modelo cibernético para la dirección del sector industrial." *INTEC: revista del comité de investigaciones tecnológicas de Chile*, June 1973, 5-18.

Barr-Melej, Patrick. *Reforming Chile: Cultural Politics, Nationalism, and the Rise of the Middle Class*. Chapel Hill: University of North Carolina Press, 2001.

"Bases para un sistema intercambio." *La Nación*, 25 October 1966, 3.

Bastos, Maria Inês, and Charles Cooper, eds. *Politics of Technology in Latin America.* New York: Routledge, 1995.

Becket, Michael. "Beer: The Hope of Chile." *Daily Telegraph*, 10 August 1973, 7.

Beer, Stafford. *Brain of the Firm: The Managerial Cybernetics of Organization.* 2nd ed. New York: John Wiley, 1981.

———. *Cybernetics and Management.* 2nd ed. London: English Universities Press, 1967.

———. *Decision and Control: The Meaning of Operational Research and Management Cybernetics.* New York: John Wiley, 1966.

———. *Designing Freedom.* New York: John Wiley, 1974.

———. *Platform for Change: A Message from Stafford Beer.* New York: John Wiley, 1975.

Benavides, Leopoldo. "La historia oral en Chile." Paper presented at the seminario interdisciplinario autobiografía, testimonio, literatura documental, Santiago, December 1987.

———. "Historia oral: problemas y perspectivas, documento de trabajo." Santiago: FLACSO, 1984.

Bengoa, José. "El testigo: apuntes de clase de un curso de historias de vida." *Proposiciones*, no. 29 (1999): 15-34.

Beniger, James R. *The Control Revolution: Technological and Economic Origins of the Information Society.* Cambridge, Mass.: Harvard University Press, 1986.

Bethell, Leslie, ed. *The Cambridge History of Latin America.* New York: Cambridge University Press, 1984.

———. *Chile Since Independence.* New York: Cambridge University Press, 1993.

Bijker, Wiebe E., Thomas Parke Hughes, and T. J. Pinch, eds. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology.* Cambridge, Mass.: MIT Press, 1987.

Bitar, Sergio. *Chile: Experiment in Democracy.* Translated by Sam Sherman. Philadelphia: Institute for the Study of Human Issues, 1986.

———. *Isla 10.* 3a ed. Santiago: Pehuén, 1988.

Black, Edwin. *IBM and the Holocaust: The Strategic Alliance Between Nazi Germany and America's Most Powerful Corporation.* New York: Crown, 2001.

Boehm, B. W., and B. Dexter. "Software in Developing Countries." *Datamation* 20, no. 9 (1974): 73-7.

Boehm, Barry W. "Computing in South America." *Datamation* 16, no. 5 (1970): 97-108.

Bonsiepe, Gui. *Del objeto a la interfase*. 3 ed. Buenos Aires: Ediciones Infinito, 1998.

———. "Subdesarollo, tecnología y universidad. Reflexiones metatecnológicas." *Cuadernos de la realidad nacional*, no. 11 (1972): 137-49.

Boock, Alfredo Hoppe. "Nuevo espíritu educacional ante cambios sociales." *El Mercurio*, 23 May 1965, 1.

Bourne, Richard. *Political Leaders of Latin America*. Baltimore: Penguin, 1969.

Bowker, Geoffrey C., and Susan Leigh Star. *Sorting Things Out: Classification and Its Consequences*. Cambridge, Mass.: MIT Press, 1999.

"Box por Computadora." *La Nación*, 23 January 1970, 4.

Brevis, Abel. "Ciencia ¿Superstición del Siglo XX?" *La Nación*, 18 January 1970, 5.

Brewer, Roy. "Facsímiles de impresos transmitidos por línea telefónica." *La Nación*, 7 October 1970, 4.

"Buenas ideas, pilares de IBM." *Diálogo IBM Chile*, September-October 1977, 4-5.

Burchell, Graham, Colin Gordon, and Peter Miller, eds. *The Foucault Effect: Studies in Governmentality: With Two Lectures by and an Interview with Michel Foucault*. Chicago: University of Chicago Press, 1991.

"Buscan mayor participación trabajadores en planes de Alianza para el Progreso." *La Nación*, 28 September 1966, 7.

"Calculadora de circuitos digitales mostraron a Frei." *La Nación*, 11 June 1970, 2.

"Calculadora Electronica Digital Sony." *El Mercurio*, 7 February 1979, 4.

Calloni, Stella. *Los años del lobo: Operación Condor*. Buenos Aires: Ediciones Continente, 1999.

"Cambios de Ejecutivos." *Informática*, January 1988, 6.

Campbell-Kelly, Martin, and William Aspray. *Computer: A History of the Information Machine*. 1st ed. New York: Basic Books, 1996.

"Canciller Viajó Anoche a EE.UU." *La Nación*, 26 July 1969, 3.

Cañete, Roberto. "The Brain of the Government: An Application of Cybernetic Principles to the Management of a National Industrial Economy." Paper presented at the 22nd annual North American meeting of the Society for General Systems Research, Avoiding Social Catastrophes and Maximizing Social Opportunities: The General Systems Challenge, Washington, D.C., 13-15 February 1978.

Cano, Sonia. "ECOM: después del lodo viene el cambio." *Informática*, July 1982, 4-5.

———. "Leandro Sanhueza: lo que pasó en ECOM." *Informática*, November 1983, 4-6.

———. "Las nuevas raíces de ECOM." *Informática*, January-March 1983, 9-10.

———. "Qué pasó con PLANACAP?" *Informática*, August 1983, 27.

———. "Sonda a la conquista." *Informática*, June 1985, 29-30.

———. "SONDA: una empresa de servicios que sirve servicialmente." *Informática*, December 1984, 26-29.

Cardoso, Fernando Henrique, and Enzo Faletto. *Dependencia y desarrollo en América Latina*. Lima: Instituto de Estudios Peruanos, 1967

———. *Dependency and Development in Latin America*. Translated by Mariory Mattingly Urquidi. Berkeley: University of California Press, 1979.

"Cartulina para tarjetas de IBM." *Diálogo IBM Chile*, November-December 1976, 3.

Casabellas, Fernando. "Electrotecnía contra criminales." *La Nación*, 19 February 1967, 2.

Castells, Manuel, ed. *End of Millennium*. Vol. 3 of *Information Age: Economy, Society, Culture*. Malden, Mass.: Blackwell, 1998.

———. *The Power of Identity*. Vol. 2 of *Information Age: Economy, Society, Culture*. Malden, Mass.: Blackwell, 1997.

———. *The Rise of the Network Society*. Vol. 1 of *Information Age: Economy, Society, Culture*. Cambridge, Mass.: Blackwell, 1996.

Cavallo, Ascanio, Manuel Salazar, and Oscar Sepúlveda. *La historia oculta del régimen militar: memoria de una época 1973-1988*. Santiago: Grijalbo Mondadori, 1997.

"Censada población nacional." *El Mercurio*, 23 April 1970, 1.

"Censo continuará empadronamiento." *El Mercurio*, 24 April 1970, 16.

Centro de computación, Facultad de Ciencias Físicas y Matemáticas de la Universidad de Chile. *Actividades Docentes 2.o semestre 1964*. Santiago: Prensa Lationamericana S.A., 1964.

"Centro de computación instalaran las 'UES.'". *La Nación*, 24 October 1971, 6.

Centro de Estudios Públicos. *"El ladrillo": bases de la política económica del gobierno militar chileno*. Santiago: Centro de Estudios Públicos, 1992.

"Centro de servicios de computación." *El Mercurio*, 19 January 1969, 29.

"Centro electrónico fue inaugurado por S.E. en la Universidad de Chile." *El Mercurio*, 18 January 1967, 21, 25.

"Cerca de 100 son las Filiales de la CORFO." *CORFO: en el gobierno de la Unidad Popular, memoria CORFO 1970-1971*. CORFO, Santiago, 1971.

"Cerebro electrónico comenzó a funcionar." *La Nación*, 18 January 1967, 5.

"'Cerebro electrónico' en muestra estudiantil." *El Mercurio*, 30 May 1966, 39.

"Cerebro electrónico: 'funcionario' fiscal múltiple e idóneo." *La Nación*, 29 June 1969, 2.

"Cerebro electrónico para obtener empleo." *La Nación*, 19 June 1967, 13, 18.

"Cerebros electrónicos ponen notas a 50 mil estudiantes." *La Nación*, 22 November 1969, 5.

"CEREN: ciencia en la tradición del Marxismo." *Qué Pasa*, 14 June 1973, 58-59.

"CEREN: doble desafío en el plano universitario y social." *La Nación*, 3 January 1971, 5.

Ceruzzi, P. "Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After." *IEEE Annals of the History of Computing* 23, no. 2 (2001): 74-75.

Ceruzzi, Paul E. *A History of Modern Computing*. Cambridge, Mass.: MIT Press, 1998.

Chandler, Alfred. *The Visible Hand: The Managerial Revolution in American Business*. Cambridge, Mass.: Harvard University Press, 1977.

"Chile afronta el desafío de la era de la computación." *El Mercurio*, 19 June 1970, 32.

"Chile en el camino de la alianza para el progreso." *La Nación*, 17 August 1968, 2.

"Chile en la ruta de las comunicaciones con satélites." *La Nación*, 30 October 1967, 15.

"Chile inicia utilización de satélites artificiales." *El Mercurio*, 9 October 1966, 20.

"Chile marcha a la cabeza en sistemas de computación." *La Nación*, 8 August 1969, 6.

"Chile penetra en el progreso de la era tecnología y de la computación." *El Mercurio*, 18 January 1969, 31.

"Chile se coloca a la cabeza del progreso computacional y tecnológico de América Latina." *La Nación*, 18 January 1969, 7.

"Chile y la alianza para el progreso." *La Nación*, 26 October 1966, 3.

Chonchol, Jacques. "Qué es el CEREN." *Cuadernos de la realidad nacional* 1 (1969): 5-14.

"El ciclotrón de la Facultad de Ciencias de la Universidad de Chile." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, June 1967, 7.

"Ciencia, tecnología y desarrollo." *El Mercurio*, 14 September 1965, 3.

"La ciencia en el desarrollo." *El Mercurio*, 21 June 1967, 3.

"La ciencia en el desarrollo de América Latina." *La Nación*, 16 October 1966, 11.

"Ciencia e imperialismo." *La Nación*, 1 July 1971.

"Ciencia y subdesarrollo." *La Nación*, 14 February 1968, 3.

"Ciencia y técnica, claves para el desarrollo de los pueblos." *La Nación*, 7 July 1971, 8.

"Ciencia y tecnología, claves del desarrollo." *El Mercurio*, 28 September 1965, 3.

"Ciencia y tecnología en Chile." *El Mercurio*, 17 May 1970, 9.

"Ciencia y tecnología son el futuro de Latinoamérica." *La Nación*, 1 March 1969, 2.

"La ciencia y la tecnología son vitales para el desarrollo integral de la nación." *La Nación*, 1 August 1969, 1, 5.

"Cientista venezolano llegó ayer a Santiago." *La Nación*, 25 May 1970, 12.

"Cinco años de alianza para el progreso." *La Nación*, 17 August 1966, 3.

"Cinco nuevas reparticiones creó Vuskovic en la CORFO." *El Mercurio*, 24 May 1973, 2.

Cleaves, Peter S. *Bureaucratic Politics and Administration in Chile*. Berkeley: University of California Press, 1974.

Cline, William R. *Informatics and Development: Trade and Industrial Policy in Argentina, Brazil, and Mexico*. Washington, D.C.: Economics International, 1987.

Cockcroft, James D., ed. *Salvador Allende Reader*. Hoboken, N.J.: Ocean Press, 2000.

Codero, Raquel. "La increíble aventura musical de las máquinas computadores." *El Mercurio*, 22 July 1973, 63.

