arq (2017), **21.1**, 33–44. © Cambridge University Press 2017

This paper argues that the disparity between the utopian concept of cybernation and cybernetic research of the 1960s results from a fundamentally different idea about the future of man and machine.

Witless slaves or lively artifacts? A debate of the 1960s

Jan Müggenburg and Claus Pias

During late modernism, the promise of, not only vaguely, but also precisely predicting the future had acquired enormous prestige. When evoked, this predictive project lent power, legitimacy, and a cohesive identity to endeavours in almost any realm of society and culture – including the discipline of architecture. In particular, in cybernetics, seen as a means of regulating and controlling complex systems, these optimistic ideas of 'mastering the big picture' flourished.

Under the heading of 'Cybernetics: Circular Casual, and Feedback Mechanisms in Biological and Social Systems', the umbrella organisation Josiah Macy Jr. Foundation hosted ten conferences on this very topic between 1946 and 1951.[1] These events, known as the Macy Conferences, provided a forum for the collation and presentation of existing research, and in retrospect can be seen to have been the most important 'get-together' of their kind, judged in relation to subsequent crucial findings in the history of science after the Cold War. Based upon the theoretical framework of the terms of 'information', 'feedback', and 'analog/digital', they searched for that single universal theory of regulation and control – which they claimed might be applied to any species, machine, economic or psychological process, aesthetic or sociological phenomenon. As a consequence, cybernetics transformed into a tool to describe and explain methodologies not only in its own core knowledge/research area, but became seen as a subject capable of giving answers to societal questions of any kind. In doing so, cybernetics linked new scientific-technical methods with all issues of social relevance.

In recent years, German media theory and related branches of media studies have undertaken documentation of and profound research into, the history and significance of cybernetics.[2] In contrast, architectural science has only sporadically addressed the consequences that might ensue from the implementation of this technical thinking in the planning, drafting, and final implementation of architecture.[3] In the 1950s and 1960s cybernetics was warmly, even ecstatically embraced and productively employed by a number of architects. For example, Nicholas Negroponte and Yona Friedman dealt with the question of how cybernetics and information theory could open up new options for the use of creative tools for future societies. In their drafts and concepts, Negroponte and Friedman already showcased the first outlines of contemporary globally-used digital networks and communication structures, which, in the long run, were to fundamentally alter social and spatial realities. Whereas Negroponte investigated human-machine-interaction at Boston-MIT in order to, so to speak, amplify the creative component in the design process, the Stuttgart-based architectural theorist Manfred Kiemle, around the group of Max Bense, rather applied quantitative aesthetics to it – paying more attention to the decision-making process.[5] However, it was Frei Otto who in those new and operative spaces of technical systems, procedures, and processes detected the possibility of overcoming conventional boundaries between object and subject, nature and culture in order to, based upon his findings, develop a genuinely new and synthesising effect on performative architecture.

In their paper, Jan Müggenburg and Claus Pias throw the utopian idea of cybernetics and its mythologizing power into question. They discuss the reciprocal influences between natural sciences, technical sciences, and the humanities in times of technophilia and euphoric attitudes towards planning processes. Their arguments include an interrogation of the fundamental ideological premises on which this infinite optimism towards forthcoming progress was based. The paper searches for those key actors of paramount importance who sought to implement their scholarly work as an agent of progress in politics, society, culture, and the arts, while analysing the consequences of those promises for a new kind of knowledge/knowledge culture on traditional cultural values and orders. Thus, Müggenburg's and Pias's approach paves the way for contextualising current debates about information technology-based impacts on architecture. It can be regarded as another important contribution to the debate on how the methodological appeal of cybernetics has had a lasting and continuing effect on architecture, and on how this abstract world of modelling, made up of symbolic machines, still exerts a lingering effect on the discipline of design formerly determined by intuitive drafts and the idea of pure material reification alone.

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doi:10.1017/S1359135517000197

One has to remain silent about that which is not programmable.[5]
(Wolfgang Welsch)

It is our greatest achievement [...] that we trivialize the world and its 'furniture' [...] That people constantly cut their fingers, get hurt and fall into despair over it, is thus [...] the great problem of civilization.[6]
(Heinz von Foerster)

Introduction

Technologies of automation and their effects on the freedom of man were the focal point of numerous debates and utopian dreams during the 1960s. Two primary discourses associated with North American cybernetics developed within this context. Though they developed simultaneously, these discourses adopted different approaches when treating this contemporary phenomenon. Whereas one side feared a creeping 'trivialization' and the impending effacement of man's autonomy, the other side thought that having machines take over trivial tasks would allow for the creation of a 'New Man' and a 'New World'. The term 'trivialization' refers to the distinction between 'trivial machines' and 'non-trivial machines' that was introduced into cybernetic theory by the Austrian physicist Heinz von Foerster.[7] While within the cybernetic paradigm the term 'machine' could mean both non-living and living systems, e.g. human beings, the behaviour of trivial machines, according to Foerster, was predictable and analysable, while non-trivial machines consistently change their behaviour contingent on their history and in an unpredictable manner. Foerster called the process of 'reducing' a non-trivial machine to a trivial machine 'trivialization'.[8] As far as the automation debate is concerned, 'trivialization' in the figurative sense thus meant the elimination of unpredictability from society.

Pointing out the dangers of such a development, Foerster continued to grapple with the resolution of a dilemma that had occupied cybernetics since the days of Norbert Wiener. That is, while the realisation grew ever stronger that man has to be understood as only one functional element within a highly complex network of technological and natural processes of communication, theoreticians such as Foerster attempted to 'preserve' the autonomous human subject within their theories, thus perpetuating the liberal-humanist legacy to which they still felt obligated. In addition to the theoretical work regarding new boundaries and categories beyond the simple man/machine-distinctions, Foerster and his colleagues dedicated themselves to the construction of machine-models according to 'biological' principals. Due to their ability to behave as unpredictably and unexpectedly as man does, these lively artifacts were thought to bear witness to and uphold the freedom of man.

It was, however, precisely this type of cybernetic research that produced a phantasmic surplus beyond the boundaries of academic discourse, thus triggering a completely different kind of debate. In various extra-scientific circles, the conception that the entire production of goods could be delegated to a quasi-autonomous cybernetic machine park became popular around 1960 – an idea that was eventually labelled 'Cybernation'. As entrepreneurs such as Leon Bagrit and John Diebold confidently voiced, instead of threatening man's autonomy, this process of trivialisation would allegedly result in quite the opposite: namely, the liberation of the truly human. Accordingly, the Cybernation-debate produces an anthropological redefinition of man inspired by cybernetics: that which remains as the residue of non-machine-able tasks is considered specifically to be human. The Cybernation debate therefore eliminates any form of indistinctness, vagueness, and anthropological challenge that was simultaneously addressed by the bio-cybernetic discourse.

