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Socialism and Cybernetic Planning: Lessons from project Cybersyn

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ABSTRACT: Should Marxism draw inspiration from cybernetic management theories and systems science in order to rethink the question of economic planning? In this article, we propose to examine the convergence between cybernetics and socialism through the example of *Cybersyn*: how did Marxist and cybernetic perspectives interact—or contradict one another—at the technical, theoretical, and political levels in this specific case? The hypothesis is as follows: from a theoretical and historical standpoint, first-order cybernetics and Marxism initially appear too far apart, even though certain points of convergence can be identified. Within the specific case of *Cybersyn*, however, Stafford Beer developed a model of cybernetic planning that embodied an overly idealistic vision of socialism—resulting in an original yet ultimately technocratic project. Nevertheless, the historical and political reality of Chile between 1971 and 1973 highlighted what was missing for the project to become genuinely relevant: namely, its appropriation within the context of class struggle. The lesson seems particularly important today, in the age of pervasive "techno-solutionism:" neither emancipation nor planning should be conceived primarily through a technological lens, no matter how sophisticated. Rather than a conceptual self-organization inherited from cybernetics, it is the real autonomy of the working class and social movements that should form the foundation for the appropriation and management of the means of production from the bottom up.

KEYWORDS: Cybernetics, socialism, economic planning, complexity, management, technocracy, class struggle, Chile, Stafford Beer.

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Introduction

Should Marxism draw inspiration from cybernetic management theories and systems science in order to rethink the question of economic planning? This, at any rate, is the hypothesis advanced by several contemporary scholars and activists. Two French Marxist researchers, Cédric Durand and Razmig Keucheyan, have been arguing for several years that, despite the fall of the Berlin Wall and the defeat of the Soviet model, "planning remains unfinished matter" (Durand and Keucheyan 2019, 81). On the one hand, states have played a leading role in keeping capitalism afloat since 2008—through stimulus packages, bank bailouts, and the artificial sustenance of the economy during lockdowns. On the other hand, "progress made in computation now makes possible the centralized determination of the optimal allocation of resources." (Ibid., 93)

Among the historical examples cited by Durand and Keucheyan is the *Cybersyn* project, carried out by Stafford Beer and Fernando Flores between 1971 and 1973 in Allende's Chile. This reference to Cybersyn also appears in the work of British scholar and activist Richard Barbrook, a staunch advocate of "cybercommunism" and critic of the "Californian ideology."[1] According to Barbrook, the bursting of the dot-com bubble and the 2008 crisis mark the end of a cycle that must now be overcome by revisiting pre-neoliberal experiments such as Allende's Chile. Finally, the Marxist researcher and critic of new technologies Evgeny Morozov has also examined Cybersyn in detail in a podcast series titled *The Santiago Boys*, with the explicit aim of fostering a socialist imaginary of technological reappropriation (Morozov 2024).

In this article, I propose to examine the convergence between cybernetics and socialism through the example of *Cybersyn*: how did Marxist and cybernetic perspectives interact—or contradict one another—at the technical, theoretical, and political levels in this specific case? My hypothesis is as follows: from a theoretical and historical standpoint, first-order cybernetics and Marxism initially appear too far apart, even though certain points of convergence can be identified. Within the specific case of *Cybersyn*, however, Stafford Beer developed a model of cybernetic planning that embodied an overly idealistic vision of socialism—

1. See his presentation at an anniversary conference of the Centre for the Study of Democracy in London, where he introduces the guest of the day, Raúl Espejo, one of Cybersyn's directors. The entire conference can be found on YouTube: https://www.youtube.com/watch?v=JGTEoJI5-Y4

resulting in an original yet ultimately technocratic project. Nevertheless, the historical and political reality of Chile between 1971 and 1973 highlighted what was missing for the project to become genuinely relevant: namely, its appropriation within the context of class struggle.

I. Controlling complexity

Cybernetics

Nevertheless, the historical and political reality of Chile between 1971 and 1973 highlighted what was missing for the project to become genuinely relevant: namely, its appropriation within the context of class struggle. Contrary to what Durand and Keucheyan suggest, the originality of the *Cybersyn* project lies in its approach to planning without linking it to centralization or to an optimal allocation of resources, as in the classical approach of "socialist calculation". In contrast, the cybernetician Stafford Beer—the project's designer—proposed a decentralized model that emphasized the autonomy of workers and factories, asserting the impossibility of any "vertical" planning of social complexity. How, then, can such decentralized planning function? To answer this question, we must first return to the theoretical foundations that enabled Stafford Beer to develop his doctrine of "cybernetic management." Far from being a Marxist theorist or a socialist economist, Beer was first and foremost a management specialist who sought to integrate the emerging tools of operational research and cybernetics into the service of major British firms such as United Steel. What, then, was Beer looking for in cybernetics?

When he coined the term cybernetics in 1948, Norbert Wiener defined it as "the entire field of control and communication theory, whether in the machine or in the animal" (Wiener 2019, 18). By "control," Beer refers to a field of engineering devoted to the study and design of servomechanisms—control systems that use the principle of feedback to keep a machine aligned with a predetermined goal, despite fluctuations in its environment. Feedback mechanisms already existed throughout industry, technology, and society; the strength of cybernetics was to abstract this notion and turn it into a transversal concept, capable of analyzing a wide range of phenomena through a shared grammar. By "communication," he means all issues related to the transmission of messages—from their material form to the quantity of information they convey. Taken together, *control* and *communication* aim to place the analysis of living behavior on the same level as that of machines: both become describable as phenomena governed by physics and determinism.

Wiener traces the term's etymology to the Greek *ho kubernētēs*—the helmsman—citing the steering mechanisms of ships as one of the earliest forms of feedback devices. The political resonance of *cybernetics* is not difficult to hear: the term "government" also derives from the Greek *kubernētēs*, and Plato already used the metaphor of the ship's pilot to describe the ruler of the city. Above all, the cyberneticians clearly nurtured the ambition that their concepts and tools would have a transformative impact on the postwar world—which they sought to help rebuild and protect from itself :

> We have seen that communication is the cement of society, and that those who have made the clear maintenance of the channels of communication their business are those who have most to do with the continued existence or the fall of our civilization. (Wiener 1950, 144).