Collier, Simon, and William F. Sater. *A History of Chile, 1808-1994.* New York: Cambridge University Press, 1996.

Comisión Central del Censo. "Censo de la República de Chile levantado el 28 de noviembre de 1907." Sociedad Imprenta y Litografia Universo, Santiago, 1908.

"Comisión nacional de investigación científica y tecnológica." *La Nación*, 23 April 1967, 11.

"Comisión nacional de investigación científica y tecnológica." *La Nación*, 3 August 1969, 4.

"La comisión que organiza los trabajos del próximo censo." *El Mercurio*, 5 April 1929, 12.

Compañia de Telefonos de Chile. "Mas progreso para Chile: nueva central telefónica automática en Maipú." *Revista chilena de ingeniería y anales del Instituto de Ingenieros,* 1961.

"Composición de tipografía a velocidad diez veces mayor." *La Nación*, 11 November 1970, 14.

"Compositor chileno obtiene un premio internacional de música electrónica." *La Nación*, 2 June 1970, 16.

"Computación: clave de nuestra época." *La Nación*, 22 January 1969, 4.

"Computación de la CODE en sede del PDC." *El Mercurio*, 5 March 1973, 12.

"Computación electrónica." *El Mercurio*, 29 July 1969, 3.

"La computación en la agricultura." *El Mercurio*, 11 August 1970, 12.

"La computación en la construcción." *El Mercurio*, 7 August 1970, 2.

"Computador de la 'U': en 30 minutos hace el trabajo de tres años." *La Nación*, 20 April 1969, 3.

"Computador electrónico permitirá mejorar atención a imponentes." *La Nación*, 7 September 1966, 7.

"Computador electrónico recibe a las 11.30 horas la U. técnica." *El Mercurio*, 13 January 1965, 3.

"Computador electrónico recibió Universidad Técnica del Estado." *El Mercurio*, 14 January 1965, 29.

"Un computador en el Banco del Estado." *La Nación*, 3 September 1969, 4.

"Computador sentimental." *El Mercurio*, 27 September 1970, 27.

"Computadora procesará desarrollo del país." *El Mercurio*, 6 January 1969, 33.

"La computadora electrónica." *El Mercurio*, 18 April 1971, 7.

"Una computadora evita la congestión de autos." *La Nación*, 10 October 1970, 4.

"¿Computadoras dirigiendo empresas?" *El Mercurio*, 14 August 1970, 2.

"Computadoras para el proceso electoral." *El Mercurio*, 12 November 1972, 1.

"Computadoras y simios para curar enfermedades." *La Nación*, 21 September 1970, 8.

"Computadores calculan edificios de la UNCTAD." *El Mercurio*, 27 September 1971, 21.

"Computadores dan 60.8% para la CODE." *El Mercurio*, 7 March 1973, 15.

"Cómputos electorales." *El Mercurio*, 3 April 1971.

"Computadores electrónicos." *Revista chilena de ingeniería*, no. 318 (1967): 3-15.

"Computadores futuristas." *El Mercurio*, 8 January 1970, 3.

"Las computadores vencen al ingenio y la pillería." *La Nación*, 15 January 1971, 2.

"Los computadores y la salud en el año 2.000." *La Nación*, 15 April 1968, 14.

"Conceptos expresados por el presidente del Colegio de Ingenieros de Chile, don Mario Durán M., en la reunión final con el comité de ministros para la ciencia y tecnología en Moscú." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 31 (1966): 11-12.

"Concluye torneo sobre ciencia y tecnología." *El Mercurio*, 22 September 1965, 1.

"Condiciones para el desarrollo científico y tecnológico." *El Mercurio*, 30 August 1965, 3.

"Conectados por radio funcionarán computadores entre Chile y EE.UU." *El Mercurio*, 6 July 1965, 15.

"Con el Presidente Frei se reune comisión de nacionalización." *La Nación*, 10 July 1968, 3.

"Conferencia sobre política científica." *El Mercurio*, 7 July 1971, 1.

"Conocimientos de tecnología para el presente y el porvenir." *El Mercurio*, 21 April 1971, 26.

"Con rayos láser se enviarán radiofotos." *El Mercurio*, 23 April 1973, 16.

"Consenso científico y tecnológico hemisférico." *El Mercurio*, 21 May 1972, 43.

"Con sistema electrónico sorprenderán fraudes tributarios." *La Nación*, 7 February 1965, 18.

"Consorcio 'IBM' trata de salvar a Venecia." *La Nación*, 7 December 1969, 9.

Constable, Pamela, and Arturo Valenzuela. *A Nation of Enemies: Chile Under Pinochet*. 1st ed. New York: W. W. Norton, 1991.

"Los contadores sus cerebros electrónicos." *La Nación*, 12 November 1969, 3.

"Un continuado progreso gráfico." *El Mercurio*, 1 June 1970, 6.

"Convención mundial IBM se inicia el 13." *La Nación*, 8 March 1967, 7.

"Convenio científico y tecnológico entre Chile y Alemania." *El Mercurio*, 27 October 1970, 20.

"Cooperación cultural, científica y técnica francesa en Chile." *El Mercurio*, 14 July 1971, 27.

"La cooperación de Alemania en el campo de la educación y tecnología en nuestro país." *El Mercurio*, 10 September 1965, 31.

"Cooperación económica brinda Estados Unidos para contribuir al desarrollo de nuestro país." *El Mercurio*, 2 March 1965, 24.

"Cooperación en el campo educacional." *El Mercurio*, 6 February 1965, 3.

"Cooperative de EE.PP. Contará con un Computador Electrónico." *Lá Nación*, 25 December 1967, 8.

CORFO. "Comité de las industrias eléctricas y electrónicas." *CORFO en el gobierno de la Unidad Popular*, 4 November 1971, 15.

———. "Proyecto Synco conceptos y práctica del control; una experiencia concreta: la dirección industrial en Chile." Santiago, 1973.

"CORFO bienio 1967-68." Santiago de Chile: CORFO, 1968.

"CORFO comprara acciones particulares de la CAP." *La Nación*, 12 Febrero 1971, 2.

"CORFO crea empresa electrónica nacional." *El Mercurio*, 14 June 1969, 27, 33.

"La CORFO es el elemento básico del desarrollo." *La Nación*, 14 January 1969, 2.

"CORFO planifica nueva industria electrónica." *El Mercurio*, 1 April 1971, 26.

CORFO Relaciones Publicas. "Rol de CORFO en los propósitos de cambios." *CORFO en el gobierno de la Unidad Popular*, 4 November 1971, 8-9.

"CORFO 71: en la ruta del desarrollo." *La Nación*, 15 December 1970, 2.

Correa, Sofia, Consuelo Figueroa, Alfredo Jocelyn-Holt, Claudio Rolle, and Manuel Vicuña. *Historia del siglo XX chileno*. Santiago: Editorial Sudamericana, 2001.

"Correción electrónica de pruebas de conocimiento." *El Mercurio*, 16 January 1970, 25.

Cortada, James W. *Before the Computer: IBM, NCR, Burroughs, and Remington Rand and the Industry They Created, 1865-1956.* Princeton, N.J.: Princeton University Press, 2000.

"Creando carreras cortas la UTE absorberá a 10 mil estudiantes." *La Nación*, 13 December 1970, 3.

"Crónica de un paro." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 61 (1972): 4-9.

Crozier, Michel. *The Bureaucratic Phenomenon.* Chicago: University of Chicago Press, 1964.

Crummet, Maria de los Angeles. "El Poder Feminino: The Mobilization of Women Against Socialism in Chile." *Latin American Perspectives* 4, no. 4 (1977): 103-13.

Cruz, Rafael. "La transferencia de la tecnología a los países en desarrollo." *Mensaje*, March-April 1972, 147, 227.

"Cuadernos del CEREN: ¿Donde queda el rigor universitario?" *Qué Pasa*, 1 February 1973, 51.

"¿Cuáles Serán los Inventos del Futuro?" *El Mercurio*, 2 March 1973, 27.

Cuarto mensaje del Presidente de la República de Chile don Eduardo Frei Montalva al inaugurar el periodo de Sesiones Ordinarias del Congreso Nacional, 21 de Mayo de 1968. Santiago: Departamento de Publicaciones de la Presidencia de la Republica , 1968.

"Cuatro osados sondautas viajan en el tiempo." *Sondauta*, January-February 1994, 10-11.

"Curso de producción e ingeniería en la TV." *La Nación*, 13 January 1969, 10.

"Cursos y seminarios para ingenieros: computación." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 52 (1971): 9.

"'Cyberstride.' Ciencia-ficción computacional para la UP." *Qué Pasa*, 25 August 1983, 5.

Davis, Nathaniel. *The Last Two Years of Salvador Allende*. Ithaca, N.Y.: Cornell University Press, 1985.

Debray, Régis, and Salvador Allende Gossens. *The Chilean Revolution: Conversations with Allende*. 1st American ed. New York: Pantheon, 1972.

de Castresana, Luis. "El robot invasor." *El Mercurio*, 27 June 1970, 3.

Dekovic Torres, José. "Metodología general para evaluación y selección de sistemas de procesamiento de datos." Paper presented at the Segundo Congreso Latinoamericano sobre la Computación Electrónica para el Desarrollo, Lima, Perú, December 1968.

D'Etigny, Enrique. "Copia de carta enviada por el decano de la Facultad de Ciencias y Matématicas de la Universidad de Chile, ing. Enrique D'Etigny, al rector de la U. Técnica del Estado." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 34 (1967): 4-6.

Departamento de Asistencia Técnica Internacional. "La asistencia técnica internacional recibida por Chile, 1965-1968: un intento de evaluación," 1-52. ODEPLAN, Santiago, 1970.

Departamento de Estudios Financieros. "Manual de la administración publica de Chile." Ministerio de Hacienda, Santiago, 1959.

"Desafíos de la computación." *El Mercurio*, 11 August 1970, 3.

"Desarrollo de la utilización de la tecnología de computadores en Chile." *Informática*, May 1979, 21-26.

Desrosières, A. "How to Make Things Which Hold Together: Social Science, Statistics and the State." In Peter Wagner, Björn Wittrock and Richard Whitley, eds., *Discourses on Society: The Shaping of the Social Science Disciplines*, 195-218. Boston: Kluwer Academic, 1991.

Deutsch, Sandra McGee. "Gender and Sociopolitical Change in 20th Century Latin America." *Hispanic American Historical Review* 71, no. 2 (1991): 259-306.

De Vylder, Stefan. *Allende's Chile: The Political Economy of the Rise and Fall of the Unidad Popular.* New York: Cambridge University Press, 1976.

———. "La UNCTAD III. ¿Hacia un tercer fracaso?" *Cuadernos de la realidad nacional* 12 (1972): 3-25.

"Día a día computadora." *El Mercurio*, 7 November 1972, 3.

"Dialogarán con el computador de la "U"." *La Nación*, 12 July 1967, 5.

Dinges, John. *The Condor Years: How Pinochet and His Allies Brought Terrorism to Three Continents*. New York: New Press, 2004.

Dinges, John, and Saul Landau. *Assassination on Embassy Row*. 1st ed. New York: Pantheon, 1980.

Dirección General de Estadística. "Censo de población de la República de Chile levantado el 15 de Diciembre de 1920." Soc. Imp. y Litografía Universo, Santiago, 1925.

———. "Estadística chilena." Dirección General de Estadística, Santiago, 1928.

———. "Resultados del X censos de la Republica de Chile 1930 efectuado el 27 de Noviembre de 1930 y estadísticas comparativas con censos anteriores." Impresa Universo, Santiago, 1931.

———. "X censos de la Republica de Chile 1930 efectuado el 27 de noviembre de 1930 edad, estado civil, nacionalidad, religión e instrucción." Impresa Universo, Santiago, 1933.