Cybernation

Today, the term 'Cybernation' has been largely forgotten.[9] The utopian potential of mass unemployment – which this term once was meant to denote – perished with its usage, and only some scattered occupational visionaries persistently use it today.[10] During the cybernetically-focused 1950s and 1960s however, 'Cybernation' was in common parlance. Though what was meant by this term seems farcical today: the chance to create a new man, a new society, and a new economy by way of mass unemployment. This postwar idea virtually inverted the industrial prewar conditions without leaving the scene: while in the latter instance the New Man was to be created with and through work, Cybernation aimed at the same goal through the deliverance from work. Scientific Management à la Frank Gilbert or Ernst Jünger – whose systems were designed to permeate all aspects of life – was not only conceived as energy- and attention-optimisation, but simultaneously as cognitive design that promised to change and pointedly control the 'bias' of entire cultures via the formation of systemic knowledge.[11] Contrary to this, the utopian vision of Cybernation was founded on a claim of overcoming an anthropology of work and ultimately eliminating the difference between work and leisure time, thus allowing the constitution of a meaningful newly found freedom.[12]

When looking at the large body of literature regarding automation published during the cybernetics boom after 1945, the usage of the term 'automation' appears paradoxical.[13] This paradox consists in the fact that while 'automation' was meant to describe an actual change during the 1950s, it was nevertheless an exhausted and historically burdened concept that was generally associated with assembly-line work and 'Detroit Automation'. Even John Diebold, who opened the debate with his 1952 book *Automation: The Advent of the Automatic Factory*, felt obliged to clarify a decade later that by introducing the term 'automation' he had meant to declare the end of the Industrial Revolution.[14] In order to prevent confusion, numerous authors in the 1960s (with recourse to Norbert Wiener) preferred to use the term Cybernation, which was thought to clarify the significance of cybernetics as a

https://doi.org/10.1017/S1359135517000197 Published online by Cambridge University Press

temporal indication. It was probably coined by Donald M. Michael of the Peace Research Institute in 1962, but quickly taken up by Marshall McLuhan, Erich Fromm, Leon Bagrit, and numerous other authors.[15] The role of feedback and black box concepts especially was thought to be expressed through Cybernation. Above all, digital computers and their ability to process, save, and manipulate data came to the fore of societal and technological reflection, which largely took place in industry at the time. The first periodical dealing with computers, which was first published in 1952, was called *Computers and Automation* for a reason.[16]

Cybernation was understood to be a comprehensive social, political, and economic challenge and opportunity. This notion had already been anticipated by Norbert Wiener, who assessed that Cybernation was the liberation from the 'deadly uninteresting nature of the repetitive tasks' and that it created the 'leisure necessary for man's full cultural development'.[17] The new cybernetic machines that allowed for this liberation were, following Wiener, the equivalent of slaves. Thus, one had to begin thinking about the economic conditions of modern slave labour, because such conditions would eventually cause an 'unemployment situation, in comparison with which the present recession and even the depression of the thirties will seem a pleasant'.[18]

Both aspects – crisis and utopian dream – would be frequently taken up again and discussed during the following years. This was a crisis not only in an economic sense, but also a psychological, societal, and philosophical identity crisis of epochal dimensions, addressed in an almost infinite number of texts. The utopian dream aspect on the other hand, spoke of a New World and a New Man. Such phenomena were imagined as the potential of just this crisis, as well as the necessary steps towards the controverted goals. To the authors of these texts, the actual technology was either of no interest at all, or it was presented in the form of science fiction (partly sombre, partly radiant), which amounts to the same thing. Accordingly, in the spring of 1966 Henry Winthrop was able to report in relation to the Conference on the Cybercultural Revolution of the New York Institute for Cybercultural Research, that the Revolution was simply the 'result of science fiction in technical dress'.[19] A survey of the year 1964 may clarify the lines of argument at the time.

1964, take one

The book *The Age of Automation* by the computer manufacturer and director of the Royal Opera House in Covent Garden, Sir Leon Bagrit, may serve as the first example.[20] Already the beginning is charged with epoch-making pathos:

> [N]*ow at last we have it in our power to free mankind once and for all from the fear which is based on want. Now, for the first time, man can reasonably begin to think that life can be something more than grim struggle for survival.*[21]

On the second page, Bagrit adds the more cautious thought that the revolution must be correctly implemented, and that means comprehensively. Cybernation, following Bagrit, is 'communication, computation, and control'.[22] This is a familiar phrase from the military, where C3 means nothing else than Command, Control & Communication. Bagrit's figure of thought is typical for the mid-1960s. Cybernation appears as the opposite of 'mechanization'. Man is not turned into a robot; robots rather relieve man of the robot-like elements of his existence. They virtually subtract the 'dead work in linear order' from human existence so that ultimately something 'purely' human remains, which is thought to develop all the better and purer.[23] This repeats in various places in the system and on different hierarchical levels. Bagrit's example considers not only the difficult physical work in factories or the daily car ride to the office, but also the level of executive management. Everything that is routine, everything that can happen 'automatically' because it is prescribed – that is, programmed – that way, and everything that is determined according to formalisable criteria, will be eliminated. What remains is a being, that makes those decisions that are not automatable, programmable, or formalisable. What remains is the so-called human being.

Accordingly, Cybernation denotes first and foremost the notion of a realisation (or, more radically, the invention), of a particular version of humanism. As Bagrit formulates the case: 'I am convinced that automation has only one real purpose, which is to help us to become full human beings.'[24] As we will show below, this figure of thought regarding a release of the actually human via the delegation of redundancies permeates such different spheres of knowledge as work, economy, science, and ethics. Max Bense's often quoted dictum that only anticipatable worlds are programmable and that only programmable worlds are constructible as well as inhabitable by man is the German echo to Bagrit's observations, delayed by a few years.[25]

This cybernetic double movement of man as increasingly (ill-)defined is not unproblematic. Man, whose uniqueness and particularity, on the one hand, is disputable due to his functional equivalence with machines, is nevertheless, on the other hand, thought to be redefined precisely on the basis of his difference with substitutive machines. The case is probably just as problematic as the belief that we might arrive at a new humanism by forcing technisation, an idea that finds its precursors in the American technocracy-movements of the prewar years, and which the Frankfurt School was soon to dismantle so thoroughly.[26] Lastly, it is justifiably dubious that repetitions of routines can be excised from human existence in an offhand manner, just because they are presented as being inessential. The idea that physical as well as psychological routines figure essentially in the self-constitution is, within the framework of the cybernation debate, only expressible by way of a negative formulation: automatisms preclude man from 'pure evolvement' and constitute a deficient 'unfree' self. Taking all of this into consideration, what remains is that the Cybernation-argument

https://doi.org/10.1017/S1359135517000197 Published online by Cambridge University Press

seemed cogent in the 1960s because it was based on the belief that current (or imagined) technologies would assign a new place to the 'human being' and force man to reconsider his own status.