Wiener writes this in *The Human Use of Human Beings*, a work that contrasts democratic societies—where open communication channels allow fluid feedback between population and government—with totalitarian ones, which remain frozen in top-down, inhuman hierarchies. The democratic ideal of cybernetics, aiming at horizontal governance and world peace, is perhaps best captured in these words by cybernetic neurologist Warren McCulloch in 1948:

> I know of no utopian dream that would be nearer to everybody's wishes, including my own, than that man should learn to construct for the whole world a society with sufficient inverse feedback to prevent another and perhaps last holocaust. (Abraham 2016, 117)

Wiener was also deeply concerned about the future of new technologies, since, in his view, "the fate of information in the typically American world is to become something with a price, which can be bought and sold" (Wiener 1950, 125). In response, he writes: "The answer, of course, is to have a society based on human values other than buying or selling. To arrive at this society, we need a good deal of planning and a good deal of struggle" (Wiener 2019, 41). Not only did the inventor of cybernetics himself advocate planning, but—much like the socialists—he opposed it to the market order, of which he was deeply suspicious. Beyond his postwar refusal to collaborate with military research or to train administrative executives at General Electric, Wiener also established contact with several trade unions (including those in the typography and automobile sectors) in an effort to forge alliances he hoped would benefit workers.

Nevertheless, Wiener—who made no secret of his sympathy for socialist ideas and was even placed under FBI surveillance during the McCarthy era—remains an exception among cyberneticians. His personal political engagement was neither intrinsically linked to the themes of cybernetics nor to any broader political movement. The question of planning, in particular, was not a major topic during the *Macy Conferences*, the beating heart of cybernetics between 1947 and 1953. As Steve Heims has convincingly shown in his fascinating inquiry into the "cybernetic group," there was no political homogeneity among its members (Heims 1991). Wiener's idealistic stance appears rather isolated compared to that of Frank Fremont-Smith, Lawrence Frank (both initiators of the Macy Conferences), and Margaret Mead. These three, for instance, played a key role in founding the World Federation for Mental Health in 1948—an endeavor whose preparation brought together 351 working groups across five continents (200 of them from the United States). To Heims, "the premises of that organization are evidence that mental health was seen as an ideological alternative to Marxist Thought" (Heims 1985, 171). Mead and Frank drafted the report that preceded the conference, in which they outlined the necessary connection between mental health and political action:

> Research must be conducted in such away that the psychiatrist and social scientist are brought into the closest possible contact with the administrator and political leader [...] The goal of mental health has been enlarged from the concern for the development of healthy personalities to the larger task of creating a healthy society. [...] The concept of mental health is co-extensive with world order and the world community that must be developed so that men can live together in peace with each other. (Heims 1991, 173–74)

In contrast to Marxism—which has always acknowledged struggle and the fractures within the social body—the mental health movement was characterized by its desire to eradicate conflict by targeting its psychological causes: the principal problem, in this view, did not lie in capitalism itself but in the brain and the psychological traumas of the population. Naturally, a more strategic reading is in order: focusing on mental health served to mitigate class conflict, disguising this aim under the broad humanist banner of a general struggle against war. Within this context, Wiener appears somewhat naïve regarding the broader political currents in which cybernetics became entangled during its early years. Beyond Wiener's isolated good intentions, then, can one discern a deeper connection between cybernetics and planning?

Complexity

To understand the links between cybernetics and planning, we need to take a theoretical detour through the notion of complexity. One of the central theoretical issues in the cybernetic movement is the nature of thought and information. The original ambition was to mechanize thought using the tools of physics and neurology. Wiener sought to bring together "under one and the same name [...] what, in the case of man, is sometimes imprecisely called 'thinking,' and what is known in the field of technology as control and communication" (Hörl 2007). McCulloch asserted that "cybernetics has helped to pull down the wall between the great world of physics and the ghetto of the mind" (McCulloch 2016, 169). To this end, cyberneticists pursued two goals: on the one hand, to reduce all thought to computational operations; on the other, to identify the material substrate—electronic or neurological—that makes such computation possible. In doing so, they encountered a theoretical problem they never managed to resolve: the nature of thought itself. This remains a central problem in the history of AI to this day (Triclot 2008; Pasquinelli 2023). On one side, thought was conceived from a cognitivist perspective, as the logical manipulation of symbols (i.e., information), which could be embodied in any material form—whether a brain, a computer, or something else. On the other side, thought was seen as the emergent order resulting from the arrangement of multiple interconnected elements (real or artificial neurons, for instance). John von Neumann—the mathematician who both calculated the optimal height for the atomic bomb explosion in 1945 and designed the logical architecture of early computers—admitted that logical reasoning alone could not account for some aspects of thought and brain function, such as pattern recognition:

> The order of complexity is out of all proportion to anything we have ever known. We have no right to assume that the logical notations and procedures used in the past are suited to this part of the subject. It is not at all certain that in this domain a real object might not constitute the simplest description of itself, that is, any attempt to describe it by the usual literary or formal-logical method may lead to something less manageable and more involved. (Von Neumann 1976, 311)

This is where the notion of *complexity* enters the picture—as a limit to knowledge. For certain objects, it may be that any explanation becomes more complex than the object itself, rendering the scientific process obsolete. In such cases, the real object (von Neumann had the brain in mind) may be its own best model and best description. "Some results in

modern logic," he wrote, "would tend to indicate that phenomena like this have to be expected when we come to really complicated entities." As a logician, von Neumann could only conclude that "in this process logic will have to undergo a pseudomorphosis to neurology to a much greater extent than the reverse" (Ibid.).

To go further, we must turn to another cyberneticist: William Ross Ashby, whose background was closer to psychiatry and neurology. According to Jean-Pierre Dupuy, "Ashby, in a sense, took the problem of complexity so seriously that his whole life was devoted to extracting its quintessence" (Dupuy 2005). Ashby emphasized two key scientific virtues of cybernetics :

> One is that it offers a single vocabulary and a single set of concepts suitable for representing the most diverse types of system [...] The second peculiar virtue of cybernetics is that it offers a method for the scientific treatment of the system in which complexity is outstanding and too important to be ignored" (Ashby 1956, 4-5).

For two centuries, the experimental sciences had focused on simple phenomena—or on phenomena reducible to simple components—whose behavior could be predicted and controlled by varying one factor at a time. Although he never provides a clear definition of *complexity*, Ashby hints at it in the terms he uses to describe complex systems: they are "so dynamic and interconnected that the alteration of one factor immediately acts as cause to evoke alteration in others." As examples, he mentions "the cerebral cortex of the free-living organism, the ant-hill as a functioning society, and the human economic system." His concern is not purely epistemological. Ashby writes that "Cybernetics offers the hope of providing effective methods for the study, and control, of systems that are intrinsically extremely complex," such as "psychoses untreated, societies declining, and economic systems faltering" (Ibid., 5–6). At this point, epistemological, technological, and political questions converge:

> – How can we understand "extremely complex" entities that conventional science cannot analyze?
>
> – What tools do we need to address them?
>
> – Can we use those tools to cure or control them?