———. "X censos de la Republica de Chile 1930 efectuado el 27 de noviembre de 1930 ocupaciones." Impresa Universo, Santiago, 1935.

"La directiva del colegio se entrevista con el Presidente de la República don Eduardo Frei." *Ingenieros: boletin oficial del Colegio de Ingenieros de Chile*, no. 24 (1965): 8-9.

"Director para centro de computación." *El Mercurio*, 19 October 1971, 25.

"Diseño de una sala de operaciones." *INTEC: revista del comité de investigaciones tecnológicas de chile*, June 1973, 19-28.

Donoso I., Patricio. "SONDA: ímpetu, innovación y emprendimiento." In Matko Koljatic M., ed., *La nueva empresa chilena: un estudio de casos*, 205-24. Santiago: Eds. Universidad Católica de Chile, 1999.

Dorfman, Ariel, and Armand Mattelart. *How to Read Donald Duck: Imperialist Ideology in the Disney Comic*. 2nd enlarged ed. New York: International General, 1984.

Drake, Paul W. "From Good Men to Good Neighbors: 1912-1932." In Abraham F. Lowenthal, ed., *Exporting Democracy: the United States and Latin America*, 3-41. Baltimore: Johns Hopkins University Press, 1991.

———. *Socialism and Populism in Chile, 1932-52.* Urbana: University of Illinois Press, 1978.

Drake, Paul W., and Ivan Jaksic, eds. *The Struggle for Democracy in Chile.* Rev. ed. Lincoln: University of Nebraska Press, 1995.

Du Bridge, Lee A. "Cambio tecnológico y capitalismo." *El Mercurio*, 19 December 1966, 34.

Ducci, Mercedes. 2003. Vivir en Cuatro Ruedas. Canal 13, http://reportajes.canal13.cl/index_repdelsiglo.html (11 November, 2004).

Eagleton, Terry. *Ideology: An Introduction.* New York: Verso, 1991.

ECOM. "Caracteristicas principales de los sistemas Iris-80 e Iris-60." In *Conferencia de procesamiento electrónico de datos para empresas y organismos gubernatales.* Santiago: Empresa Nacional de Computación e Informática, 1973.

———. "Programa capacitación Iris-80." In *Conferencia de procesamiento electrónico de datos para empresas y organismos gubernatales.* Santiago: Empresa Nacional de Computación e Informática, 1973.

———. "Resolución de problemas de bibliotecas por medio de computadores." 33 pp. Santiago, 1972.

ECOM, OCOM. "Proyecto rol único nacional y registro nacional de población." OCOM-ECOM, Santiago, 1972.

"ECOM inauguro su nuevo edificio." *Informática*, September 1987, 5.

"ECOM: nuevo nombre para una empresa que surge." *La Nación*, 7 January 1971, 2.

"Edificio especial para computación de impuestos." *La Nación*, 24 September 1971, 2.

"La educación, fuente de desarrollo." *El Mercurio*, 2 March 1965, 3.

"Educación, tecnología y desarrollo." *El Mercurio*, 17 March 1965, 3.

"Educación tecnológica." *El Mercurio*, 10 June 1965, 3.

Edwards, Paul N. *The Closed World: Computers and the Politics of Discourse in Cold War America.* Cambridge, Mass.: MIT Press, 1996.

Edwards, Thomas L. *Economic Development and Reform in Chile: Progress Under Frei, 1964-1970.* East Lansing: Latin American Studies Center, Michigan State University, 1972.

"Efectuaran un simposio sobre la administración científica." *La Nación*, 25 August 1965, 9.

"Electrónica al servicio de los delegados." *El Mercurio*, 16 March 1972, 20.

"Electrónica demuestra terrorífica tendencia a sustituir al hombre." *La Nación*, 16 January 1967, 9.

"La electrónica en la moderna conducción de los negocios." *El Mercurio*, 2 August 1965, 36.

Elliott, Jorge. "Suiza, ¿país subdesarrollado?" *El Mercurio*, 16 December 1964, 33.

EMCO. "Seminario sobre sistemas de información en el gobierno." 159 pp. EMCO, United Nations Development Program, Santiago, 1969.

"Empresa de servicio de computación." *La Nación*, 3 November 1969, 24.

"La empresa moderna como función social." *El Mercurio*, 14 February 1965, 3.

"En Chile, segundo país en el mundo, método de comprensión directa entre ingeniero y computador electrónico." *El Mercurio*, 16 July 1967, 41.

"Encuesta científica-tecnológica." *La Nación*, 23 February 1970, 12.

"En defensa de la ingeniería." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 60 (1972): 3-7.

ENDESA. "La computación: herramienta revolucionaria para el progreso." 10 pp. Santiago de Chile: ENDESA, 1972.

"En 1983: $466 millones perdió ECOM." *El Mercurio*, 11 March 1984, B1.

"ENTEL, su desarrollo y realizaciones." *El Mercurio*, 7 August 1970, 2.

"ENTEL ampliará red de comunicación." *El Mercurio*, 11 September 1970, 23.

"ENTEL: nervio fundamental de nuestras comunicaciones." *La Nación*, 14 January 1969, 22.

"Entrevista al brigadier general Sr. José Mutis Puccio, delegado de informática." *Informatica*, November 1981, 32-33.

"Equipo de telex simplificará funciones del registro civil." *La Nación*, 13 June 1969, 3.

"Equipos electrónicos en vez de examinadores." *La Nación*, 18 March 1970, 1.

Escobar, Arturo. *Encountering Development: The Making and Unmaking of the Third World.* Princeton, N.J.: Princeton University Press, 1995.

"La Escuela de Ingenieros Industriales cumplirá 25 años de labores docentes." *El Mercurio*, 25 May 1966, 23.

Escuela Nacional de Adiestramiento. "Organización para el trabajo eficiente (O.T.E)." Sub-dirección de Racionalización y Función Pública, OCOM, Santiago, 1972.

Espejo, Raúl. "Cybernetic Praxis in Government: The Management of Industry in Chile 1970-1973." *Cybernetics and Systems: An International Journal* 11 (1980): 325-38.

Espinosa, Juan G., and Andrew S. Zimbalist. *Economic Democracy: Workers' Participation in Chilean Industry, 1970-1973.* New York: Academic Press, 1978.

"Espíritu renovado para formar científicos e ingenieros." *El Mercurio*, 13 February 1966, 1.

"Estado de la hacienda pública en 1928." *El Mercurio*, 26 February 1929, 14.

"Europa en Chile: computador electrónico jugaba al poker." *La Nación*, 13 September 1967, 23.

Evans, Peter B., Claudio Frischtak, and Paulo Bastos Tigre, eds. *High Technology and Third World Industrialization: Brazilian Computer Policy in Comparative Perspective*. Berkeley: International and Area Studies, University of California, 1992.

"Expansión de la industria electrónica." *La Nación*, 17 September 1968, 4.

"Experto norteamericano dicta curso sobre computación." *El Mercurio*, 23 July 1965, 26.

"Expertos de Estados Unidos participarán en plan sobre computadores y estructuras." *El Mercurio*, 23 January 1965, 20.

Ezrahi, Yaron. *The Descent of Icarus: Science and the Transformation of Contemporary Democracy*. Cambridge, Mass.: Harvard University Press, 1990.

Facultad de Ciencias Físicas y Matemáticas. "Informativo centro de computación." 53 pp. Universidad de Chile, Santiago, 1971.

"Facultad de Ciencias Físicas y Matemáticas proyecta crear nuevas carreras profesionales." *El Mercurio*, 2 August 1965, 29.

Falcoff, Mark. "Amplio porvenir se abre a la ciencia e investigación." *La Nación*, 20 April 1967, 5.

———. *Modern Chile, 1970-1989: A Critical History.* New Brunswick, N.J.: Transaction, 1989.

Faletto, Enzo. "Imagenes sociales de la transformación tecnológica." *Revista de la CEPAL*, no. 45 (1991): 7-17.

Faúndez, Julio. *Marxism and Democracy in Chile: From 1932 to the Fall of Allende*. New Haven, Conn.: Yale University Press, 1988.

"Fernando Romero: millonario en tarjetas." *Dialogo IBM Chile*, July-August 1979, 8.

Ffrench-Davis, Ricardo. *Entre el neoliberalismo y el crecimiento con equidad: tres décadas de política económica en Chile*. Santiago, Chile: Dolmen Ediciones, 1999.

———. *Políticas económicas en Chile, 1952-1970*. 1. ed. Santiago, Chile: Ediciones Nueva Universidad Universidad Católica de Chile, 1973.

"Finalizó seminario sobre computación." *El Mercurio*, 1 August 1969, 25, 30.

Finerman, Aaron. "Computing Capabilities in Argentine and Chilean Universities." *Communications of the ACM* 12, no. 8 (1969): 425-31.

Flamm, Kenneth. *Creating the Computer: Government, Industry, and High Technology*. Washington, D.C.: Brookings Institution, 1988.

Fleet, Michael. *The Rise and Fall of Chilean Christian Democracy*. Princeton, N.J.: Princeton University Press, 1985.

"Fondo mundial tecnológico." *El Mercurio*, 3 August 1973, 29.

"Fondos para desarrollo de Universidad Ténica." *El Mercurio*, 27 June 1967, 1, 18.

Forgacs, David, ed. *An Antonio Gramsci Reader: Selected Writings, 1916-1935*. 1st American ed. New York: New York University Press, 2000.

"La formación de científicos calificados es una necesidad impostergable para el país." *El Mercurio*, 6 February 1965, 28.

Foucault, Michel. *Archaeology of Knowledge*. New York: Routledge, 2002.

———. *Discipline and Punish: The Birth of the Prison*. 2nd ed. New York: Vintage, 1995.

———. *The Order of Things: An Archaeology of the Human Sciences*. New York: Vintage, 1973.

———. *Power/Knowledge: Selected Interviews and Other Writings, 1972-1977*. Edited and translated by Colin Gordon. New York: Pantheon, 1980.

Franceschet, Susan. "'State Feminism' and Women's Movements: The Impact of Chile's Servicio Nacional de la Mujer on Women's Activism." *Latin American Research Review* 38, no. 1 (2003): 9-22.

"Frei inauguro computador de más alta productividad en América Latina." *La Nación*, 17 January 1969, 5.

Frei Montalva, Eduardo. "The Aims of the Christian Democracy." *Commonwealth*, 9 October 1964.

———. "The Alliance That Lost Its Way." *Foreign Affairs* 45, no. 3 (1967): 438-48.

———. *América Latina tiene un destino*. Santiago: Zig Zag, 1967.

———. "Discurso del Presidente Frei en inauguración computador electrónico." Oficina de Difusión y Cultura de la Presidencia de la República, Santiago, 1969.

———. "Latin America in the World of Today." *International Affairs* 42, no. 3 (1966): 373-80.

———. *Latin America: The Hopeful Option*. New York: Orbis, 1978.

———. *El mandato de la historia y las exigencias del porvenir*. Santiago: Editorial del Pacifico, 1975.

———. *Memorias: (1911-1934) y correspondencias con Gabriela Mistral y Jacques Maritain*. Santiago: Planeta, 1989.

Frei Montalva, Eduardo, Radomiro Tomic, Jaime Castillo, and Genaro Arriagada. *Democracia cristiana y partido comunista*. Santiago: Editorial Aconcagua, 1986.

Frenk, Eduardo. "El extraño mundo de las máquinas." *La Nación*, 6 March 1966, 2.

Friedmann, Efraín. "Los computadores y los ingenieros." *Revista chilena de ingeniería*, no. 312 (1965): 28-31.

———. *La gestión y los computadores: conferencias*. Santiago: Empresa de Servicio de Computación Ltda., 1969.