With this, it is not uninteresting that this argumentation requires the perpetuation of a certain taboo, a point that Bagrit explicitly makes. Although the computer is at the heart of Cybernation, 'thinking' is nevertheless foreclosed to it, for as Bagrit contends, '[a]ny idea of "thinking machines" is nonsense.'[27] Apparently, such a notion, contrary to the popular idea regarding the 'electronic brain', would not be compatible with the idea of freedom of thought as an uniquely human trait. What would follow, after all, from the contention that man is free to think in an unrivalled way, and simultaneously, that the slavish computers—which putatively give rise to such freedom in the first place—are able to do so as well? Accordingly, proponents of the Cybernation-movement ignored the contemporaneous question regarding thought that Heidegger asked of cybernetics, and which was an element of the core-provocations of the cybernetic movement.[28] (Below we will elaborate on the fact that cyberneticists themselves in fact did hold onto the 'idea of thinking machines'.) At all events, the notion of Cybernation dropped the idea of a systematic melding of man and machine and replaced it with the mere division of labour: the society of 'colleague computer' appears as a partnership based on different competencies.

Therefore, the remaining problems lie, according to Bagrit, not with the technological, but with the social. If, taking up Hermann Schmidt's 1941 proto-cybernetic dictum, everything is controlled that is controllable, then Man needs to be prepared for his newly gained leisure time so that he does not have to face it in a helpless and bewildered state. Following Bagrit, the 'reign of cybernation' has to begin in the educational system. From here, a scientific humanist who can overcome the gap between the so-called 'Two Cultures' ought to emerge. Still following Bagrit, such a figure would be able to spend his time well once everything else runs by itself. He would experience this condition as freedom, rather than free time, or the absence of work. The danger that this acquired freedom could produce different 'creatures of habit' after having eliminated all previous routines, does not seem to bother Bagrit. For him, the time of this New Man would be organised by and filled with artistic, artisanal, scientific, or charitable pursuits, those self-technologies that Bagrit sees as non-programmable and therefore, as meaningful and especially human. Such a life would be spent preferably in the bucolic atmosphere of Devonshire, Cumberland, or Cornwall with millions of early-retired men in garden city-like 'retirement resorts'.[29]

Intermezzo

In 1964, Bagrit found himself and his arguments in good company. Below, we will briefly outline three contemporary examples that structurally argue in a similar way.

First, we consider Marshall McLuhan, who, in his 1966 essay 'Cybernation and Culture' somewhat radically addressed such questions with regards to education in the 'electronic age'. In this essay, McLuhan always uses the term 'Cybernation', not 'Cybernetics'. In doing so, he suggests the context of the automation debates, which he, along with such important automation theoreticians such as John Diebold, encountered through conferences during this time.[30] In *Understanding Media*, arguably his most important work, McLuhan begins and ends with discussing Cybernation and connects technological transitions with changes in mentality and social history:

> *With automation, it is not only jobs that disappear,* [but the] *complex roles that reappear.* [...] *The restructuring of human work and association was shaped by the technique of fragmentation that is the essence of machine technology. The essence of automation technology is the opposite. It is integral and decentralist in depth, just as the machine was fragmentary, centralist, and superficial in its patterning of human relationships.* [...] *The electric age of servomechanisms suddenly releases men form the mechanical and specialist servitude of the preceding machine age. As the machine and the motorcar released the horse and projected it onto the plane of entertainment, so does automation with men. We are suddenly threatened with a liberation that taxes our inner resources of self-employment and imaginative participation in society. This would seem to be a fate that calls men to the role of artists in society.*[31]

Cybernation is not only part of what McLuhan predicted as 'retribalization', but also introduces a future of lifelong learning: '[L]earning itself', argued McLuhan, becomes 'the principal kind of production and consumption'.[32] Accordingly, the uproar regarding unemployment is pointless. '[T]he entire business of man becomes learning and knowing', asserts McLuhan, 'In terms of what we still consider an "economy" (the Greek word for a house-hold), this means that all forms of employment become "paid learning".'[33] This would not least make academics happy, since the entrepreneurs would soon be humbled, once 'Doctores philosophiae' are taking over the executive suites.[34]

Secondly, one may consider the recently and extensively reconstructed Cybersyn-project by the British Management-Cyberneticist Stafford Beer.[35] The goal of this endeavour was the control of the Chilean economy by way of one central mainframe computer in order to realise a cybernetic nation. What is noteworthy here is how cybernation extends beyond the factory; this is an example of cybernation at the management level. The software is thought to take over automatically every decision that is formalisable, and silently to make 'optimal' decisions (according to predetermined criteria), so that—albeit not on the level of production, but certainly on the level of administration – everything automatable is automated. What remains is a think tank of seven thinking and controlling men who make all the non-automatable decisions, and who – with ashtrays and drink holders in the armrests of

https://doi.org/10.1017/S1359135517000197 Published online by Cambridge University Press

their Opsroom-armchairs – form a reservation of sovereign openness to the future and specifically human creativity.

Thirdly and lastly, one may remember Joseph Licklider's classic texts on the Man-Machine-Symbiosis in the realm of militaristic, engineering-technological, and economical decision-making, which were also written in the 1960s and commence with an emblematic Man-Computer-Comparison:

> [M]*en are noisy, narrow-band devices, but their nervous systems have very many parallel and simultaneously active channels. Relative to men, computing machines are very fast and very accurate, but they are constrained to perform only one or a few elementary operations at a time. Men are flexible, capable of 'programming themselves contingently' on the basis of newly received information. Computing machines are single-minded, constrained by their 'pre-programming'*.[36]

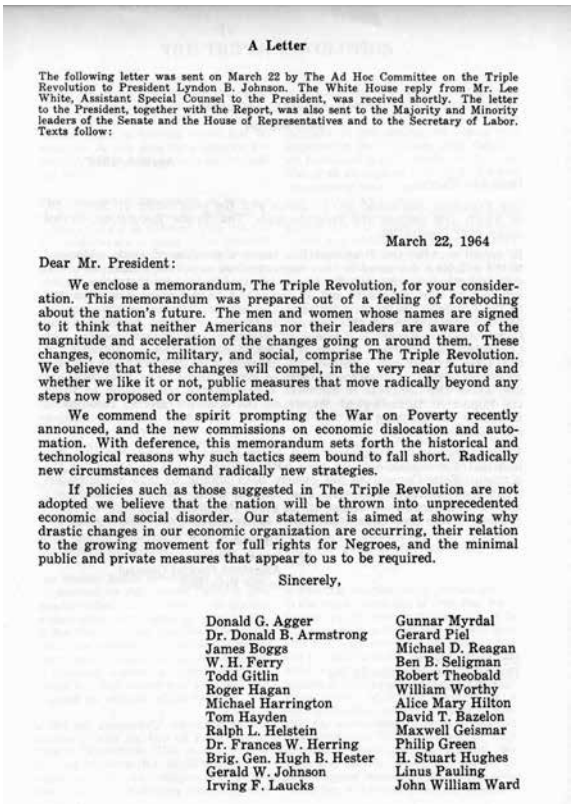
The discussion leads to the assertion that appropriate steps have to be taken based on the division of labour: According to Licklider, 85% of everyday intellectual work – of the engineer, one might add – is 'inauthentic'. Or, as he himself observed:

> [M]*y 'thinking' time was devoted mainly to activities that were essentially clerical or mechanical: searching, calculating, plotting, transforming, determining the logical or dynamic consequences of a set of assumptions of hypotheses, preparing the way for a decision or an insight. Moreover, my choices of what to attempt and what not to attempt were determined to an embarrassingly great extend by considerations of clerical feasibility, not intellectual capability.*[37]

This means that with the intended symbiosis of man and machine, the computer takes over all automatable tasks and that man (due to this designation) has more time for the development of his 'creative' potential (here: regarding engineering and military strategy). In other words, man has more time to decide on such question that can only be decided by human beings. Such a respite resulting in an increase of creativity is extremely important when considering the ongoing 'race of political systems'. As publicly (or, military-industrially) subsidised creativity research shows, the advancement of individual creativity at the time of the Cold War was also meant to promote the capitalist system as against Communism.

1964, take two

The second example, this time from the United States and also from the year 1964, is the collaborative manifesto *The Triple Revolution*, which was directed at president Lyndon B. Johnson. The list of signees includes not only journalists, students, economists, and political scientists, but also industrials, historians, and sociologists. Cybernation – mentioned immediately on the first page of the manifesto – requires a fundamental evaluation of the situation regarding values and institutions.[38] The authors regard it as one of the three great revolutions, along with the 'Weaponry Revolution' (weapons prevent wars) and the 'Human Rights Revolution' (globalisation of human rights). Yet Cybernation – understood here as a 'new era of production' by computers and feedback – is the central and most important revolution.



A Letter

The following letter was sent on March 22 by The Ad Hoc Committee on the Triple Revolution to President Lyndon B. Johnson. The White House reply from Mr. Lee White, Assistant Special Counsel to the President, was received shortly. The letter to the President, together with the Report, was also sent to the Majority and Minority leaders of the Senate and the House of Representatives and to the Secretary of Labor. Texts follow:

March 22, 1964

Dear Mr. President:

We enclose a memorandum, The Triple Revolution, for your consideration. This memorandum was prepared out of a feeling of foreboding about the nation's future. The men and women whose names are signed to it think that neither Americans nor their leaders are aware of the magnitude and acceleration of the changes going on around them. These changes, economic, military, and social, comprise The Triple Revolution. We believe that these changes will compel, in the very near future and whether we like it or not, public measures that move radically beyond any steps now proposed or contemplated.

We commend the spirit prompting the War on Poverty recently announced, and the new commissions on economic dislocation and automation. With deference, this memorandum sets forth the historical and technological reasons why such tactics seem bound to fall short. Radically new circumstances demand radically new strategies.

If policies such as those suggested in The Triple Revolution are not adopted we believe that the nation will be thrown into unprecedented economic and social disorder. Our statement is aimed at showing why drastic changes in our economic organization are occurring, their relation to the growing movement for full rights for Negroes, and the minimal public and private measures that appear to us to be required.

Sincerely,

Donald G. Agger	Gunnar Myrdal
Dr. Donald B. Armstrong	Gerard Piel
James Boggs	Michael D. Reagan
W. H. Ferry	Ben B. Seligman
Todd Gitlin	Robert Theobald
Roger Hagan	William Worthy
Michael Harrington	Alice Mary Hilton
Tom Hayden	David T. Bazelon
Ralph L. Helstein	Maxwell Geismar
Dr. Frances W. Herring	Philip Green
Brig. Gen. Hugh B. Hester	H. Stuart Hughes
Gerald W. Johnson	Linus Pauling
Irving F. Laucks	John William Ward

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1 Cover letter, *The Triple Revolution* (1964).

The line of argument is similar to Bagrit's, although somewhat more radical and with reference to economic aspects. The authors of the manifesto argue that in their time there still exists a rivalry between man and machines for the production of wealth. This will end however, as soon as machines take over production. Yet the industrial system will not be able to handle this 'unlimited capacity of a cybernated productive system', which is why the authors demand a new system that no longer asks how production can be increased, but instead, how the surplus can be divided.[39] 'The new science of political economy will be built on the encouragement and planned expansion of cybernation', the authors explain. It will also have to answer this question: 'What is man's role when he is not dependent upon his own activities for the material basis of life?'[40] In a word: Cybernation appears to be a utopian chance to end wage labor and with it, to end an economy of scarcity. This marks the simultaneous beginning of a surplus economy. This 'economy of abundance' shall at once create the basis for 'a true democracy of participation, in which man no longer need to feel themselves prisoners of social forces'.[41]

Such a paradigm shift has to be well organised: it demands, for example, a 'public philosophy for the transition', and a new process of meaning-production that revises the modern concept of labour as it emerged in the late eighteenth century, which was bound to concepts of scarcity, monetary

https://doi.org/10.1017/S1359135517000197 Published online by Cambridge University Press

economy, and certain forms of production. Furthermore, this transition must bring its general historical contingency to mind. Coupled with this are also concrete political demands, such as a public education program, minimal wage, public housing, public transport, public energy supply, tax reforms, and so on.[42] Here too, it is recognisable that technological parameters of automation are not at issue; rather what is at stake is bearing such changes socially, economically, and intellectually, and making them a comprehensive utopian option.

Of course, topics and considerations regarding enjoyment without lack and value without scarcity, systems that do not regulate themselves based on austerity, etc. are not actually new. Within the framework of a historical 'Anthropology of Labor', such systems have rather a long motivic tradition.[43] In this sense, one would not have to search for abundance in economy, but rather in discourse-history. The 'slaves' of the humanistically educated Norbert Wiener have more then metaphoric authority, because the issue here is a return to an Aristotelian economy as the distribution of a productive surplus. Different from chrematistics, which Aristotle understands as the enrichment that is directed at the perpetual multiplication of money by way of usury and commercial capital, the Aristotelian economics is a household doctrine of use values that only enters the exchange when rational human demands obtain other use values by way of trade. Whereas the modern economy of scarcity concepts had once organised a protracted farewell to Aristotelianism, the latter shall now, under high-tech conditions, make an abrupt comeback. Another example would surely be Marx's and Engels's utopian intarsia from the critique of the *Gothaer Programm* (1875), according to which one could proceed 'to hunt in the morning, fish in the afternoon, rear cattle in the evening, criticise after dinner, just as I have a mind', once the class struggles are over.[44] This condition of 'free activities' – likely only possible after the 'abolition of labor' – is surprisingly similar to the fantasies of the politically quite different authors from the Cybernation-Debate.[45] If and how this 'economy of abundance' under the conditions of Cybernation, is always also a (anxious or fascinated) reaction to the USSR, its planned economy and its cybernation is anyone's guess.[46] What can be retained at this point is that such concepts flourish and generate an enormous body literature, whenever they face (or seem about to face) new technologies and new possibilities of programmability.[47]