To this end, Ashby employs a typically cybernetic stratagem, already used by Wiener and the early behaviorist psychologists before him: the concept of the "black box." By definition, one does not know what happens inside a black box, nor what it is made of; one can only observe it

from the outside and describe its visible behavior over time. For Ashby, the entire world must ultimately be considered as a multitude of black boxes: after all, we never truly understand how the things we use every day actually function. Hence:

> What is being suggested now is not that Black Boxes behave somewhat like real objects but that the real objects are in fact all Black Boxes, and that we have in fact been operating with Black Boxes all our lives. The theory of Blax Boxes is merely the theory of real objects or systems, when close attention is given to the question, relating object and obsever, about what information comes from the object, and how it is obtained. (Ibid., 110)

This « *Black Box ontology* » (Pickering 2010, 20) goes beyond the lab or science – it shapes all possible relationships to the world, with oneself, and with others (on this point, see Galison 1994). What matters to us here is that you can put anything into a black box. Although Ashby mainly focused on the brain—which he considered a black box, treating it with Electroconvulsive Therapy (ECT) by varying electrical currents—he often mentioned that the same method could apply to companies or even society. As a political liberal, Ashby believed that complex objects inherently ruled out any kind of centralized planning, since such an approach would mean applying the methods of classical science to "extremely complex" systems. This was not the view of another cyberneticist who concerns us here: the British theorist Stafford Beer.

Stafford Beer and cybernetic management

It is because he developed "a very creative extension of Ashby's cybernetics into and beyond the world of organizations and management" (Pickering 2010, 224) that Beer was hailed by Wiener as "the father of cybernetic management." After a brief period studying philosophy and psychology, Beer enlisted in the British Army in India (1944). Upon returning in 1949, he worked in Sheffield for a subsidiary of United Steel, where he set up and directed an Operations Research group. A pioneer in the use of computers to model a company and improve its management, Beer was appointed in 1956 as head of Operations Research and Cybernetics for all of United Steel. His task force moved into the "Cybor House"—a name he coined—which housed the world's largest operations research team. The group grew to around seventy people and mobilized interdisciplinary tools to rationalize company operations, including production, finance, marketing, and energy, using one of the first computers installed for management purposes.

Between 1961 and 1966, Beer launched and directed another company, SIGMA (Science in General Management), which provided cybernetic management consultancy services to major British companies, as well as to various governments and ministerial agencies around the world. His company developed management models for energy, railways, and ports (for the British government), as well as for shipbuilding, education (in Yugoslavia), tourism (in Israel), and nationalized economies (in South America). In 1966, after leaving SIGMA, he became Development Director for the International Publishing Corporation—then the world's largest publishing firm. At the same time, he served on the board of a company he had founded, International Data Highways, which aimed to develop telepublishing and telemessaging. From 1971 to 1973, he served as an advisor to the Cybersyn project in Chile, which we will examine shortly.

Before doing so, let us look more closely at Beer's approach to the problem of complexity in the context of management. While operations research offers a means to analyze situations in detail to find concrete solutions among various options, cybernetics, for Beer, addresses what he called "inconceivable" objects. As with Ashby, *complexity* here denotes a kind of epistemological or cognitive limit: "The systems under discussion are unthinkable, in the sense that they are too complex to fathom" (Beer 1981, 51). Beer classified objects of study by their degree of complexity:

SYSTEMS	*Simple*	*Complex*	*Exceedingly complex*
Deterministic	Window catch	Electronic digital computer	EMPTY
	Billiards	Planetary system	
	Machine-shop lay-out	Automation	
Probabilistic	Penny tossing	Stockholding	The economy
	Jellyfish movements	Conditioned reflexes	The brain
	Statistical quality control	Industrial profitability	THE COMPANY

Figure 1. Summary table of the different types of systems (Beer 1959, 18).

Among the examples he gives of "exceedingly complex" systems are three that had already appeared in Ashby's work: the economy, the brain, and the firm. For Beer, "the real problem of management [...] is the complexity: how to measure it, how to manipulate it?" (Beer 1981, 3). Complexity is measured using the rules for calculating the quantity of information developed by Claude Shannon and Norbert Wiener: the total number of possible states of a system is reduced to "bits" (binary digits)—the minimum number of binary alternatives required to encode them. Once measured, how can such complexity be controlled or shaped? "The question is: how does a system conveniently and effectively undertake this fearful task? The answer is: by organization" (Ibid., 50).

Organization, for Beer, is a more flexible and effective form of control than coercion: "our concept of control is naïve, primitive [...]. Control to most people is a crude process of coercion" (Beer 1959, 21). To identify an adequate model of organization or control, he turned to the internal organization of living organisms, where coercion is absent: "by understanding these principles properly, we may well be able to facilitate regulation without imposing it. And that is something all good managers try to do" (Beer 1981, 4).

Beer therefore looked to the human body and nervous system as the ideal model of flexible and effective control:

> Our physical activity is wholly integral, and the many conflicting demands that are made on our internal resources at any given moment are being resolved into a smooth operation. Most of the control is intrinsic, in that the 'senior management', conscious cerebration itself, does not and in most senses cannot concern itself with the biochemichal or electrical details. When rest is required, it can be obtained, and when violent action is urgently needed, the whole physical apparatus leaps into fully geared actiity with a very rapid response time. Surely this is good management *par excellence.* (Beer 1981, 86–87)

Here, cybernetics serves as a common grammar for both anatomy and management. For example, the neuron can be likened to the leader of a state or company: "Both the neuron and the manager have one really basic task to perform: to decide," which means, in the end, "to say yes or no" (Ibid., 64). It was with these principles that Beer developed the *Viable System Model* (VSM), which he would later apply to the cybernetic management of Chile's economy. The VSM refers to the general structure of any system that must perform tasks while adapting to its environment. The nervous system consists of large autonomous or hori-

zontal units—such as reflex arcs and habitual behaviors that do not require conscious intervention—and a vertical axis linked to the spinal cord. In a business context, this autonomy corresponds to an intermediate management function. But Beer emphasizes its contrast with executive operations: "And already the managerial comparison is clear, because the firm really runs itself and the manager intervenes 'by exception'" (Ibid., 109). Finally, Beer offers two versions of the VSM—one for the nervous system (descriptive), and one for firms (prescriptive), showing how they should be organized:

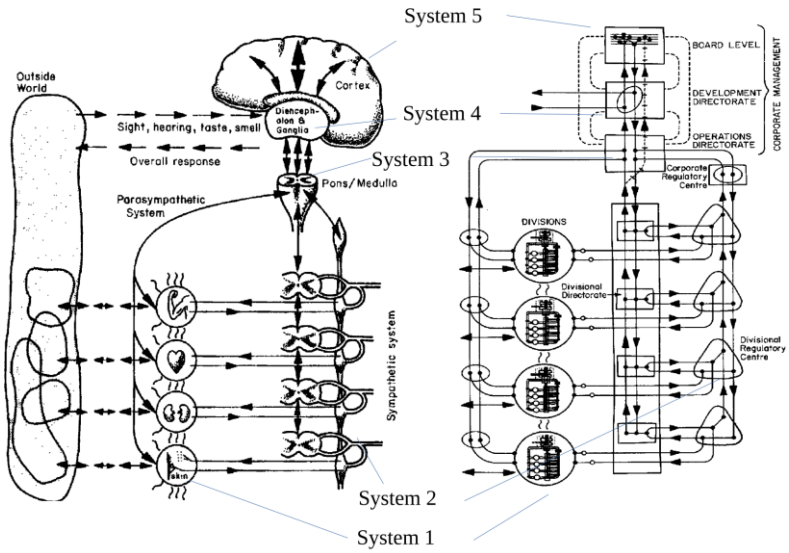
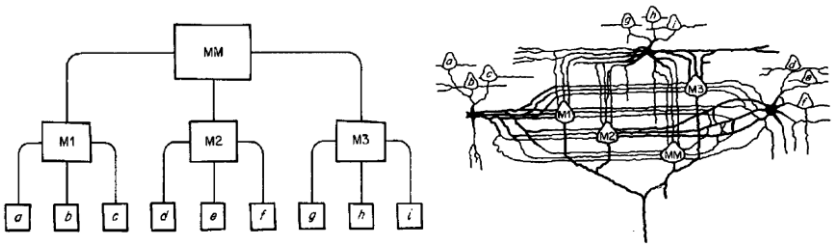


Figure 2 and 3. Beer's Viable System Model for the human nervous system (left) and for a firm (right) (Beer 1981, 131; 157).

In the firm, the first level of control (or "*system 1*") is made up of company divisions—production, distribution, and so on. *System 2* links these divisions to ensure, for instance, that one does not produce far more than another. *System 3* is the higher level of autonomous management and controls "the stability of the internal environment of the firm and this it does by providing feedback" (Ibid., 129). These three levels form the company's "autonomous management," which ensures its stability without central intervention. Next is *system 4*, which corresponds to development management: it monitors the external environment and projects into the future. This is perhaps Beer's most important level, since it allows the company to focus on "inventing the future" (Ibid., 198)

rather than merely reproducing the past. This continual projection requires constant feedback and continuous plan modification based on new information.

Finally comes *system 5*—the highest level of control—corresponding to the cerebral cortex in the nervous system and general management in the company. Beer stresses that this level depends entirely on systems 3 and 4, since it has no direct access to either internal operations or the outside world; all information must pass through those layers. To underscore that this top level must not reproduce conventional rigid hierarchies, Beer contrasts two organizational models:



Figures 4 and 5. Classic organizational flowchart (left) and its "actual functioning" (right), which can also be used to illustrate the neuroanatomy of the cerebral cortex (Beer 1981 201; 204).

In the classic model, each lower unit reports upward, but horizontal communication is forbidden. This multiplies the chances of error and poor decisions. In contrast, the second model—based on neuroanatomy—reduces errors through greater communication across and within levels. Concretely, this requires challenging traditional management assumptions:

1. that any boss is a colleague — *primus inter pares* — of a group which includes his subordinates.
2. that the 'one man, one boss' principle may work in some contexts [...] but that protocol must not forbid rich interactions throughout a group, and
3. that there is necessarily more communication between people at the same level in the enterprise. (Beer 1981, 207)

This, then, is Beer's new art of management, modeled—in his view—on how things actually work. He is not naïve about the nature of such relationships:

> The operation of such a system is usually called 'politics'. And success goes to the politically skilled because of the immense complexity of the communication paths. Moreover, the whole ethos of the multinode is political — there are manifest opportunities to manipulate other people to one's own ends, to renegue on one's boss, or one's staff, or one's colleagues. (Beer 1981, 207)

How, then, are we to describe the relationship between divisional autonomy (system 1), "autonomous management" (systems 1, 2, 3), and central management, in this tangled five-level model? Their relationship is always ambivalent: "A division is essentially autonomous. That means it 'does what it likes' within just one limitation: it continues to belong to the organism," which imposes three managerial constraints:

1. "Operate within the Intention of the Whole Organism." The division must remain aligned with top-down instructions from System 5.
2. "Operate within the Co-ordinating Framework of System Two:" one division must not outproduce or undermine another.
3. "Submit to the Automatic Control of System Three Itself," which can decide at any time that a division is no longer useful. (Beer 1981, 159–60)

Autonomy, then, is always conditional. It operates only within a larger system whose objectives are determined elsewhere, and which it cannot itself direct or define. However, Beer nevertheless makes it possible to conceive a decentralized model of management that significantly reduces the amount of calculation required at the highest level: only in the case of a major problem do the hierarchy and System 5 intervene.

At this stage, what is the relationship between Beer's cybernetic management and Marxism? Strictly speaking, there is none. The reference to Marx is entirely absent from his first book, *Cybernetics and Management*, published in 1959. Rather than any connection with Marxism, Beer's intellectual and political affinities lie more with the Labour Party—though this is reflected neither in his cybernetic theory—heavily influenced by Ross Ashby, himself an explicit liberal—nor in his practice, which consisted mainly of management consulting aimed at improving the productivity of large corporations.

Above all, it is important to note that planning is here conceived from the standpoint of the firm's problems and within the theoretical framework of mastering complexity. To this end, Beer employs models that

naturalize control (via the nervous system) and preemptively resolve all conflicts within a totality whose ultimate goal is survival, like a living organism adapting to its environment: hence, there is no place for class struggle in his system. As with Wiener, Beer's connection to socialist ideas at this point remains a matter of personal political affinity rather than a genuine theoretical or practical upheaval.

But in a letter dated July 13, 1971, Fernando Flores—then in charge of the nationalization of the economy under Allende's government in Chile—wrote to Beer, stating that he was "in a position from which it is possible to implement on a national scale—for which the cybernetic approach becomes a necessity—a scientific approach to management and organization." "He hoped I would be interested," Beer wrote; "I was." (Ibid., 247). The Chilean experiment would compel Beer to confront both practically and theoretically the problems of Marxism and socialism, to which he would attempt to bring the tools of his science.

II. Cybernetics, socialism and project Cybersyn

Championed by the Popular Unity coalition, the "Chilean road to socialism" that brought Allende to power in 1970 was based on the hope of radical social, political, and economic change "without sacrificing Chile's preexisting constitutional framework of democracy," according to Eden Medina (Medina 2014, 16). In her view, it was this tension—between the desire for radical change and the maintenance of a stable organizational structure, between popular "autonomy" and national "cohesion"—that made the cybernetic approach of Beer, a supporter of the English Labour Party, particularly compatible. Raul Espejo, one of the Chilean leaders of the Cybersyn project, invokes a similar argument:

> Socialists' experiences, such as in the Soviet Union and Cuba, were driven by a centralized model of the economy and constructed on the shoulders of millions of people following the dictates of a planning system reflecting the views of a relatively small group of bureaucrats and experts. Enforcing centralized planning in Chile was not feasible; its long-term democratic tradition had made that option difficult, if not impossible. (Espejo 2014, 79)

A third way, then—between centralized authoritarian communism and classical liberalism. However, as Evgeny Morozov emphasizes in his study, the short-lived Chilean socialist experiment cannot be understood outside the context of the Cold War—particularly the tireless efforts of the United States to destabilize and ultimately destroy it. From its intervention in Allende's campaigns (as early as 1964) to the coup

d'état of September 11, 1973, the United States played a decisive role (Morozov 2024, 23–24).