———. "Management of Computer Resources in LDC's." Paper presented at the Jerusalem Conference on Information Technology, Jerusalem, August 1971.

Friedmann, Santiago I. "La enseñaza de la investigación de operaciones en la formación del ingeniero." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, October 1968, 2-7.

———. "La era del computador se inicia en Chile." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, October 1962, 11-15.

"Funcionario socialista destruyó tarjetas IBM." *El Mercurio*, 8 September 1972, 20.

"Fusión en la cumbre." *Señal*, January 1987, 2-6.

"Futuro de la investigación científica en Chile." *El Mercurio*, 9 May 1971, 1.

Gannon, Ísabel, and Lucía Ribeiro. "El problema que no tiene nombre: la situación de la mujer." *Cuadernos de la realidad nacional* 13 (1972): 260-70.

Garcia C., Fernando. "El cerebro electrónico aplicado a la programación." *Revista Chilena de Ingenieria y Anales del Instituto de Ingenieros*, February 1964, 16-21.

García, Fernando, and Oscar Sola. *Salvador Allende: una época en blanco y negro*. Buenos Aires: El País Aguilar, 1998.

García Márquez, Gabriel. *One Hundred Years of Solitude*. Translated by Gregory Rabassa. New York: Alfred A. Knopf, 1995.

Garfinkel, Simson. *Database Nation: The Death of Privacy in the 21st Century*, 2nd ed. Cambridge, Mass.: O'Reilly, 2001.

Gauzner, Nikolái. "Alianza con la maquina electrónica." *La Nación*, 26 November 1970, 14.

Gazmuri, Cristián, Patricia Arancibia, and Álvaro Góngora. *Eduardo Frei Montalva y su época*. 2 vols. Santiago: Aguilar, 2000.

Geisse, Guillermo, and Enrique Browne. "¿Planificación para los planificadores o para el cambio social?" *Cuadernos de la realidad nacional* 11 (1972): 117-36.

Gerovitch, Slava. *From Newspeak to Cyberspeak: A History of Soviet Cybernetics*. Cambridge, Mass.: MIT Press, 2002.

Giorgi, Luis. "La pérdida de personal científico e ingenieros en América Latina." *Revista chilena de ingenieria y anales del Instituto de Ingenieros*, November-December 1965, 12-17.

"Gobierno espera ayuda por US$ 120 milliones para 1967." *El Mercurio*, 12 October 1966, 19.

"El gobierno preocupado por la 'fuga de cerebros'." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 38 (1968): 14-15.

Goldstine, Herman Heine. *The Computer from Pascal to von Neumann*. Princeton, N.J.: Princeton University Press, 1972.

Gómez Millas, Juan. "Ciencia y Tecnología." *La Nación*, 19 January 1968, 4.

Góngora, Mario. *Ensayo histórico sobre la noción de estado en Chile en los siglos XIX y XX*. 2nd ed. Santiago: Editorial Universitaria, S.A., 1986.

"Gran presupuesto para la alianza." *La Nación*, 25 January 1967, 12.

Gräwell, W. "Conferencia sobre la organización de la estadística." *Anales del Instituto de Ingenieros de Chile* (1928): 734-47.

Greve, Ernesto. *Historia de la ingeniería en Chile.* Vols. 1 and 2. Santiago: Imprenta Universitaria, 1938-44.

Grosch, Herb. "Chilean Economic Controls." *New Scientist*, 15 March 1973, 626-27.

Gross, Leonard. *The Last Best Hope: Eduardo Frei and the Chilean Democracy.* New York: Random House, 1967.

Guajardo, Guillermo. "Burocracía Técnica y cambios socio-economicos en Chile: El caso de los Ferrocarriles del Estado, 1852-1914." Universidad de Chile, Santiago, 1988.

"Guía electrónico para los aviones." *El Mercurio*, 6 December 1966, 1.

"Guillermo Ramírez Baraona: 'estoy orgulloso de trabajar en una de las tres principales empresas de mundo.'" *Diálogo IBM Chile*, November-December 1980, 5.

Gunder Frank, Andre. *Capitalism and Underdevelopment in Latin America: Historical Studies of Chile and Brazil.* New York: Modern Reader Paperbacks, 1969.

Gupta, Akhil. *Postcolonial Developments: Agriculture in the Making of Modern India.* Durham, N.C.: Duke University Press, 1998.

Gutierrez, Raul. "Chile en la época de la computación." *En Viaje*, July 1969, 10-11.

Gúzman, Juan Andrés. "Proyecto Synco: El Sueño Cibernético de Allende." *Clinic*, July 2003, 5-8.

"Hablan los precursores." *IBM Diálogo*, July 1987, 4-5.

"Hace 20 años se produjo el milagro del "transistor"." *La Nación*, 9 June 1968, 2.

Hacia una política de desarrollo científico y tecnológico para Chile. Santiago: Universidad de Chile Rectoría, 1972.

Halperín Donghi, Tulio. *The Contemporary History of Latin America.* Translated by John Charles Chasteen. Durham, N.C.: Duke University Press, 1993.

Hanlon, Joseph. "Chile Leaps into Cybernetic Future." *New Scientist*, 15 February 1973, 363-64.

Haraway, Donna J. *Modest-Witness@Second-Millennium.FemaleMan-Meets-OncoMouse: Feminism and Technoscience.* New York: Routledge, 1997.

———. *Simians, Cyborgs, and Women: The Reinvention of Nature.* New York: Routledge, 1991.

Hardings, Jens, and Werner Westermann. 2004. ¿Neutralidad Tecnológica? Desencuentros de la política tecnológica chilena. www.softwarelibre.cl/modules.php?op=modload&name=News&file=article&sid=288&mode=thread&order=0&thold=0. (March 8, 2004).

Harrison, P. J., and C. R. Stevens. "A Bayesian Approach to Short-Term Forecasting." *Operational Research Quarterly* 22, no. 4 (1971): 341-62.

"Hay una maquina Burroughs para cualquier negocio." *El Mercurio*, 12 October 1930, 44.

Headrick, Daniel R. *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century*. New York: Oxford University Press, 1981.

Hecht, Gabrielle. *The Radiance of France: Nuclear Power and National Identity After World War II*. Cambridge, Mass.: MIT Press, 1998.

Heims, Steve J. *The Cybernetics Group*. Cambridge, Mass.: MIT Press, 1991.

Henkel, Tom. "El computador personal de IBM." *Informática*, October 1981, 34-35.

"El 'hermano mayor' de Mr. Beer." *Ercilla*, 23-30 January 1973.

Hess, David J. *Science and Technology in a Multicultural World: The Cultural Politics of Facts and Artifacts*. New York: Columbia University Press, 1995.

———. *Science Studies: An Advanced Introduction*. New York: New York University, 1997.

Hoare, Quintin, and Geoffrey Nowell-Smith, eds. *Selections from the Prison Notebooks of Antonio Gramsci*. London: Lawrence and Wishart, 1971.

"El hombre: esclavo del progreso tecnológico." *El Mercurio*, 15 May 1971, 29.

"El hombre y el robot." *El Mercurio*, 11 May 1972, 3.

"Hoy se inaugura conferencia sobre ciencia y tecnología." *La Nación*, 13 September 1965, 20.

Hughes, Agatha C., and Thomas Parke Hughes, eds. *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After*. Cambridge, Mass.: MIT Press, 2000.

Huneeus, Carlos. *La reforma universitaria: veinte años después*. 1st ed. Santiago: CPU, 1988.

Hutchinson, Elizabeth Quay. "From 'La Mujer Esclava' to 'La Mujer Limón': Anarchism and the Politics of Sexuality in Early Twentieth Century Chile." *Hispanic American Historical Review* 81, no. 3-4 (2001): 519-53.

Ibañez Santa Maria, Aldolfo. *Herido en el ala: estado, oligarquías y subdesarrollo.* Santiago de Chile: Universidad de Andres Bello, 2003.

———. *Los ingenieros, el estado y la política en Chile: del Ministerio de Fomento a la Corporación de Fomento, 1927-1939.* Vol. 7, *Estudios Históricos.* Santiago de Chile: Instituto de Historia, Pontificia Universidad Catolica de Chile, 1985.

———. "Los 'ismos' y la redefinición del estado: tecnicismo, planificación y estatismo en Chile, 1920-1940." *Atenea*, no. 474 (1996): 23-50.

IBM. *El enfoque.* Translated by OCOM. Santiago: Ministerio de Hacienda, 1968.

———. *El método: segunda parte.* Translated by OCOM. Santiago: Ministerio de Hacienda, 1968.

IBM Archives. 2004. Frequently Asked Questions. IBM. http://www-1.ibm.com/ibm/history/documents/pdf/faq.pdf. (July 15, 2004).

———. 2004. IBM Highlights, 1885-1969. IBM Archives Documents. http://www-03.ibm.com/ibm/history/documents/pdf/1885-1969.pdf. (18 February, 2004).

———. 2004. IBM Highlights, 1970-1984. IBM Archives Documents. http://www-03.ibm.com/ibm/history/documents/pdf/1969-1984.pdf. (18 February, 2004).

IBM Chile. "IBM/360." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, May-June 1965, 39.

IBM de Chile. "Dispone de sólo cinco minutos-cual es el área de 4,5,6,7?" *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, July-August 1964, 4.

"IBM: gigante mundial de las computadores." *El Mercurio*, 18 October 1972, 25.

"Implantación del sistema "telex" incorpora a las comunicaciones nacionales la técnica más moderna." *La Nación*, 2 March 1965, 8.

"Importancia del computador en el desarrollo del país." *El Mercurio*, 29 July 1969, 4, 16.

"Impuestos internos utiliza servicios electrónicos." *La Nación*, 3 November 1965, 101.

"Impulso a las escuelas técnico -- profesionales." *La Nación*, 16 January 1971, 7.

"Impulso al desarrollo electrónico y de las telecomunicaciones." *El Mercurio*, 12 June 1973, 18.

"Inaugurada computadora que realiza treinta mil operaciones por segundo." *La Nacion*, 28 September 1968, 3.

"Inaugurado computador electrónico de Chilectra." *La Nación*, 2 September 1969, 2.

"Inaugurado computador para el sector público." *El Mercurio*, 17 January 1969, 23.

"Inaugurado Instituto Tecnológico." *El Mercurio*, 15 July 1970, 1.

"Inaugurado laboratorio de microelectrónica." *El Mercurio*, 22 September 1972, 15.

"Inauguran exposición móvil de equipos electrónicos." *La Nación*, 13 March 1969, 5.

"Inflexibles computadoras nos llevarán la cuentas." *La Nación*, 11 November 1969, 5.

"La ingeniería chilena, en la avanzada del progreso Ténico y Científico." *Ingenieros: boletin oficial del Colegio de Ingenieros de Chile*, no. 33 (1967): 16.

"Ingeniería de ejecución, carrera consciente del avance tecnológico." *La Nación*, 4 October 1970, 4.

"Ingeniería extranjera." *Ingenieros: boletin oficial del Colegio de Ingenieros de Chile*, no. 47 (1970): 19.

"La ingeniería se incorpora al uso de los computadores." *El Mercurio*, 20 July 1967, 28.

"'Ingenieros' conversó con don Salvador Allende." *Ingenieros: Boletin oficial del Colegio de Ingenieros de Chile*, no. 50 (1970): 7.

"Ingenieros del país asisten a escuela de seguridad minera en Universidad Técnica del Estado." *El Mercurio*, 28 March 1965, 49.

"Inician plan de gran alcance con computadores electrónicos." *El Mercurio*, 5 June 1965, 29.

"Inició labores conferencia de la UNESCO de ciencia y tecnología." *El Mercurio*, 14 September 1965, 21.

"Inquieta a cuidadanía insólito atraso en entrega de cómputos." *El Mercurio*, 6 March 1973, 1.