Three interventions

Parallel to the Cybernation-debate of the 1960s, another discourse existed that centred on the institutionally-established American bio-cybernetic developments. This latter discourse was a public discussion concerning the relationship of (mechanical) triviality and (human) freedom. While entrepreneurs such as Leon Bagrit or John Diebold took the impulses from the cybernetic research to think about the primarily social, political, and economic ramifications of a coexistence of man and machine based on the division of labor, contemporary bio-cybernetic circles represented an approach to what were ultimately the same questions from the opposite direction.

In the following section we will examine the apparent divergence between cybernetics and Cybernation, by discussing three poignantly formulated (i.e. quite disputatious) 'interventions'. First, man does not appear as an indistinct remainder or reserve of the non-mechanical in the bio-cybernetic discourse, but rather emerges as the starting point for the development of congenial machines. Such machines will be similar to man, and endorse him as non-mechanisable, adaptive, and creative being. Instead of a rhetoric of liberation in this instance however, the affirmation of the specifically human was at stake here. Second, the creators of the new cybernetic machines did not expect them to take-over redundant and inconvenient tasks reliably. On the contrary, they expected them to show unexpected behaviour. Third – and this might be the most important departure from the Cybernation-debate – one did not try to concretise a difference between unfree machines and man liberated by them. Rather, the aim in cybernetics was to find a superordinate differentiation that would classify the totality of man and machine into two camps of opposing organisational forms: free man and free machines on the one side as well as unfree man and unfree machines on the other.

First intervention: similarity instead of difference

In 1962, the same year during which the term Cybernation was introduced to societal debates in the US, the British cyberneticist Gordon Pask formulated his own expectations regarding the future.[48] As a response to Orwell's famous dystopia, Pask described a scenario for the year 1984, which, at first glance, has many similarities to the Cybernation-utopias of Bagrit and Diebold. In Pask's formulation, labour for automatons would in the future only be delegated to automatons, and man could finally dedicate himself to activities that are usually perceived as creative and 'worthwhile'. Here, Pask's vision agrees with the outlines of Cybernation for the moment, for within the framework of this new division of labour society will have to adjust its value system:

> *It means that we must change our ideas of value, for the most valuable man may never do a stroke of conventional work. It means that the organization must pay for creativity or wisdom or humor, or many other nebulous characteristics currently taken on a more or less 'charitable' basis, rather than only tangible success.*[49]

Even though Pask appears to have conceptualised the utopian dream of Cybernation two years prior to Bagrit and Diebold, his vision differs in one crucial aspect: the seamless meshing of unemployment and paid creativity would only become effective, if 'the man-made organisations of 1984 [...] be planned as living organisms'.[50] Should future machines have the same flexible and relational form of organisation as

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living organisms, a dignified coexistence of man and machine could emerge on the horizon of a cybernetic worldview, for as Pask claims, '[w]e do not loose our personality in this organisation but gain the dignity we rightly claim.'[51] With this contention however, Pask indicates an utterly different approach than that advocated by representatives of Cybernation. Pask's projection does not expect 'witless slaves', that would relieve man of the burden of machine-like tasks. Instead of a separation of the technical from the human, Pask demands the replication of the specifically human by technological means: 'Broadly, the contention is that man, as a self-organising system, should live in a man-made environment which is also a self-organising system and which is in this sense part of him.'[52]

By referencing his own area of expertise, Pask argues that the construction of novel biological forms of organisation in the field of mechanical engineering is not just a bold claim. On the contrary: it is already an object of contemporary research. The exploration of novel 'computing elements, and new methods of measuring and controlling human behaviour' within the framework of cybernetics already makes it possible to realise artificial biological forms of organisation.[53] The 'versatile design' approach employed here is about circumventing the rigid organisational fixation of common machines. Instead of continuing to construct machines, whose 'structures [...] exist independently of the transformation effect', this is a vision of implementing dynamic and flexible structures and control procedures. Following Pask, this concept of a versatile design could principally be applied to all kinds of future technologies from 1984:[54]

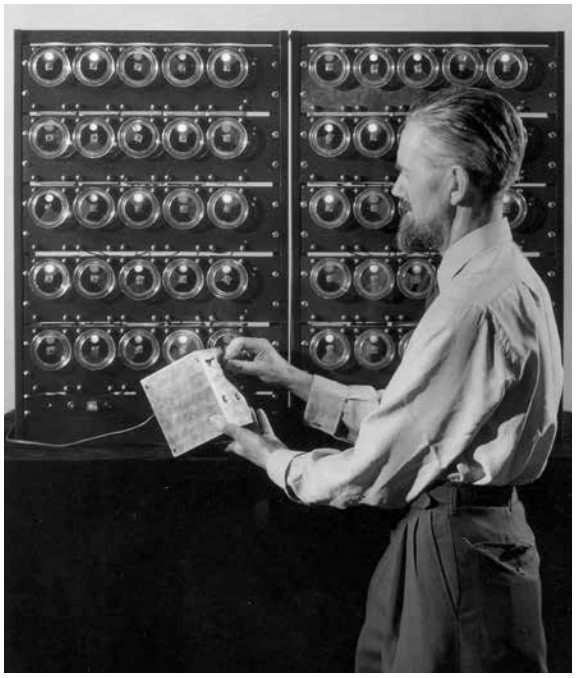
> *A self-organizing aircraft will change its form like a bird, to suit the air conditions. The strength of a self-organizing motor vehicle will not lie in rigid members but in relations between fairly delicate parts kept fixed by dynamic control systems* [...]. *Or, consider a pipeline and pumping station, which is a typical but lamentably inflexible way of moving fluid over long distances. A self-organizing equivalent might be modeled upon the heart and arteries of a mammal.*[55]

The examples chosen by Pask make clear that the cyberneticist was not interested in freeing man from automatisms, but rather was interested in some kind of mirroring and affirmation of man's freedom within the surrounding 'machine park'. Put differently, Pask thought the freedom, which in 1962 allowed him to conceive of a technological future of self-organisation, to be a basic constant that had to be preserved for all futures of the technological. Since, following Pask, the unique characteristic of man is accounted for by his ability to shape his own environment, this environment must be 'a man-made organisation imposed upon the world by the activity of his own species and because this is so, because man has insulated himself from the vagaries of nature, he can evolve far more rapidly than the beasts'.[56] The attempt to preserve this scope of creativity and to represent man as a creative and active being on the basis of his own technological work could possibly be identified as the epistemological backbone of cybernetics. Around 1960, cyberneticists did not so much support conceptualising the difference between man and machine as suggested by the cybernation-debate a few years later, but rather the will to recognise commonalities and to create similarities between man and machine.