How did cybernetics enter the picture? The initiative came less from Allende himself than from Fernando Flores, who was the director of the Cybersyn project. After graduating in industrial engineering from the Catholic University of Santiago in 1968, Flores traveled to the United States, where he discovered Beer's theories on cybernetic management. Upon returning to Chile, he was appointed director of the Catholic University's engineering school. In 1969, along with other young intellectuals, he co-founded the MAPU (Popular Unitary Action Movement), a centrist and progressive party that later joined the Popular Unity coalition and helped Allende win the 1970 election. Flores was then appointed General Technical Director of CORFO (Corporación de Fomento de la Producción), responsible for industrial development. As CORFO's third-highest-ranking official, he oversaw the day-to-day regulation of nationalized companies. From this position, he convinced his director to recruit Beer as an external consultant in 1971.

Planning nationalization on the VMS model

How can the challenge of decentralized planning be addressed ? The "trick," as Medina writes, consisted in "black-boxing" parts of the observed system, retaining only its crucial aspects—that is, those that provided levers for action (Medina 2014, 27). As Espejo also recalls:

> It [the cybernetic approach] recognises that often it is not necessary to enter the black box to understand the nature of the function it performs. This is Beer's First Regulatory Aphorism […] For Cybersyn black boxes were the dominant mode of description. The Viable System Model was used as a set of black box descriptions of the industrial economy. They took the form of quantified flowcharts. (Espejo 2014, 91–92)

The aim was not just to collect this data—which required the involvement of local managers or workers—but to design it in such a way as to "convert raw data into usable patterns," as Pepa Foncea, one of the project's graphic designers, explained, so that it would be easily understandable. Although the expressions "mastering complexity" or "reducing variety" remain theoretically ambiguous, design here offers a practical path toward making them concrete. By creating the right indicators and effective visualizations, it becomes possible to reduce black-boxed complexity to a manageable level:

> For Cybersyn the design was reducing the large complexity of production activities at all structural levels, from plants to CORFO, and the disturbances buffeting them, to relevant information for management. The point was ignoring what deserved to be ignored and reporting significant changes. An aim for variety engineering in the project was offering a model driven approach to reducing situational complexity to a manageable level, while at the same time improving performance. (Espejo 2014, 82)

Reducing complexity to a manageable level involved "design[ing] performance indices, based on the actualities (ACT), capabilities (CAP), and potentialities (POT) of essential variables for all the operational units, from the local to the global" (Ibid.). In other words, to master complexity, the project had to first black-box it, then study it through the lens of information, and finally design indicators based on that information. These indicators would measure the relation between actual performance, possibility, and potential – all in the service of performance improvement rather than relying on monetary indicators or top-down objectives.

As the political and economic situation deteriorated in 1972, Flores begged Beer to spend more time in Chile working on the project and the questions he was facingwith his team : "How can factories get computer assistance when there's no money to buy them computers? How can science be handed to the people, instead of being used to exploit them?" (Beer in Morozov 2024, 129). More specifically : how would all this data be processed in real time, in a country that had just 57 computers in 1971 ? And how could information flow across Chile's 4,300 kilometers—from the Peruvian border in the north to Cape Horn in the south ?

Both problems were "solved" through what was arguably the most visionary and pragmatic part of Cybersyn: the *Cybernet* network. Rather than assigning a computer to each factory, the Santiago Boys devised a plan to circulate information via a network of *telex* machines—a set of teletypewriters connected by the existing telegraph infrastructure. Having secured several hundred unused telex machines, Cybersyn engineers began distributing them to factories across Chile. Workers would use them to enter relevant data, which was then sent to Santiago, to a CORFO office, where it was processed by the project's only computer (an IBM 360/50—one of the most advanced models of its time).

Sometimes romanticized as an early version of the "socialist Internet," this telex network echoed both the U.S. Arpanet of the 1960s and Soviet computer-networking plans for economic coordination dating back to 1956. (For a comparison of the three, see Medina 2014, 62–64.) Cybernet stood out, however, for making the most of limited resources:

the network did not connect computers, but instead enabled each local unit to benefit from centralized computing power by sending in its data. Above all, unlike the military objective of the Arpanet or the Soviet model of centralized planning, Cybernet sought to promote the autonomous development of Chilean industries.

If the System 1 of the VSM corresponded, in Cybersyn, to the factories, System 2 can be associated with the Cybernet network, while System 3 corresponded to a data-processing program called Cyberstride. This program used Bayesian methods to predict future data based on present inputs through statistical inference. Beer emphasized that "At any rate, there is nothing retrospective or historical about this data collection system, which is wholly oriented to prediction" (Beer 1981, 263). This reflects his obsession with the idea that government is always lagging behind what it governs, due to delays in the collection and processing of information. Thanks to the telex network, the Cyberstride program was intended to have "real-time" data on the state of the economy and thus to make short-term predictions in order to determine whether decisions needed to be made or not. The computing power of the project's computer was also initially meant to inform enterprises of potential problems so that these could be resolved locally. In other words, the aim was not to oversee enterprises from above by issuing instructions from a centralized plan, but rather to help them analyze their own data so that they could make the right decisions. Here is how Espejo summarizes it:

> Enterprises' data were transmitted to the government's computer center, where Cyberstride did the data processing. If significant changes were detected reports were sent back to the affected units. The expectation was that problems would be solved locally, however if problems persisted, after an agreed period with the affected managers, indices reports automatically jumped to the next level up under the assumption that these managers would have more chances to solve the related problems. This jumping up of algedonic signals was intended for all structural levels. (Espejo 2014, 83)

Under the leadership of Isaquino Benadoff—a Stanford graduate with perhaps the strongest computer expertise among the Santiago Boys—the software was developed by a British firm, Arthur Andersen and Co., at a cost of roughly $300,000 (in 2009 dollars). A provisional version was delivered in March 1972; the full system was intended to go live in 1973. For the first time, Beer's Viable System Model was implemented in software.

The next layer of the model—System 4 in the VSM—addressed the overall economic environment in which industry operated. Its purpose was to enable proactive decision-making on a macroeconomic scale. This was the role of *CHECO* (CHilean ECOnomy), a simulator that Beer described as the government's experimental laboratory. It was meant to test policy measures by modeling their consequences. As Espejo put it: "particularly it was to balance the ear on the ground provided by Cyberstride's indices with the eye on the future provided by these dynamic models" (Ibid.).