"Instituciones financieras agilizan sus operaciones con el sistema "en línea" de N.C.R." *El Mercurio*, 4 August 1965, 19.

Instituto Nacional de Estadísticas. "Reseña historica del Instituto Nacional de Estadisticas, centesimo cuadragesimo aniversario 1843-1983." INE, Santiago, 1983.

"El Instituto Tecnológico de Chile." *El Mercurio*, 16 July 1970, 3.

INTEC. "Introducción a una nueva revista." *INTEC*, December 1971, 5.

"Integración de la ciencia y a técnica en la América Latina." *La Nación*, 22 September 1965, 3.

"Integración para el avance tecnológico." *La Nación*, 16 January 1969, 4.

"Intensa labor de comisiones en congreso de ciencia y tecnología." *El Mercurio*, 16 September 1965, 21, 26.

"Intercambio científico con Alemania." *La Nación*, 8 April 1969, 4.

"Investigaciones y otras actividades del CEREN." 258-75. Santiago de Chile: CEREN Apartado de Cuadernos de la Realidad Nacional, 1971.

Irustra, Gerardo. *Espionaje y servicios secretos en Boliva*. La Paz: n.p., 1995.

Jaramillo, Andrés Estefane. "'Un alto en el camino para saber cuántos somos.' Los censos de población y la construcción de lealtades nacionales. Chile, Siglo XIX." 39 pp. Pontificia Universidad Católica de Chile, 2001.

Jocelyn-Holt Letelier, Alfredo. *El Chile perplejo: del avanzar sin transar al transar sin parar*. 1st ed. Santiago: Planeta/Ariel, 1998.

———. *'El peso de la noche': nuestra frágil fortaleza histórica*. 2. ed. Santiago: Planeta/Ariel, 1997.

Joerges, B. "Do Politics Have Artefacts?" *Social Studies of Science* 29, no. 3 (1999): 411-31.

"Julio Stevenson: un vínculo de 35 años." *Dialogo IBM*, January-February 1980, 8.

Kennedy, John F. "Address at a White House Reception for Members of Congress and the Diplomatic Corps of the Latin American Republics." John Fitzgerald Kennedy Library, Boston, 1961.

Kirkwood, Julietta. *Ser política en Chile: los nudos de la sabiduría feminista*. 2nd ed. Santiago: Editorial Cuarto Propio, 1990.

Kissinger, Henry. *White House Years*. 1st ed. Boston: Little, Brown, 1979.

Klaren, Peter F. *Promise of Development: Theories of Change in Latin America*. Boulder, Colo.: Westview, 1986.

Klarmann M., Mario. "La computación digital en los problemas ferrovarios." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, February 1969, 11-19.

Klimpel, Felicitas. *La mujer chilena: el aporte femenino al progreso de Chile, 1910-1960*. Santiago: Editorial Andres Bello, 1962.

Klubock, Thomas Miller. *Contested Communities: Class, Gender, and Politics in Chile's El Teniente Copper Mine*. Durham, N.C.: Duke University Press, 1998.

———. "Writing the History of Women and Gender in Twentieth Century Chile." *Hispanic American Historical Review* 81, no. 3-4 (2001): 493-518.

Kornbluh, Peter. *The Pinochet File: A Declassified Dossier on Atrocity and Accountability*. New York: New Press, 2003.

Labarca Grant, Gustavo. "Reestructuración de Obras Publicas." *Revista chilena de ingenieria y anales del Instituto de Ingenieros*, July-August 1964, 8-9.

———. "Urge pasar del subdesarrollo al desarrollo." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, no. 301 (1963): 12-14.

Langer, E. D. "Generations of Scientists and Engineers: Origins of the Computer Industry in Brazil." *Latin American Research Review* 24, no. 2 (1989): 95-111.

Larrain, Jorge. *Identity and Modernity in Latin America*. Oxford: Polity, 2000.

———. *Ideology and Cultural Identity: Modernity and the Third World Presence*. Cambridge, Mass.: Polity Press, 1994.

———. "Orientaciones y actividades de la Confederación Democrática de Partidos durante la crisis de octubre de 1972." *Cuadernos de la realidad nacional* 16 (1973): 229-49.

———. *Theories of Development: Capitalism, Colonialism, and Dependency*. Cambridge, Mass.: Blackwell, 1989.

Latham, Michael E. *Modernization as Ideology: American Social Science and "Nation Building" in the Kennedy Era*. Chapel Hill: University of North Carolina Press, 2000.

Latour, Bruno. *Aramis, or, the Love of Technology*. Cambridge, Mass.: Harvard University Press, 1996.

———. "Drawing Things Together." In Michael Lynch, ed., *Representations in Scientific Practice*, 19-68. Cambridge, Mass.: MIT Press, 1990.

———. *The Pasteurization of France*. Cambridge, Mass.: Harvard University Press, 1988.

———. *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge, Mass.: Harvard University Press, 1987.

———. *We Have Never Been Modern*. Cambridge, Mass.: Harvard University Press, 1993.

———. "Why Has Critique Run out of Steam? From Matters of Fact to Matter of Concern." *Critical Inquiry* 30 (2004): 225-48.

Lavin, Joaquín. *Chile: A Quiet Revolution.* Translated by Clara Iriberry and Elena Soloduchim. Santiago: Zig-Zag, 1988.

"Lenguaje de computación para ingeniería en la Universidad Católica de Chile." *El Mercurio*, 22 September 1967, 15.

Lettvin, J. Y., H. R. Maturana, and W. S. McCulloch. "What the Frog's Eye Tells the Frog's Brain?" *Proceedings of the Institute of Radio Engineers* 47, no. 11 (1959): 1940-51.

"Listo sistema de votación electrónica." *El Mercurio*, 13 October 1971, 19.

Lobel, Juan. "Desarrollo de un repetidor de televisión heterodino." *INTEC*, December `1971, 27-40.

Love, Joseph L. "Economic Ideas and Ideologies in Latin America Since 1930." In Leslie Bethell, ed., *Ideas and Ideologies in Twentieth Century Latin America*, 207-74. New York: Cambridge University Press, 1996.

———. "The Origins of Dependency Analysis." *Journal of Latin American Studies* 22, no. 1 (1990): 143-68.

Loveman, Brian. *Chile: The Legacy of Hispanic Capitalism.* 3rd ed. New York: Oxford University Press, 2001.

———. *For la Patria: Politics and the Armed Forces in Latin America.* Wilmington, Del.: SR Books, 1999.

Loveman, Brian, and Thomas M. Davies. *The Politics of Antipolitics: The Military in Latin America.* Rev. and updated ed. Wilmington, Del.: Scholarly Resources, 1997.

Lundell, John E. "Organización del trabajo eficiente." OCOM, Dirección de Presupuestos, Ministerio de Hacienda, Santiago, 1969.

Lyón, Cristián. 2003. Creando el yagán. Corporación de Televisión de la Pontificia Universidad Católica de Chile, www.reportajesdelsiglo.cl/reportajes/reportajes/auto/entrevista/lyon.htm. (11 November, 2004).

MacKenzie, Donald A. *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance.* Cambridge, Mass.: MIT Press, 1990.

Mahoney, M. S. "The History of Computing in the History of Technology." *Annals of the History of Computing* 10, no. 2 (1988): 113-25.

Mainwaring, Scott, and Timothy Scully. "The Diversity of Christian Democracy in Latin America." In Mainwaring and Scully, *Christian Democracy in Latin America*, 30-63.

———, eds. *Christian Democracy in Latin America: Electoral Competition and Regime Conflicts*. Stanford, Calif.: Stanford University Press, 2003.

Malik, Rex. "Chile Steals a March." *Data Systems*, April 1973, 14-15.

———. "Industrias Británicas de Computadores." *La Nación*, 28 December 1969, 3.

———. "Inside Allende's Economic Powerhouse." *Data Systems*, May 1973, 14-16.

"Máquina de diagnósticos médicos causa expectación." *El Mercurio*, 2 December 1966, 1.

"Máquina electrónica "revisará" exámines." *El Mercurio*, 6 January 1967, 21, 25.

"Máquina electrónica somete a examen médico a una mujer." *El Mercurio*, 1 December 1966, 27.

"Máquinas en la vitrina." *Diálogo IBM Chile*, March/April 1977, 6.

"Máquinas especiales se emplearán en el escrutinio del censo general." *El Mercurio*, 6 March 1930, 7.

Mariano, Nilson. *Operación Cóndor: terrorismo de estado en el Cono Sur*. Buenos Aires: Ed. Lohlé Lumen, 1998.

"Maria Teresa Rosende." *Informática*, September 1986, 16.

Maritain, Jacques. *Integral Humanism: Temporal and Spiritual Problems of a New Christendom*. New York: Scribner, 1968.

Martner, Gonzalo. *El pensamiento económico del gobierno de Allende*. Santiago: Editorial Universitaria, 1971.

Marx, Karl. *Capital.* Vol. 1. New York: Penguin, 1990.

———. *Economic and Philosophic Manuscripts of 1844*. New York: International Publishers, 1964.

Marx, Karl, and Friedrich Engels. *The German Ideology: Including* Theses on Feuerbach *and Introduction to* The Critique of Political Economy. Amherst, N.Y.: Prometheus, 1998.

Martorell, Francisco. *Operación Cóndor, el vuelo de la muerte: la coordinación represiva en el Cono Sur*. 1. ed, *Colección Septiembre*. Santiago: Lom Ediciones, 1999.

"El más grande computador de Sud América inaugura mañana el Banco del Estado." *La Nación*, 31 August 1969, 3.

"Las matemáticas: números y signos que cambian el mundo." *La Nación*, 28 June 1970, 1.

Maturana, Humberto R., and Francisco J. Varela. *Autopoiesis and Cognition: The Realization of the Living*. Boston: D. Reidel, 1980.

———. *De máquinas y seres vivos: una caracterización de la organización biológica*. Santiago: Editorial Universitaria, 1973.

Maximovich, G. "Computadora que Proyecta Computadores." *El Mercurio*, 21 November 1971, 6.

"Mayor impulso a carreras técnicas dan Universidades." *La Nación*, 16 January 1971, 7.

"Médico electrónico examinó a paciente." *La Nación*, 1 December 1966, 1.

"Medidas para entrega rápida de los cómputos." *El Mercurio*, 18 July 1971, 35.

Medina, Eden. "Designing Freedom, Regulating a Nation: Socialist Cybernetics in Allende's Chile." *Journal of Latin American Studies* (under review).

Medina, Eden Miller. "Democratic Socialism, Cybernetic Socialism: Making the Chilean Economy Public." In Bruno Latour and Peter Weibel, eds., *Making Things Public: Atmospheres of Democracy.* Cambridge, Mass.: MIT Press, 2005.

Meller, Patricio. *Un siglo de economía política chilena (1890-1990)*. Santiago: Editorial Andres Bello, 1996.

Melo, Julieta. *La Escuela de Ingeniería: quién y qué es la Facultad de Ciencias Físicas y Matemáticas de la Universidad de Chile*. Santiago: Eds. Mil Hojas, 1997.

"Memoria de la Corporación de Fomento de la Producción." CORFO, Santiago, 1964.

"Memoria de la Corporación de Fomento de la Producción." CORFO, Santiago, 1965.

"Memoria de la Corporación de Fomento de la Producción." CORFO, Santiago, 1966.

Mensaje del Presidente Allende ante el Congreso Pleno, 21 de Mayo de 1972. Santiago: Departamento de Publicaciones de la Presidencia de la Republica, 1972.

"Mensaje de nuestro gerente general." *IBM Diálogo*, July 1987, 3.

Mensaje leido por S.E. el Vicepresidente de la República en la apertura del Congreso Nacional el 21 de Mayo de 1927. Santiago, Chile: Imprenta Nacional, 1927.