Second intervention: emergence instead of repetition

In his prediction for 1984, Gordon Pask was writing in response to his impressions of current developments in American Cybernetics. He became familiar with this *milieu* as a visiting professor to Heinz von Foerster's newly-established Biological Computer Laboratory (BCL), from 1959 to 1960.[57] With his new laboratory at the University of Illinois in Urbana-Champaign, Foerster pursued the idea of extending the program of cybernetic research and, with his colleagues, constructing machines that were similar to living systems in their central characteristic of being 'self-organizing systems'.[58] Consequently, the cybernetic research practice of the early 1960s was not about the reliable delegation of redundancies and routines to slave-like appliances. Rather, it was concerned with the production of emergences and unpredictabilities with the help of a type of machines that can be denoted as 'lively artifacts'.[59] A brief look at two of the representatives of this 'New Vivacity' provides a good example of why these machines were utterly incompatible with the conceptions of cybernation.

The first machine is an inconspicuous apparatus, which another colleague of the BCL used periodically in demonstrations for the freshmen in his introductory lecture to cybernetics during the mid-1960s. The small square appliance, which neuro-



2 Ross Ashby at the Biological Computer Laboratory, holding his 'Ashby Box' and standing in front of his 'Grandfather's Clock'.

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psychiatrist Ross Ashby constructed especially for the purpose of this didactic presentation, had two switches with two states respectively (On/Off), and two lamps with two states as well. (Accordingly, there were a total of sixteen different combination possibilities of how the switches and lamps could behave in relation to each other.) Ashby assigned his students the task of analysing and documenting the transfer function of the machine, asking questions such as, what is the relationship between inputs and outputs of the machine? How must one operate the switches for the left lamp, the right lamp, or both lamps to be on? The punch line was simply that the task was basically insoluble: following every switching operation, the Ashby Box changed its inner status depending upon its own past behaviour. As a consequence, the box was always completely determined, but factually not analysable, unless one could open the machine and study its inner construction.[60] From the perspective of the freshman student, the machine resisted an intuitive operation; it reacted unpredictably and surprisingly. However, it was precisely this characteristic of his prototypical 'black box', that was thought to illustrate the fundamental unfathomability of self-organising processes in nature and technology.[61]

That such enigmatic machines would not only fascinate inexperienced students, but also their own maker can be demonstrated by another machine, on which Ashby spent much additional time. The so-called 'Grandfather Clock' was comprised of two insert casings, each with five rows of five lamps. Small round, translucent panes with four sectors, each a different colour, were in front of every lamp. Every pane was equipped with a small servomotor and was able to rotate ninety degrees, so that the lamp below would light up in one of the four colours. Just as with the Ashby Box, the behaviour of the rotatable panes was dependent upon the other panes and their past operations. Foerster recounts that Ashby could spend hours in front of his machine, observing how it produced ever new colour patterns. He himself labelled the self-organising grandfather clock his personal 'inspirational device', because, despite its simple construction plan, the machine displayed complicated and unpredictable behaviour, which fascinated even its own maker.[62]

Looking beyond Ashby's machines, the following objection may be raised at the address of Cybernation-authors: the central ambition of contemporary cybernetic practice was the construction of machine-models that would behave unpredictably and surprisingly based on the recursive ties of their behaviour with their history – precisely the kind of characteristic one would not expect from industrial robots. Accordingly, these lively artifacts in no way guarantee the silent takeover of inconvenient tasks, nor do they aim – as is otherwise generally assumed regarding media – to conceal their own medial function.[63] As representative of an anthropology of 'reflexivity' that understands recursive automatisms as an essential factor of self-constitution, these machines are supposed to meet man at eye level and remind him of his existence as a free individual.[64]

Third intervention: free man and free machines

In 1970, when the BCL was barely able to stay financially afloat and the temporary end of institutionalised cybernetic practice was imminent, Foerster again formulated the cybernetic anthropology that was practised in his own laboratory.[65] His later influential theory of 'non-trivial machines' initially repeated the cybernetic critique of the behaviourist conception of the human being.[66] A machine behaves non-trivially, according to Foerster, if its output is determined by the input, as well as by its inner status. This most recent inner status is in turn dependent upon the preceding operations of the machine and not immediately accessible to the current user of the machine. That is to say: non-trivial machines have a history, or, more precisely, their most recent inner status is an expression of their history. Such a history co-determines their kind of reaction to a specific input. For the outside observer, this inner status remains concealed and the observer has no knowledge of the rules according to which the machine will change it – and with it, its future output-behaviour – as a result of a specific input. From his point of view, the behaviour of the machine is, as impressively demonstrated by Ashby's small appliance, not predictable or analysable.

However, Foerster's important amendment was that a non-trivial machine can be reduced to a trivial one, 'if it [becomes] insensitive to changes of internal states, or if the internal states do not change'.[67] Accordingly, if the inner status of a machine is 'neutralised' or ascertained, a machine can be described as a definite function which assigns a specific input a specific original state. Foerster calls such a reduction from unpredictable to predictable behaviour a process of 'trivialization'.[68]

Based on their nature, living systems such as animals or human beings are, according to Foerster, fundamentally non-trivial machines, and his accusation addressed at the neobehaviourists surrounding B. F. Skinner is that they subject non-trivial systems to trivial environments in their experimental arrangements. Rats that are faced with a sub-complex environment of reaction-levers and food-dispensers (a so-called Skinner box), would be turned 'from a "probabilistic (nontrivial) machine" to a "deterministic (trivial) machine"', and only as such are they objects of the behavioral sciences.[69]

At the same time, Foerster's critique of the behaviourist method fulfils one primary purpose. He points towards the greater context of a societal trivialisation of man within the framework of a general critique of modernity: similar to the behaviourist, according to Foerster, modern man has the tendency to turn all non-trivial machines he encounters into trivial ones.[70] What may be quite desirable in the realm of some machines that we use in our everyday lives becomes certainly 'useless and destructive', if we apply it to ourselves.[71] It was along those lines that Foerster criticised the American educational system of the 1960s, and repeatedly called schools 'institutions of trivialization' in which children and students are