To model not just the economy but its evolution, Beer rejected conventional approaches for being "deplorably static," relying on data that took years to collect and using rigid equation-based models (Beer 1981, 266). He turned instead to the work of MIT engineer Jay Forrester, known for designing the SAGE air defense system in the 1950s. Beer was especially interested in Forrester's programming langage *Dynamo* (for Dynamic Models), which had been used to simulate systems like industry, cities, and global development. The Club of Rome had used it for their 1972 report *Limits to Growth*. Dynamo's advantage was that it could simultaneously solve many differential equations, simulating systems by focusing on their structure rather than on expanding data sets. Its many feedback loops made it possible to relate macroeconomic variables (money, employment, investment, production, etc.) and simulate the effects of policy changes. As with Cyberstride, British programmers worked with Chilean teams to build the CHECO simulator.

Finally, at the highest level of the VSM comes System 5, embodied in the famous Operations Room—the control room imagined by the Santiago Boys, modeled after the British war rooms of the Second World War. After Cybernet, Cyberstride, and CHECO, Beer wrote: "The objective of CYBERSYN is to draw [these tools] together in an effective control center—the operations room to be installed by November 1972" (Medina 2014, 88). Although Beer often emphasized the decentralized and autonomous nature of Cybersyn, it was this command room that became its iconic image in later years:

Figure 6. 3D reconstruction of the Cybersyn Operation Room.[2]

The goal was to create "a proper 'environment for decision'" (Beer 1981, 254), a man–machine interface meant to improve decision-making (Espejo 2014, 83). This included the ability to call or telex companies directly from the room, and to view images and diagrams controlled in part through buttons on the chairs. In November 1971, Beer needed approval from President Allende for the Cybersyn project. He recalls:

> The government should be conceived as a viable system (System Five being the President of the Republic). I drew the square on the piece of paper, labelled Five. He [Allende] threw himself back in his chair: 'at last', he said, 'el pueblo'. (Beer 1981, 258)

According to Rodriguez, the result was deeply ambivalent: "the place was very elegant, it was something smooth, like a church. You enter, it was silent. We were not acustomed to that, it was something more european" (Rodriguez in Morozov 2024, 115).

The "elegance" of the church-like space contributed to the Opsroom's iconic status as the symbol of Cybersyn. Its European design reflects the ambivalence of a room conceived by an English cybernetician and a German designer, in the name of the Chilean people. And its silence raises an important question: was the room ever actually used?

Idealism and Technocratic Marxism

2. Source of the figure : Wikipedia, https://en.wikipedia.org/wiki/Project_Cybersyn.

In their final conversation in the summer of 1973, Allende pushed again when Beer asked how far workers' control over the economy should extend: "to the maximum (al maximo)," he replied (Rodriguez in Morozov 2024, 115). In terms of intentions, the Cybersyn project as a whole was meant to be under popular control and to serve the interests of the workers by providing them with tools for self-management. Yet this aspect turned out to be more a limitation of Cybersyn than its achievement. Even Raul Espejo, once the project's director, admitted in a 2006 interview that worker participation was important "at a declarative level" but not at "the operational level, the level of action" (Ibid.), while Sergio Bitar, Minister of Mines under Allende, later referred to it as an "exotic experiment", "absolutely disconnected from the reality." Morozov writes:

> While Stafford's vision of popular power is certainly something to admire, it also has its share of political blindspots. Doesn't it reduce workers to trivial positions? Are they supposed to be knowledge contributors to his flowcharts and nothing more ? Or mere button pushers, who are stuck in the operations room? The whole set up feels more like a superficial nod to democracy not a system that genuinely values workers' wants and needs. (Morozov 2024, 125)

In the same spirit, Medina explains:

> Oral and archived source materials show that by March 1973 Cybersyn had done little or nothing to empower Chilean workers, while at the same time the number of engineers involved in the factory modeling process continued to grow. It is also telling that in March 1973 CORFO published a report detailing how to build quantified factory models for Project Cybersyn. The report was more than ninety pages long and was clearly written for an audience that had a university education in a technical field. Despite Beer's claims that Cybersyn was an instance of the "people's science," the project was clearly run by and for government technologists. (Medina 2014, 184)

The technocratic dimension of the Cybersyn project can be perceived in its practical details. Workers in the factories connected to the telex network often hesitated or were slow to provide their "personal data" on time—data that were necessary to construct the indicators devised by Beer (*actuality*, *capacity*, *potentiality*). Upstream from this process, in order for the data to result in "quantified flow diagrams," Medina recalls that it was necessary to model each of these diagrams on a factory-by-factory basis. This process required dialogue between CORFO engineers and factory personnel. Beer noted that, ideally, this stage should have

been carried out with the workers themselves, so that they could appropriate the graphical and quantitative representation of their factory, and even determine the thresholds at which alerts would be sent to higher levels.

At least at a declarative level, Beer grasped the political and epistemological importance of this moment: the kind of data collected (does one include the workers' daily attendance? the list of suppliers?), their level of detail (how far should one go?), their representation, and their limits—all of this had consequences for future management and for the potential of self-management. Yet, in practice, the Cybersyn engineers mostly interacted with the factory managers rather than with the workers.

> The modelers did talk to committees of workers in some cases but not as a rule. More often technocracy eclipsed ideology on the factory floor. Despite the explicit instructions the engineers received to work with worker committees, often the converse occurred, and the engineer treated the workers with condescension or 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 benefits, thereby avoiding potential conflicts. (Medina 2014, 131)

One engineer, Tomás Khon, responsible for modeling company data, recalled a "fairly technocratic approach," "top down," which never involved "speaking to the guy who was actually working on the mill or the spinning machine or whatever" (Medina 2014, 131). In short, while one might have expected technocracy to appear in the Opsroom—with centralized, top-down decisions—it was already at work at "level 1" of the cybernetic Viable System: on the surface of the black box, at the point of data collection.

As well as a technocratic configuration, cybernetic planning also appears as a refinement of management techniques. With their start-up-like culture and obsession with change—"CHANGE is a state of mind that everyone shares," Beer repeats in his "good government" manual—with their emphasis on fluidity, "real time," and hatred of bureaucracy, Stafford Beer and Cybersyn are part of a broader movement to reinvent management using technological tools. But rather than producing a qualitative transformation accompanied by social change, this upheaval seems more like an intensification of older methods. Medina also makes this point by comparing factory diagrams designed for Cybersyn with "the time studies that characterized the Taylor system of management,

which had been introduced in a number of Chilean factories before Allende came to power" (Medina 2014, 132). Worse still, Cybersyn allowed managers "to exert control over labor through an abstract technological system instead of a shop floor manager with a stop watch" (Ibid.): cybernetics appears here as a refined version of Taylorist government. As Tomas Kohn wrote to Beer in April 1973: "Ultimately your work is accepted as long as it provides tools to achieve a more effective *traditional* management" (Ibid., 193).