Mensaje Presidente Allende ante Congreso Pleno, 21/Mayo '73. Santiago, Chile: Departamento de Publicaciones de la Presidencia de la Republica - Chile, 1973.

Mercer, David. *IBM: How the World's Most Successful Corporation Is Managed*. London: Kogan Page, 1987.

"Mesa redonda sobre telecomunicaciones." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, February 1964, 4-5.

Michaels, Albert L. "The Alliance for Progress and Chile's 'Revolution in Liberty,' 1964-1970." *Journal of Interamerican Studies and World Affairs* 18, no. 1 (1976): 74-99.

Michelow, Jaime. *Introducción a la computación*. Washington, D.C.: Secretaria General de la Organización de los Estados Americanos, 1980.

Michelow, Jaime, and Inés Harding. *Elementos de computación*. Vol. 1 of *La Matemática del Mundo Contemporáneo*. Santiago: Editorial Universitario, 1973.

"El milagro boxístico: computador electrónico." *La Nación*, 15 February 1968, 14.

Mindell, David A. *Between Human and Machine: Feedback, Control, and Computing Before Cybernetics*. Baltimore: Johns Hopkins University Press, 2002.

"La 'minicomputadora' soviética." *La Nación*, 7 January 1970, 4.

"Minicomputadores digital PDP-11." *Informática*, September 1981, 7.

Ministerio de Hacienda. DFL-106. 25 February 1960.

———. "Estudio e informe sobre labores preliminares para la implantación del registro único nacional." Oficina Central de Organización y Métodos, Dirección de Presupuestos, Ministerio de Hacienda, Santiago, 1968.

———. "Informe sobre racionalización efectuada en el Departamento de Pensiones, Ministerio de Hacienda." Ministerio de Hacienda, Dirección de Presupuestos, OCOM, Santiago, 962.

———. "Introducción en la administración pública de un carrera funcionaria." Ministerio de Hacienda, OCOM, Santiago, 1964.

———. Ley-17271. 31 December 1969.

———. "Nomina única de cargos administración civil del estado." Ministerio de Hacienda, Dirección de Presupuestos, Oficina Central de Organización y Metodos, Santiago, 1967.

———. "Nomina única de cargos administración civil del estado, índice." Ministerio de Hacienda, OCOM, Santiago, 1967.

———. "Programa de adiestramiento en la administración publica y creación de la escuela nacional de adiestramiento." Ministerio de Hacienda, Dirección de Presupuestos, OCOM, Santiago, 1968.

———. Rebaja derecho ad valorem a bienes de capital que indica, Decreto 1130. 19 July 1974.

———. "Registro único nacional." Ministerio de Hacienda, Dirección de Registro Civil e Identificación, OCOM, Santiago, 1969.

"Ministro Fernando Flores discrepa con informe MAPU." *El Mercurio*, 3 March 1973, 20.

"Ministro Flores conocerá abastecimiento de zona norte." *La Nación*, 20 January 1973, 8.

"Ministro Flores viaja al norte." *La Nación*, 19 January 1973, 8.

Misa, T. J. "How Machines Make History, and How Historians (and Others) Help Them to Do So." *Science Technology & Human Values* 13, no. 3-4 (1988): 308-31.

Misa, Thomas J, Philip Brey, and Andrew Feenberg, eds. *Modernity and Technology*. Cambridge, Mass.: MIT Press, 2003.

"Moderno computador inauguró B. del Estado." *La Nación*, 2 September 1969, 5.

"Modificaciones en los planes de la enseñanza de la ingeniería." *El Mercurio*, 8 February 1965, 21.

Molina Silva, Sergio. *El proceso de cambio en Chile: la experiencia 1965-1970, Textos del Instituto Latinoamericano de Planificación Económica y Social*. Santiago: Editorial Universitaria, 1972.

"Música electrónica." *El Mercurio*, 29 March 1973, 3.

Moulian, Tomás. *Chile actual: anatomía de un mito*. Santiago: LOM, 1997.

———. *El consumo me consume*. Santiago: LOM, 1998.

Muller Plantemberg, Urs, and Franz Hinkelammert. "Condiciones y consecuencias de una política de redistribución ingresos." *Cuadernos de la realidad nacional* 16 (1973): 203-28.

Muñoz Labraña, Carlos. *Historia de la Facultad de Ingeniería Universidad de Concepción*. Santiago: Ediciones Universidad de Concepción, 1992.

Nanda, M. "The Epistemic Charity of Social Constructivism and Why the Third World Should Refuse the Offer." In Noretta Koertge, ed., *A House Built on Sand: Exposing Postmodernist Myths About Science*, 286-311. New York: Oxford University Press, 1998.

Nandon, Carlos. "Nuevo aniversario de la Alianza." *La Nación*, 18 August 1965, 4.

National Research Council. *Funding a Revolution: Government Support for Computing Research.* Washington, D.C.: National Academy Press, 1999.

Navarro Haeussler, Andrés. "Sondauta: 25 años de vocación de servicio." *Sondauta*, October-November 1999.

Navasal, Jose M. "Ciencia y tecnología." *El Mercurio*, 20 June 1967, 1, 18.

———. "El computador con surmenage." *El Mercurio*, 2 August 1969, 3.

———. "Nixon se propone 'latinizar' la Alianza para el Progreso." *El Mercurio*, 7 November 1968, 2.

"NCR de Chile S.A. una historia de medio siglo." *Mundo NCR*, May 1988, 12-15.

"Necesidad de modificar estatuto orgánico de Universidad Técnica señala rector D. Horacio Aravena." *El Mercurio*, 19 June 1965, 27.

"Nivel académico para el "maestro chasquillas": calculadora electrónica construyeron en la 'U'." *La Nación*, 23 May 1969, 3.

Noble, David F. *Forces of Production: A Social History of Industrial Automation.* 1st ed. New York: Alfred A. Knopf, 1984.

"9a Memoria y Balance General." ENTEL-Chile, Santiago, 1973.

"Nuestra portada." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, September-December 1961, 1.

"Nuestra portada." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, March-May 1963.

"Nuestro futuro depende del lo que podamos crear nosotros mismos y adaptar del proceso mundial de avance tecnológico." *El Mercurio*, 18 July 1970, 15.

"Nuestro país entra en la era de la computación." *La Nación*, 25 July 1969, 8.

"Nuestros expertos en inversiones y la computador trabajan gentilmente para usted." *El Mercurio*, 25 March 1970, 7.

"Nuevas instalaciones de ENTEL en el norte." *El Mercurio*, 8 August 1971, 32.

"Nuevo computador adquirirá la UC." *La Nación*, 22 July 1969, 6.

"Nuevo computador se instala en el país." *La Nación*, 7 January 1970, 5.

"Nuevo director en ECOM." *Informática*, May 1986, 5.

"Nuevos progresos en el control de los procesos industriales por computador." *La Nación*, 4 November 1970, 16.

"ODEPLAN frente al futuro chileno." *La Nación*, 30 November 1969, 6.

"ODEPLAN mostrará su labor a la prensa." *La Nación*, 13 November 1969, 3.

Oficina Central de Estadística. "Sinopsis estadística de la República de Chile." Sociedad de Imprenta y Litografía Universo, Santiago, 1916.

"Oh, la cibernética! computadoras dan alimentos en idioma numerado." *La Nación*, 30 December 1969, 2.

"Optimismo del Ministro Flores." *El Mercurio*, 12 June 1973, 3.

Organización de los Estados Americanos. "Alianza Para el Progreso." OEA Documentos Oficiales, Punta del Este, Uruguay, 1961.

"Organización y funciones de la CORFO." *La Nación*, 29 April 1969, 16.

Ortega Martínez, Luis. *Corporación de Fomento de la Producción: 50 años de realizaciones, 1939-1989*. Santiago: Universidad de Santiago Facultad de Humanidades Departamento de Historia, 1989.

"El país a través de las cifras estadísticas." *El Mercurio*, 8 February 1929, 12.

"Para mejorar los telégrafos." *El Mercurio*, 28 September 1921, 13.

Parra Riquelme, José Luis. 2000. Andrés Navarro, presidente de Sonda: hay una gran oportunidad para decentralizar el país. www.diarioelsur.cl/archivo/abril2000/2abril2000/elsur/cronica/ind1.php3. (January 2004).

Parsons, Talcott. *Structure and Process in Modern Societies*. Glencoe, Ill.: Free Press, 1960.

"Peligro de frustración de planes sobre la Alianza para el Progreso." *La Nación*, 15 August 1965, 25.

"Pequeña industria y comercio responden al Ministro Flores." *El Mercurio*, 18 January 1973, 12.

Petras, James F. *Chilean Christian Democracy: Politics and Social Forces*. Berkeley: Institute of International Studies, University of California, 1967.

Pey, Victor, Joan E. Garcés, and Gonzalo Martner, eds. *Salvador Allende, Selected Works, Chile en el Siglo XX*. Santiago: Editorial Antártica, 1992.

Pickering, Andrew. "Cybernetics and the Mangle: Ashby, Beer, and Pask." *Social Studies of Science* 32, no. 3 (2002): 413-37.

———, ed. *Science as Practice and Culture*. Chicago: University of Chicago Press, 1992.

Pinto, Carol. "El problema tecnológico en América Latina." *La Nación*, 30 September 1970, 3.

"Los pioneros." *Sondauta*, November 1989, 7.

"Pizarras electrónicas funcionan en Pudahuel." *El Mercurio*, 15 October 1968, 33.

"Plan secreto 'cyberstride': la UP nos controla por computación." *Qué Pasa*, 15 March 1973, 7.

Politzer, Patricia. *Fear in Chile: Lives Under Pinochet*. New York: Pantheon, 1989.

"Por primera vez en Chile computadora interpretó nuestro himno nacional." *El Mercurio*, 21 September 1969, 25, 27.

Porter, Theodore. *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton, N.J.: Princeton University Press, 1995.

"Possibilidades y limitaciones del desarrollo científico-tecnológico del área andina." *El Mercurio*, 3 October 1971, 34.

Power, Margaret. "The Popular Unity Government, Science, and Development: The First National Congress of Scientists in Chile." Paper presented to the Congress of the Latin American Studies Association. Las Vegas, October 7-9, 2004.

———. *Right Wing Women in Chile: Feminine Power and the Struggle Against Allende*. University Park: Pennsylvania State University Press, 2002.

Prebisch, Raúl. *Towards a Dynamic Development Policy for Latin America*. New York: United Nations, 1963.

"Predicciones sobre la evolución del mundo en el próximo deceno." *El Mercurio*, 1 April 1973, 7.

Prenafeta Jenkin, Sergio. "Burroughs o la fe en la ingeniería chilena." *Informática*, May 1979, 30-33.

———. "ECOM, donde siempre gana visita." *Informática*, October 1979, 24-27.

———. "Efraín Friedman, presidente de SONDA 'queremos competir de igual a igual con ECOM.'" *Informática*, August 1983, 12-17.

———. "Fernando García Castro." *Informática*, September 1980, 14-18.

———. "Fernando Léniz C.: un siglo de espera para la computación." *Informática*, June 1989, 18-27.

———. "Hernan Cubillos corre su gran regata." *Informática*, April 1987, 19-23.

———. "IBM, bastante más que computación." *Informática*, April 1979, 16-19.

———. "María Teresa Rosende: después de las tinieblas, la luz en ECOM." *Informática*, May 1985, 10-16.

———. "NCR de Chile: una caja de sorpresas." *Informática*, June 1979, 4-7.

———. "La nueva era de los computadores viejos." *Informática*, May 1979, 4-9.

———. "SONDA, en muy buena onda." *Informática*, January 1988, 18-22.

———. "Victor Hugo Concha: a su computación ENDESA ha puesto energía." *Informática*, June 1981, 20-24.