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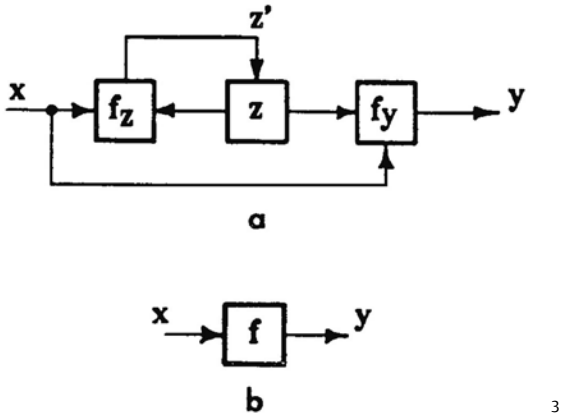

3

3 Comparison of a non-trivial and a trivial machine, draft by Heinz von Foerster, 1970. From: Heinz von Foerster, 'Molecular Ethology: An Immodest Proposal for Semantic Clarification' in G. Ungar (ed.), *Molecular Mechanisms in Memory and Learning* (p.220).

turned into trivial machines by 'trivializers' just like cars by car mechanics.[72]

Foerster's differentiation lends itself as an alternative to the Cybernation-scenario: instead of dedicating oneself primarily to the actions and modes of man and his behavior – these can be trivialised and outsourced – man should recognise himself and take himself seriously as an autonomous and non-trivial being. Similar to Pask, Foerster demands a technological environment that does not threaten the non-trivial being of man, but instead endorses and supports it by way of analogous forms: 'If we don't act ourselves', said Foerster in 1972, 'we shall be acted upon'.[73] And similar to Ashby, Foerster does not contemplate the externalisable proficiencies of man, but rather considers his inner self-technologies:

> *Instead of searching for mechanisms in the environment that turn organisms into trivial machines, we have to find the mechanisms within the organisms that enable them to turn their environment into a trivial machine.*[74]

Taken together, both arguments result in the elimination of the difference between man and machine. Here, a new demarcation line will be drawn between unfree man and machines on the one side, and free man and free machines on the other.[75]

Prospect

At first glance, it might be bewildering that the positions gathered under the term Cybernation appeal to the achievements and products of contemporary cybernetics without considering some of its central motives. The 'witless slaves', to whom one would love to relinquish all simple and thus inconvenient tasks, are here taken to be the product of a science that is much fascinated by 'lively artifacts'. However that may be, at the basis of bio-cybernetic research, one was obviously much less interested in the construction of 'dumb servants' than focused on the technical simulation of 'self-organization', that 'fundamental principle', by which cyberneticists of the 1960s such as Foerster assumed almost all exclusive phenomena of the living (and with it, the human). Accordingly, many of the prototypes constructed in the name of cybernetics were those 'meaningful' machines, which extra-scientific apologists of a 'Cybernation' (such as Bagrit) wrote off as utter nonsense.[76]

However, one possible solution to this creative misreading of cybernetics could simply be the assumption that it does not make any difference whatsoever for utopian dreams of Cybernation whether man takes his mechanical future associates as witless and soulless appliances, or if he recognises his own biological form of organisation within them. In light of the economical and societal consequences that inevitably have to be drawn in the context of new technologies, the confirming humanist endeavours as well as the resistant tendencies of actual cybernetics seem to fade away. Be it the end of the struggle for survival, or the formation of a new humankind; be it the end of an economy of scarcity and the beginning of an economy of abundance, or the foundation of an aesthetic world state. As soon as it appeared to be possible (at least theoretically) to organise the entire production of goods in the form of a self-operating, cybernetic machine park, a kind of reduced pressure on the human emerges that cannot be compensated for with an anthropology of work requiring a new 'conception of the human'.[77] That which was initially called a 'phantasmatic surplus' of new technologies would then have to be taken seriously, because it would open up an extensive discussion circling around the centre of a paradoxical relationship between modern technology and declining humanism.

Nevertheless, one consequence of the differences between cybernetics and the cybernation-debate should be to look closer in the future and to avoid premature simplifications, as well as the instrumentalisation of cybernetics for epistemic breaches and historic radical change. More recent works regarding the Northern-American history of cybernetics have shown that it is not at all a uniformly contentious or goal-oriented movement. In view of this fact, the debate discussed here would be an additional indication that cybernetic research and the attendant public discourse are characterised by deep internal paradoxes, contradictions, and ambivalences. Accordingly, cybernetic research in the 1960s was a thoroughly heterogonous and fragmentary academic creation that consolidated different ways of thinking as well as different research approaches. This research likewise had to reinvent itself repeatedly, and question its identity as (non-)discipline because of it.[78] The challenge for the history of science would then be to develop a comparative perspective within the history of cybernetics. Such an approach has gained significant fascination precisely from a specific deconstruction of the man-machine-relations. In addition to Cybernation, which in this regard falls back on a clear distinction by suggesting understanding technology as variable and 'the human being' as being, it would be important to highlight other axes within cybernetics that also and especially think of man as susceptible to change.

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Notes

A first version of this article appeared in German in Bublitz, Kaldrack, Röhle, Zeman, eds, *Automatismen – Selbst-Technologien*, pp. 45–69.