In the end, we are inclined to follow Slava Gerovič's pithy summary of Soviet cybernetics: "A capitalist dystopia turned a communist utopia and ended up a pragmatic management device" (Gerovič 2004, 302).

The political problem of technocracy and the managerial question both point to a deeper theoretical issue: the link between planning and neoliberalism via the concept of mastering complexity and autonomy, which displaces a conflict-based, class-based analysis. In practice, Stafford Beer's cybernetic management crossed paths with the neoliberal theorist Friedrich Hayek. This was the case at the Allerton symposium in 1960, which focused on principles of self-organization. There, Beer gave a remarkable presentation titled "Towards the Cybernetic Factory," in which he outlined the premises of an automated organization. In his notebook, he wrote:

> I was most gratified by the reaction of that eminent economist, Dr. Hayek, who thinks that this approach to the economic structure and control of industrial companies is a revelation compared with the classical modes of analysis. (Hancock 2024, 2)

At their core, Beer's and Hayek's approaches converge in the aim of mastering complexity not through totalitarian command, but through what Beer calls the "design of freedom," and what Hayek terms mastery of "the spontaneous ordering forces of the market" (Hayek 2013, 136). In both cases, the goal is to loosen direct control while maintaining strategic oversight, allowing people to feel free within a framework that is still controlled. But who gets to hold the point of view of the totality? Society is still conceived there as a unity, a "whole" within which conflict is regarded, at best, as a form of negative feedback. For Hayek, it is clear that because social complexity cannot be mastered, nothing should be planned: complexity, for him, serves as an obvious weapon of political neutralization.

Before his involvement in Chile, Beer's reflections—like those of Heinz von Foerster's "second-order cybernetics," which focused on self-

organization—shared many features with Hayek's liberalism. Consequently, as with Wiener before him, Beer can be associated with socialism only at the level of political affinities and a certain idealism. Yet, by paying attention to the historical unfolding of events, one can see how Beer himself was profoundly transformed, and compelled to partially reshape his model, through direct confrontation with political and social conflict.

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The 1972 Strike: Cybersyn and Class Struggle

By March 1973, Espejo telexed Beer in frustration: "useless is to tell you that the Operations room is not being used" (Morozov 2024, 130). In fact, the silence in the church-like room described by Rodriguez was never broken. Aside from the CHECO model—which was primarily used by government agencies—the most functional part of the Cybersyn system was the combination of *Cybernet* (the telex network) and *Cyberstride*. Still, none of the sources consulted report any significant effect or improvement brought about by these systems in the management of Chilean industry. Yet a sequence of events gave a different dimension to the Cybersyn project, while forcing Stafford Beer to revise some of his ideas in a less idealistic direction: the 1972 strike.

In October 1972, truckers went on strike in southern Chile to protest the state's expansion of public transport services. The economic elite and the United States seized the opportunity to paralyze the country and foment conditions for a coup. On October 10, 12,000 truck owners went on strike, and that number soon grew to 40,000. They refused to transport goods and pressured stores to close. In Valparaíso, 80% of private stores closed; in Santiago, the figure was 70%. The entire opposition and the Christian Democrats (initial allies of the government) supported the strike, as did doctors, lawyers, and engineers. Some factory owners shut down their plants and even paid workers not to work. A state of emergency was declared, over fifty factories were requisitioned, and emergency food and goods had to be distributed—sometimes directly to citizens—to bypass the blockades.

Networks loyal to Allende used their companies' trucks to support the government. Autonomous popular mobilizations formed to resist the economic sabotage. Ironically, the class conflict long feared by the right materialized—triggered not by the working class, but by a petty-bourgeois strike. On October 15, Flores and Mario Grandi, then in charge of CHECO, drafted a plan to activate the telex network. President Allende approved it, authorizing the setup of a command center in the presidential palace to receive all telex messages. These, along with telephone calls between key government figures, allowed field data (road conditions, truck availability, supply needs) to be circulated and orders relayed far more quickly than through traditional bureaucratic channels. By late October, the strike had failed to paralyze the country, but only ended after Allende allowed military officials to join the government to appease the opposition. Recalling the events years later, Beer still emphasized that the strike had been defeated "by the use of computers and teletypewriters"—a view disputed by Espejo and Chilean historians, who stress the central role of popular mobilization from below in keeping the economy and daily life going (Medina 2014, 150–151).

Rather than seeing technology as having an impact on social conflict, one must perceive the inverse movement: the way in which that conflict transformed Cybersyn and its *Santiago Boys*. The first among them, Flores, left CORFO after being promoted to Minister of the Economy, and was replaced at the head of Cybersyn by Espejo. The latter found himself isolated in carrying the project forward and ultimately secured funding for its continuation by emphasizing its technical and scientific dimensions rather than its political significance, in order to convince right-wing technocrats who had little interest in socialism.

Beer, for his part, considered that the October strike had strengthened the project, owing to Flores's promotion and the role played by the telex network. Above all, he proposed to broaden the cybernetic vision beyond industry, to include distribution and consumption, by integrating into his models the popular forms of self-organization that had emerged during the strike—such as the neighborhood Supply Committees and the *cordones industriales*, groups of factories working together with community organizations (student groups, *Centros de Madres*) to maintain distribution networks. Highlighted in Guzmán's film *La batalla de Chile*, these concrete forms of popular and workers' power recall the autonomy that Beer had long theorized but never witnessed in practice.

They did not unfold as realizations of his plans, but rather within a context of fierce struggle against the *Gremios*—the employers' associations—backed by the Americans. At the time of the 1973 coup, some thirty-one *cordones industriales* were still active. Impressed, Beer incorporated these new elements of autonomy into his post—October 1972 models (Beer 1981, 325). More importantly, he would henceforth emphasize the political dimension of the project over its technological efficiency. Rather than a contribution of cybernetics to Marxism, the reminder of reality brought about by the 1972 strike shows how concrete struggle could have shifted a technocratic project toward more democratic forms. Ultimately, the tools deployed by Cybersyn make sense only once they are genuinely appropriated by citizens—and such appropriation does not occur within a peaceful social totality, but precisely within the very dynamics of class conflict.

The importance of situating cybernetics within the class struggle became central for Stafford Beer during his last stay in Chile, in June 1973. In a short, unpublished essay entitled *Status Quo*, he even proposed a rereading of Marx through cybernetic concepts. A first way of connecting the two is, relatively simply, through updating: "Marx taught us to face facts, and to use scientific analysis rather than ideologies to investigate them. Here I use the science of cybernetics, which was not available to Marx." (Beer in Medina 2014, 199) Here, cybernetics serves to extend Marxist analysis in order to examine reality and the possibilities of its transformation through scientific categories.