"Preocupación por la ley que reduce fondos de Alianza para el Progreso." *El Mercurio*, 21 September 1968, 21.

"Preparación tecnológica para el desarrollo." *El Mercurio*, 14 June 1965, 3.

"El Presidente, don Eduardo Frei, se dirigió a los ingenieros del país." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 28 (1966): 6-7.

"El Presidente Frei inauguró computador electrónico del Banco del Estado de Chile." *El Mercurio*, 5 September 1969, 35.

"Presidentes fijarían objetivos futuros a Alianza del Progreso." *La Nación*, 23 August 1966, 8.

"Primer director del "ODEPLAN"." *La Nación*, 12 July 1967, 5.

Primer mensaje del Presidente Allende ante el Congreso Pleno, 21 de Mayo de 1971. Santiago: Departamento de Publicaciones de la Presidencia de la Republica, 1971.

Primer mensaje del Presidente de la República de Chile don Eduardo Frei Montalva al inaugurar el periodo de Sesiones Ordinarias del Congreso Nacional, 21 de Mayo de 1965. Santiago: Departamento de Publicaciones de la Presidencia de la Republica, 1965

"Primer mundial de ski en el hemisferio sur." *El Mercurio*, 7 August 1966, 2.

"Los primeros veinte." *Señal*, Jan.-Feb. 1989, 2-5.

"Problemas profesionales expuso al Jefe del Estado el Colegio de Ingenieros." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 32 (1967): 8.

"El programa de la alianza." *El Mercurio*, 7 January 1967, 3.

"Programa docente del CEREN." *Cuadernos de la realidad nacional* 16 (1973): 286-91.

"Programa docente del CEREN primer semestre de 1972." *Cuadernos de la realidad nacional* 12 (1972): 280-81.

"El progreso electrónico y la automatización son determinantes en la fabricación de los nuevos Cementos Melón." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, September-December 1961, 35-6.

"El próximo censo de la República." *El Mercurio*, 28 April 1929, 14.

"Promulgada ley que crea el premio nacional de ciencias." *La Nación*, 18 January 1968, 2.

"La puesta en marcha de planta de polycrón marca etapa del desarrollo industrial en Chile." *El Mercurio*, 27 December 1964, 19.

Pugh, Emerson W. *Building IBM: Shaping an Industry and Its Technology*. Cambridge, Mass.: MIT Press, 1995.

Pugh, E. W., and W. Aspray. "Creating the Computer Industry." *IEEE Annals of the History of Computing* 18, no. 2 (1996): 7-17.

Quinto mensaje del Presidente de la República de Chile don Eduardo Frei Montalva al inaugurar el periodo de Sesiones Ordinarias del Congreso Nacional, 21 de Mayo de 1969. Santiago: Departamento de Publicaciones de la Presidencia de la Republica, 1969.

Rabinbach, Anson. *The Human Motor: Energy, Fatigue, and the Origins of Modernity*. New York: BasicBooks, 1990.

"Rebaja de derechos para la importación de maquinas." *El Mercurio*, 11 October 1966, 1, 24.

"Rebajan los fondos de la Alianza para el Progreso." *La Nación*, 18 September 1968, 8.

"Recepción de un computador electrónico." *El Mercurio*, 13 January 1965, 27.

"Recuerdos de cambios de morada." *IBM Diálogo*, July 1987, 14.

Recuerdos de ECOM." *Nosotros*, February 1989.

"Recursos de la Alianza para el Progreso." *La Nación*, 21 September 1968, 4.

"Red de telex nacional e internacional -- Frei inauguró moderno sistema de comunicación." *El Mercurio*, 30 January 1970, 1.

"Red nacional de telex." *La Nación*, 31 January 1970, 4.

"Registros de 15 años." *Sondauta*, November 1989, 1.

"Reunión interamericana preparan los ingenieros." *El Mercurio*, 26 April 1971, 28.

"Revolucionario sistema permitirá dar casas a quienes la necesitan." *La Nación*, 15 March 1971, 3.

Reyes, Máximo Aguilera. *Estadísticas de Chile en el Siglo XX.* Santiago: Empresa Periodísta La Nación, 1999.

Ribeiro, Lucía. "La mujer obrera chilena. Una aproximación a su estudio." *Cuadernos de la realidad nacional*, no. 16 (1973): 167-201.

"Ricardo Majluf: veo la empresa que sigue como un avión." *Sondauta* 1994.

"Los 'robots' en la industria gráfica." *El Mercurio*, 1 June 1967, 5.

Rolle, Claudio, ed. *1973 La vida cotidiana de un año crucial.* Santiago: Editorial Planeta, 2003.

Rosemblatt, Karin Alejandra. "Charity, Rights, and Entitlement: Gender, Labor, and Welfare in Early Twentieth-Century Chile." *Hispanic American Historical Review* 81, no. 3-4 (2001): 555-85.

———. *Gendered Compromises: Political Cultures and the State in Chile, 1920-1950.* Chapel Hill: University of North Carolina Press, 2000.

Rosenberg, Marcy, and John Whitmarsh. "IBM y los demás: una dura lucha por el mercado." *Informatica* 1979, 28-29.

Rosenbluth, Arturo, Norbert Wiener, and Julian Bigelow. "Behavior, Purpose, and Teleology." *Philosophy of Science* 10 (1943).

Rostow, W. W. *The Stages of Economic Growth, A Non-Communist Manifesto.* Cambridge: Cambridge University Press, 1960.

Rubinstein, David G. "Hombres, Tecnología y Cambios Sociales." *El Mercurio*, 4 September 1970, 2.

Saavedra, Igor. "El problema del desarrollo científico en Chile y en América Latina." *Cuadernos de la realidad nacional* 1 (1969): 32-52.

Sachs, Wolfgang. *The Development Dictionary: A Guide to Knowledge as Power.* Atlantic Highlands, N.J.: Zed, 1992.

Sáez, Raúl. "La inversión intelectual, factor del crecimiento económico." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 47 (1970): 6-10.

———. *Raúl Sáez hombre del siglo XX.* 2 vols. Santiago: Dolmen, 1994.

Sagredo Baeza, Rafael. "Política y ferrocarril en el Chile del siglo XIX." *Patrimonio Cultural*, Autumn 2001.

Said, Edward W. *Orientalism.* 1st ed. New York: Vintage, 1979.

Salazar V., Gabriel. "Ciudadanía e historia oral: vida, muerte y resurrección." *Proposiciones*, no. 29 (1999): 198-211.

Salinas Araya, Augusto. *Ciencia, estado y revolución.* Santiago: Ediciones Universidad Finis Terrae, 1994.

———. "La ciencia en Chile y en los Estados Unidos de Norteamérica: un análisis histórico comparado (1776-1976)." CONICYT, Santiago, 1976.

Schwember, Herman. "Cybernetics in Government: Experience with New Tools for Management in Chile, 1971-1973." In Hartmut Bossel, ed., *Concepts and Tools of Computer-Assisted Policy Analysis*, 79-138. Basel, Germany: Birkhäuser, 1977.

Scott, James C. *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed.* New Haven, Conn.: Yale University Press, 1998.

Scott, Joan. *Gender and the Politics of History*. rev. ed. New York: Columbia University Press, 1999.

"Se busco una solución con el Presidente." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 20 (1963): 16-20.

"Se formará una empresa nacional de computación." *La Nación*, 27 June 1968, 3.

Segundo mensaje del Presidente de la Republica de Chile don Eduardo Frei Montalva al inaugurar el periodo de Sesiones Ordinarias del Congreso Nacional, 21 de Mayo de 1966. Santiago: Departamento de Publicaciones de la Presidencia de la Republica, 1966.

"Se inaugura hoy 5.a feria internacional." *El Mercurio*, 7 October 1967, 1, 32.

"S.E. inaugura torneo de ciencias y tecnología." *El Mercurio*, 13 September 1965, 29.

"Seminario internacional sobre tecnología." *El Mercurio*, 29 May 1973, 3.

"Seminario sobre computación." *La Nación*, 28 July 1969, 12.

"Senado aprobó creación de la Oficina de Planificación." *La Nación*, 27 April 1967, 3.

"Senado despachó el proyecto de ODEPLAN." *La Nación*, 11 May 1967, 2.

"Servicio de "telex" inauguró registro civil." *El Mercurio*, 21 October 1970, 19.

"Servidores electrónicos." *La Nación*, 7 April 1965, 4.

Sexto mensaje del Presidente de la República de Chile don Eduardo Frei Montalva al inaugurar el periodo de Sesiones Ordinarias del Congreso Nacional, 21 de Mayo de 1970. Santiago: Departamento de Publicaciones de la Presidencia de la Republica, 1970.

Sigmund, Paul E. *The Overthrow of Allende and the Politics of Chile, 1964-1976.* Pittsburgh: University of Pittsburgh Press, 1977.

———. "The Transformation of Christian Democratic Ideology: Transcending Left and Right, or Whatever Happened to the Third Way?" In Mainwaring and Scully, *Christian Democracy in Latin America*, 30-63.

"Silencioso Servidor Publico y Obediente Colega." *La Nación*, 29 April 1969, 23.

Silva, Eduardo. *The State and Capital in Chile: Business Elites, Technocrats, and Market Economics*. Boulder, Colo.: Westview, 1996.

Simon, Raúl. *Anales del Instituto de Ingenieros*, December 1927, 618.

"Sistema electrónico para la revisión aduaneraen Pudahuel." *El Mercurio*, 4 December 1967, 33, 37.

"Sistema electrónico soluciona problemas de ingeniería civil." *La Nación*, 10 May 1967, 4.

"Situación General del Pais, Comando Operativo Central." Santiago, Chile: CORFO, 1973.

Skidmore, Thomas E., and Peter H. Smith. *Modern Latin America.* 4th ed. New York: Oxford University Press, 1997.

Smith, Brian H. *The Church and Politics in Chile: Challenges to Modern Catholicism.* Princeton, N.J.: Princeton University Press, 1982.

Smith, Merritt Roe, and Leo Marx, eds. *Does Technology Drive History? The Dilemma of Technological Determinism.* Cambridge, Mass.: MIT Press, 1994.

Smith, Tony. "The Alliance for Progress: the 1960s." In Abraham F. Lowenthal, ed., *Exporting Democracy: The United States and Latin America*, 71-89. Baltimore: Johns Hopkins University Press, 1991.

"S. M. la tecnología." *El Mercurio*, 18 July 1969, 3.

Sociedad de Fomento Fabril. "Estadística industrial." *Boletín de la Sociedad de Fomento Fabril*, July 1929, 415-18.

———. "Estadística industrial." *Boletín de la Sociedad de Fomento Fabril,* 1934, 233-34.

"Sólo un 5 por ciento de la tecnología que posee Latinoamérica es propia." *El Mercurio*, 12 May 1973, 2.

"SONDA, una empresa de principios y valores." *Sondauta*, October-November 1994.

"SONDA por 22 veces 22." *Sondauta*, October-November 1996, 3.

"Sondauta 25 años." *Sondauta*, October-November 1999.

"Son detectadas dobles inscripciones electorales." *El Mercurio*, 7 February 1973, 1.

"Soprendente cerebro electrónico para la elaboración de cerveza." *El Mercurio*, 9 February 1970, 27.

Sorés. "Conception et mise en place d'une système d'aide à la gestion por l'industrie algérienne préparée pour le Ministere de l'Industrie et de l'Energie Algerie." Sorés, Montreal, 1976.

"Sostienen en Viña del Mar: ciencia y técnica, misión urgente para América Latina." *La Nación*, 14 May 1969, 6.

Soto Meza, Segio. "Aplicaciones de computadores en la toma de decisiones de ejecutivos." *Ingenieros: boletín oficial del Colegio de Ingenieros de Chile*, no. 51 (1970): 22-23.

Soza Cousiño, Francisco. "La inversión publica en la infraestructura." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, September 1967, 4-9.

Spivak, Gayatri. "Can the Subaltern Speak?" In Cary Nelson and Lawrence Grossberg, eds., *Marxism and the Interpretation of Culture*. Urbana: University of Illinois Press, 1988.

Spooner, Mary Helen. *Soldiers in a Narrow Land: The Pinochet Regime in Chile*. Berkeley: University of California Press, 1994.

Stallings, Barbara. *Class Conflict and Economic Development in Chile, 1958-1973*. Stanford, Calif.: Stanford University Press, 1978.

Stallings, Barbara, and Andrew S. Zimbalist. "The Political Economy of the Unidad Popular." *Latin American Perspectives* 2, no. 1 (1975): 69-88.

Steiner, Alejandro. "Los Trabajadores y el Cambio Tecnológico." *INTEC: revista del comité de investigaciones tecnológicas de Chile*, June 1973, 37-40.

"Tecnología e integración." *El Mercurio*, 16 January 1969, 3.

"Las telecomunicaciones en Chile." *Revista chilena de ingeniería y anales del Instituto de Ingenieros*, May-June 1966, 18-30.

"Telecomunicaciones navales de aniversario." *La Nación*, 26 November 1970, 3.

"Ten Pints of Beer: The Rationale of Stafford Beer's Cybernetic Books (1959-94)." *Kybernetes* 29, no. 5/6 (2000): 558-69.

Tercer mensaje del Presidente de la República de Chile don Eduardo Frei Montalva al inaugurar el periodo de Sesiones Ordinarias del Congreso Nacional, 21 de Mayo de 1967. Santiago: Departamento de Publicaciones de la Presidencia de la Republica, 1967.

Thompson, E. P. *The Making of the English Working Class.* New York: Pantheon, 1964.

Tigre, Paulo Bastos. *Technology and Competition in the Brazilian Computer Industry.* New York: St. Martin's Press, 1983.

Tinsman, Heidi. "Good Wives and Unfaithful Men: Gender Negotiations and Sexual Conflicts in the Chilean Agrarian Reform, 1964-1973." *Hispanic American Historical Review* 81, no. 3-4 (2001): 588-619.

———. *Partners in Conflict: The Politics of Gender, Sexuality, and Labor in the Chilean Agrarian Reform, 1950-1973.* Durham, N.C.: Duke University Press, 2002.

"Torneo científico Latinoamericano." *El Mercurio*, 4 July 1971, 29.

"Torneo continental de automatización de los bancos se hará en Chile." *La Nación*, 21 September 1969, 2.

Townsend, Camilla. "Refusing to Travel *La Via Chilena:* Working-Class Women in Allende's Chile." *Journal of Women's History* 4, no. 3 (1993): 43-63.

"Traductor maquina." *La Nación*, 4 July 1965, 11.

"Transferencia de técnicas se estudiará en reunión de UNCTAD." *El Mercurio*, 6 March 1972, 22.

"El transito también habla el idioma de la tecnología." *La Nación*, 10 February 1969, 15.

"30 Años de la CORFO." *La Nación*, 29 April 1969, 4.

"30 Años de la Corporación de Fomento de la Producción." *Ingenieros: Boletín Oficial del Colegio de Ingenieros de Chile*, no. 42 (1969): 31-33.

Trejo, Guillermo. "Sistema de computación Israelí sería más apropiado para Chile." *El Mercurio*, 30 July 1969, 25, 32.

"3 nuevos comités de desarrollo crea CORFO." *La Nación*, 27 February 1971, 2.

"Triunfo de la Unidad Popular en la técnica." *La Nación*, 21 November 1970, 5.

Tucker, Robert C., ed. *The Marx-Engels Reader*. New York: W. W. Norton, 1972.

"La TV y las computadores reemplazaran a los maestros." *La Nación*, 9 June 1968, 6.

"UNESCO apoya realización de cuatro proyectos educacionales." *El Mercurio*, 17 September 1965, 21.

Unidad Popular. *La mujer en el gobierno de la Unidad Popular*. Santiago, 1970.

United Nations. Department of Economic and Social Affairs. "The Application of Computer Technology for Development." New York, 1971.

———. "The Application of Computer Technology for Development, Second Report of the Secretary General." New York, 1973.

United Nations. Economic Commission for Latin America. *The Economic Development of Latin America and Its Principal Problems*. Lake Success: United Nations Department of Economic Affairs, 1950.

"Universidades deben estar integradas al desarrollo." *La Nación*, 12 November 1970, 9.

"Universidad Santa María contará con profesor de EE.UU." *El Mercurio*, 6 February 1965, 28.

"La Universidad Santa Maria creó carrera de ciencias de computación." *El Mercurio*, 1 April 1973, 35.

"Universidad Técnica del Estado inauguró escuela de seguridad minera." *El Mercurio*, 16 March 1965, 17.

U.S. Bureau of the Census. *U.S. Foreign Trade, Commodity by Country, Schedule B, FT410.* Washington, D.C.: U.S. Department of Commerce, 1964-1979.

U.S. Department of Commerce. *Foreign Commerce and Navigation of the United States.* Washington, D.C.: U.S. Department of Commerce, Bureau of Foreign and Domestic Commerce, Division of Foreign Statistics, 1923-1946.

"Uso de métodos modernos en la ingeniería civil." *El Mercurio*, 18 July 1967, 1, 18.

U.S. Senate. Select Committee to Study Governmental Operations with Respect to Intelligence Activities. *Alleged Assassination Plots Involving Foreign Leaders: An Interim Report of the Select Committee to Study Governmental Operations with Respect to Intelligence Activities.* Washington, D.C.: U.S. Government Printing Office, 1975.

———. *Covert Action in Chile, 1964-1973: Staff Report of the Select Committee to Study Governmental Operation with Respect to Intelligence Activities.*" U.S. Government Printing Office, 1975.

"UTE formará técnicos para mandos medios." *La Nación*, 26 March 1971, 8.

"Utilidad y maravilla de la computación." *La Nación*, 31 July 1969, 4.

Valdés, Juan Gabriel. *Pinochet's Economists: The Chicago School of Economics in Chile.* New York: Cambridge University Press, 1995.

Valenzuela, Arturo. *The Breakdown of Democratic Regimes: Chile*. Baltimore: Johns Hopkins University Press, 1978.

Valenzuela, German Urzua, and Anamaria Garcia Barzelatto. *Diagnostico de la burocracia chilena (1818-1969)*. Santiago: Editorial Juridica de Chile, 1971.

Valenzuela, J. Samuel, and Arturo Valenzuela. "Modernization and Dependency: Alternative Perspectives in the Study of Latin American Underdevelopment." *Comparative Politics* 10, no. 4 (1978): 535-52.

Valenzuela, José. "Apuntes sobre la política de acción del INTEC." *INTEC* 1 (1971): 11-26.

"Valioso Aporte de IBM a la 'U'." *La Nación*, 23 March 1969, 2.

"Un valioso computador híbrido adquirió Universidad Santa María." *El Mercurio*, 19 November 1972, 33.

Vansina, Jan. *Oral Tradition as History*. Madison: University of Wisconsin Press, 1985.

Vásquez Muruaga, Luciano. "Chile en la era de las computadoras." *El Mercurio,* 1 August 1969, 25.

"El 27 de noviembre de 1930 se hará el Censo General de la República." *El Mercurio*, 22 March 1929, 3.

Vera Azargado, Héctor. "El dilema de Navarro." *Qué Pasa*, 7 December 1998.

"Vienen expertos en computación." *La Nación*, 11 July 1969, 5.

Vidal, Virginia. *La emancipación de la mujer*. Santiago: Quimantú, 1972.

Villalobos R., Sergio. *Historia de la ingeniería en Chile*. Santiago: Hachette, 1990.

———. *A Short History of Chile*. Santiago: Editorial Universitaria, 1996.

Villanueva, Fernando. "Edición especial de aniversario, IBM 70 años en Chile." Santiago: IBM Chile, 1999.

———. "IBM en Chile." Unpublished manuscript. Santiago.

"Visita de ejecutivos de Xerox Corporation." *El Mercurio*, 27 October 1970, 20.

Watson, Thomas J., Jr. *Father, Son, & Co.: My Life at IBM and Beyond*. New York: Bantam, 1990.

Watson, Thomas J., Sr. *"As a Man Thinks." Thomas J. Watson the Man and His Philosophy of Life as Expressed in His Editorials*. New York: IBM, 1954.

Weaver, F. S., and P. B. Tigre. "Technology and Competition in the Brazilian Computer Industry." *Latin American Research Review* 21, no. 1 (1986): 173-87.

Wiener, Norbert. *Cybernetics: Or Control and Communication in the Animal and the Machine*. 2nd ed. Cambridge, Mass.: MIT Press, 1965.

———. *The Human Use of Human Beings: Cybernetics and Society,* New York: Da Capo, 1988.

Williams, Raymond. *Keywords: A Vocabulary of Culture and Society*. Rev. ed. New York: Oxford University Press, 1985.

———. *Marxism and Literature*. Oxford: Oxford University Press, 1977.

Wilson, James W. "Freedom and Control: Workers' Participation in Management in Chile, 1967-1975." Ph.D. diss., Cornell University, Ithaca, N.Y., 1979.

Wilton, Gilberto. "La computadora libera al hombre de un sinnúmero de problemas." *El Mercurio*, 31 July 1969, 25, 28.

Winn, Peter. "The Economic Consequences of the Chilean Counterrevolution: An Interim Assesment." *Latin American Perspectives* 1, no. 2 (1974): 92-105.

———. "Loosing the Chain Labor and the Chilean Revolutionary Process, 1970-1973." *Latin American Perspectives* 3, no. 1 (1976).

———. "Oral History and the Factory Study: New Approaches to Labor History." *Latin American Research Review* 14, no. 2 (1979): 130-40.

———. *Victims of the Chilean Miracle: Workers and Neoliberalism in the Pinochet Era, 1973-2002*. Durham, N.C.: Duke University Press, 2004.

———. *Weavers of Revolution: The Yarur Workers and Chile's Road to Socialism*. New York: Oxford University Press, 1986.

———. "Workers into Managers: Worker Participation in the Chilean Textile Industry." In June Nash, Jorge Dandler and Nicholas Hopkins, eds., *Popular Participation in Social Change: Cooperatives, Collectives, and Nationalized Industry*, 577-601. Chicago: Mouton, 1976.

Winner, Langdon. *Autonomous Technology: Technics-Out-of-Control as a Theme in Political Thought*. Cambridge, Mass.: MIT Press, 1978.

———. *The Whale and the Reactor: A Search for Limits in an Age of High Technology*. Chicago: University of Chicago Press, 1986.

Winograd, Terry, and Fernando Flores. *Understanding Computers and Cognition: A New Foundation for Design*. Norwood, N.J.: Ablex, 1986.

Wolpin, Miles D. *Cuban Foreign Policy and Chilean Politics*. Lexington, Mass.: Heath, 1972.

Woolgar, S., and G. Cooper. "Do Artefacts Have Ambivalence? Moses' Bridges, Winner's Bridges and Other Urban Legends in S&TS." *Social Studies of Science* 29, no. 3 (1999): 433-49.

Yates, JoAnne. *Control Through Communication: The Rise of System in American Management.* Baltimore: Johns Hopkins University Press, 1989.

Yunis Ahués, Eugenio. *Asignación de recursos y política de investigación para la ciencia y la tecnología: el caso de la Universidad de Chile*. Santiago: Ediciones C. P. U., 1972.

Zizek, Slavoj. *Mapping Ideology*. New York: Verso, 1994.

Zuboff, Shoshana. *In the Age of the Smart Machine: The Future of Work and Power*. New York: Basic Books, 1988.