Beer also suggested a political rapprochement: "For Marx, capital was evil and the enemy. For us, capital remains evil, but the enemy is STATUS QUO." (Ibid.) To explain this, he proposed a cybernetic modeling of class struggle, indicating an understanding of conflict in terms of organization: what primarily differentiates the class of the "exploited" from that of the "exploiters" is their level of organization. The former are in a "state of disarray," whereas the latter are "well organized." Between these two formations, class struggle is represented as a feedback mechanism that plays a homeostatic role:

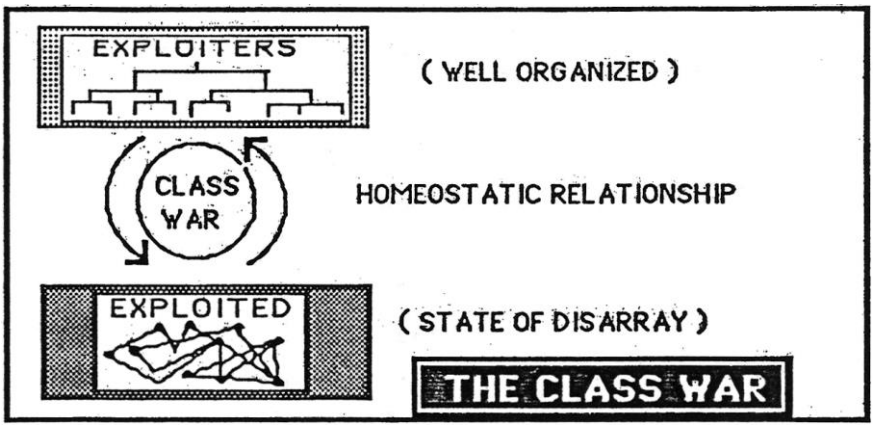

Figure 7. Beer's diagram of the class war as homemostatic relationship. (Beer in Medina 2014, 200)

How does the "status quo" intervene in this scheme? For Beer, it designates that which freezes the dynamic process of class struggle, and its main agent, according to him, is bureaucracy :

> Bureaucracy always favors the status quo, because its own viability is at stake as an integral system. […] It means that bureaucracy is a growing parasite on the body politic, that personal freedoms are usurped in the service demands the parasitic monster makes, and above all that half the national effort is deflected from worthwhile activities. […] dismantling the bureaucracy can only be a *revolutionary* aim. (Beer in Medina 2014, 201).

Drawing on the theory of autopoietic systems developed by Maturana and Varela, whom he met in Chile, Beer argues that bureaucracy is comparable to a parasite living on the back of society, concerned solely with its own self-reproduction. By accusing bureaucracy of hindering both the development of the working classes and the cybernetic process of decentralized management, Beer reminds us of the difficulties encountered by the Soviet plans for the cybernetization of the economy, as analyzed by Slava Gerovič : "industrial managers and government bureaucrats resisted the computerization of economic planning and management because it could upset the existing power structures" (Gerovič 2004, 277).

Ultimately, what the October 1972 struggle and the broader difficulties faced by Cybersyn and Allende reveal are precisely those "existing power structures" that technology alone is insufficient to overturn. At

the factory level, they refer to the managerial relationship of rationalization and exploitation of workers' labor—something that, as we have seen, remained embedded in Cybersyn's tools despite the goodwill of its designers, who sought to enhance workers' self-management. At the national level, they refer to the bureaucracy and the "status quo," which were Beer's targets in 1973. Finally, at the global level, it is the entirety of the capitalist "metasystem" that is called into question, undermining the prospects of Chilean socialism, as Beer himself analyzed in his own vocabulary:

> If the final level of societary recursion is capitalistic, in what sense can a lower level of recursion become socialist? It makes little difference if capital in that socialist country is owned by capitalists whose subject is state controls, or by the state itself in the name of the people, since the power of capital to oppress is effectively wielded by the metasystem. (Medina 2014, 201)

In other words, no form of socialism nor autonomy can truly flourish within a capitalist world.

Conclusion

Let us now return to the ambitions of Marxist economists Cédric Durand and Razmig Keucheyan, who advocate algorithmic planning as a way to overcome the current impasses of capitalism and the ecological crisis. According to them, "one of the main objections to planning," which "concerned the impossibility of making the calculations necessary for the centralized plan to function" is now obsolete: modern computing and data systems could succeed where Cybersyn and Glushkov failed—"against all odds, algorithms could be socialist" (Medina 2014, 92–95). The problem is that, so far, information technologies have largely benefited the private sector, not emancipatory planning projects. Since the early 2010s, for example, Procter & Gamble has been using the Business Sphere—"a spherical room equipped with giant screens where management information is displayed in graph form for review, processing and decision-making," whose "futuristic design" and "top-management" function are reminiscent of "the operations room imagined for the Cybersyn project" (Durand and Keucheyan 2019, 88).

However, by falling into the trap of fetishizing the Opsroom as if it alone represented all of Cybersyn, Durand and Keucheyan too quickly conflate the different forms of planning they discuss. As we have seen, the cybernetic planning developed by Beer in the Cybersyn project was conceived as an alternative to centralized Soviet-style planning, aimed at determining the optimal allocation of resources. For Beer and the

Santiago Boys, the element that was to guide planning was neither the market nor a plan devised by the highest echelons of power: it was labor itself that was meant to achieve self-regulation through technological tools.

The problem, then, is not—as Durand and Keucheyan suggest—simply having better computers or more data in order to finally complete a calculation and achieve an optimal allocation of resources. Technological refinement, as long as it remains in the hands of a technocratic authority, is unlikely to lead to emancipatory outcomes. The example of Cybersyn highlights both the idealism and the technocracy of a project built by an English cybernetician for Chilean industry, but it also points to what could have made these tools truly relevant: a more substantial democratic appropriation.

For this, the goal is not, as Beer envisioned, to deploy a vast program of pedagogical propaganda to encourage the population to use the new tools and exhort them toward abstract autonomy. Rather, it is within the very context of class struggle that technology can be meaningfully reappropriated and that real autonomy can develop. After the 1972 strike, Beer re-examined the Cybersyn project, integrating the new forms of popular autonomy. These reflections, at the twilight of Allende's government, reveal traces of a greater incorporation of economic and political conflict. The technocratic idealism that had permeated Cybersyn was transformed through direct engagement with class struggle, even if this did not result in a new project.

The lesson seems particularly important today, in the age of pervasive "techno-solutionism": neither emancipation nor planning should be conceived primarily through a technological lens, no matter how sophisticated. Rather than a conceptual self-organization inherited from cybernetics, it is the real autonomy of the working class and social movements that should form the foundation for the appropriation and management of the means of production from the bottom up.

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Biography

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