1. See Claus Pias, ed., *Cybernetics – Kybernetik: The Macy-Conferences 1946–1953, Volume / Band 2: Documents / Dokumente* (Zurich/Berlin: Diaphenes, 2004).
2. See Jan Müggenburg, 'Bats in the Belfry: On the Relationship of Cybernetics and German Media Theory', *Canadian Journal of Communication*, 42:3 (2017): 468-484.
3. See Georg Vrachliotis, *Geregelte Verhältnisse: Architektur und technisches Denken in der Epoche der Kybernetik* (Vienna/New York: Springer, 2011).
4. See Claus Pias, 'Jenseits des Werkzeugs: Kybernetische Optionen der Architektur zwischen Informationsästhetik und "design amplifier"', in *Kulturtechnik Entwerfen: Praktiken, Konzepte und Medien in Architektur und Design Science*, ed. by Susanne Hauser and Daniel Gethmann (Bielefeld: Transcript Verlag, 2009), pp. 269–86.
5. Wolfgang Welsch, 'Die Postmoderne in Kunst und Philosophie und ihr Verhältnis zum technologischen Zeitalter', in *Technologisches Zeitalter oder Postmoderne*, ed. by Walter Christoph Zimmerli (Munich: Fink, 1988), p. 49, translation by Clemens Ackermann.
6. Heinz von Foerster, *The Beginning of Heaven and Earth Has No Name: Seven Days with Second Order Cybernetics*, ed. by Albert Mueller and Karl H. Mueller (New York: Fordham University Press, 2014), pp. 22–3.
7. Heinz von Foerster, 'Molecular Ethology: An Immodest Proposal for Semantic Clarification', in *Molecular Mechanisms in Memory and Learning*, ed. by G. Ungar (New York: Plenum Press, 1970), pp. 213–48 (p. 220).
8. Ibid.
9. On the front pages of Google, only the entry from Merriam-Webster can be found. Erkki Huhtamos's media-archeological consideration has not yet reached media studies ('From Cybernation to Interaction: A Contribution to an Archeology of Interactivity', in *The Digital Dialectic: New Essays on New Media*, ed. by Peter Lunenfeld (Cambridge, MA: MIT Press, 1998), pp. 96–110.
10. Jeremy Rifkin, *The End of Work: The Decline of the Global Labor Force and the Dawn of the Post-Market-Era* (New York: Tarcher/Putnam, 1995).
11. Inge Baxmann, ed., *Arbeit und Rhythmus: Lebensformen im Wandel, Alltagswissen* (Munich: Fink, 2009).
12. Gregory R. Woirol compares the 1930s and the 1960s – not least regarding the technocratic movement – in his book *The Technological Unemployment and Structural Unemployment Debates* (Westport: Praeger, 1996).
13. E.g. Dennis Gabor, 'Technology, Life and Leisure', *Nature*, 200 (1963), 513–18; Herbert A. Simon, *The Shape of Automation for Men and Management* (New York: Harper & Row, 1965); Frederick Pollock, *Automation: A Study of Its Economic and Social Consequences* (New York: Praeger, 1957); Morris Philipson, *Automation: Implications for the Future* (New York: Vintage Books, 1962); A. J. Hayes, 'Automation: A Real "H" Bomb', in *Jobs, Men, and Machines: Problems of Automation*, ed. by Charles Markham (New York: Praeger, 1964), pp. 48–57; Paul Einzig, *The Economic Consequences of Automation* (London: Norton, 1957); Peter Drucker, 'The Promise of Automation', *Harper's Magazine* (April 1955), n.p.; R. H. Macmillan, *Automation: Friend or Foe?* (Cambridge, MA: Cambridge University Press, 1956); Alice Mary Hilton, *The Evolving Society: Proceedings of the First Annual Conference on the Cybercultural Revolution – Cybernetics and Automation* (New York: Institute for Cybercultural Research, 1966); Robert Theobald, 'Cybernation, Unemployment, and Freedom', *The Great Ideas Today* (1964), pp. 48–69. Henry Withorp, 'The Sociological and Ideological Assumptions Underlying Cybernation', *American Journal of Economics and Sociology*, 25:2 (1966), 113–26; Norbert Wiener, 'Some Moral and Technical Consequences of Automation: An American View', *The Journal of Industrial Economics* 6:3 (1958), 241–61; Robert A. Solo, 'Automation: Technique, Mystique, Critique', *The Journal of Business*, 36:2 (1963), 166–78; e.g. Atcheson L. Hench reflected on the conceptual history win his article '"Automation" Today and in 1662', *American Speech*, 32:2 (1957), 149–51.
14. Charles R. Dechert, ed., *The Social Impact of Cybernetics* (New York: University of Notre Dame Press, 1967); John Diebold, *Beyond Automation* (New York: Praeger, 1964).
15. Cf. Donald M. Michael, *Cybernation: The Silent Conquest* (Santa Barbara: Center for the Study of Democratic Institutions, 1962).
16. *Computers and Automation (1950–1972)*, ed. by Edmund C. Berkeley.
17. Norbert Wiener, *The Human Use of Human Beings* (Cybernetics and Society) (Boston, Houghton Mifflin 1950), p. 161. Cf. also Wiener's cautionary letter regarding the consequences of a 'factory without employees' to Walter Reuther, president of the automotive union, <http://libcom.org/history/father-cybernetics-norbert-wieners-letter-uaw-president-walter-reuther> [accessed 6 January 2016].
18. Ibid., p. 117. Cf. regarding the sustainability of this notion, Jeremy Rifkin, 'Langfristig wird die Arbeit verschwinden', *Süddeutsche Zeitung* (29 April 2005).
19. Henry Winthorp, 'The Sociological and Ideological Assumptions Underlying Cybernation', *American Journal of Economics and Sociology*, 25:2 (April 1966), p. 114.
20. Leon Bagrit, *The Age of Automation: The BBC Reith Lectures 1964* (London: Mentor Book, 1965).
21. Ibid., p. 11.
22. Ibid., p. 13.
23. Oskar Negt and Alexander Kluge, *Der unterschätzte Mensch: Geschichte und Eigensinn* (Frankfurt: am Main, 1993), p. 229; Bagrit, *The Age of Automation*, p. 16.
24. Ibid., p. 22.
25. Quoted in Mihiai Nadin, 'Zeitlichkeit und Zukünftigkeit von Programmen', in *Zukünfte des Computers*, ed. by Claus Pias (Zurich; Berlin: Diaphanes, 2004), p. 43.
26. Cf. a contemporary account by Henry Elsner Jr, *The Technocrats: Prophets of Automation* (New York: Syracuse UP, 1997). Some cyberneticists (such as Stafford Beer) see themselves as – as far as they refer to it at all – the conquerors of a technocracy gone stale.
27. Bagrit, *The Age of Automation*, p. 25.
28. Erich Hörl, 'Parmenideische Variationen: McCulloch, Heidegger und das kybernetische Ende der Philosophie', in *Cybernetics – Kybernetik. Die Macy-Konferenzen 1946–1953*, ed. by Pias.
29. Bagrit, *The Age of Automation*, ch. 6.
30. Marshall McLuhan, 'Cybernation and Culture', in *The Social Impact of Cybernetics*, ed. by Charles R.

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Dechert (Notre Dame: Clarion, 1966 [orig. pub. 1964]).
31. Marshall McLuhan, *Understanding Media* (New York: Signet, 1964), chs 1, 33 (pp. 382, 9 f., and 395).
32. Ibid., p. 387.
33. Ibid.
34. Ibid., p. 117 ('The hilarity, however, will die down as the Executive Suites are taken over by the Ph.D.s.')
35. Eden Medina, *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile* (Cambridge, MA: MIT University Press, 2011); Claus Pias, 'Der Auftrag. Kybernetik und Revolution in Chile', in *Politiken der Medien*, ed. by Daniel Gethmann and Markus Stauff (Zurich/Berlin: Diaphenes, 2004); Sebastian Vehlken, 'Environment for Decision: Die Medialität einer Kybernetischen Staatsregierung: Das Project Cybersyn in Chile 1971–73' (Master's thesis, Bochum, 2004).
36. Joseph C. R. Licklider, 'Man – Computer Symbiosis', *IRE Transactions on Human Factors in Electronics, HFE-1* (1960), pp. 4–11, quoted in <http://groups.csnail.mit.edu/mdeg/people/psz/Licklider.html> [accessed 6 January 2016].
37. Ibid.
38. Ad Hoc Committee, *The Triple Revolution*, p. 5. The text was published numerous times. In the following, we are quoting the typescript. Cf. also Robert Perruci and Marc Pilisuk, *The Triple Revolution: Social Problems in Depth* (Boston: Little Brown & Co., 1968).
39. Ad Hoc Committee, *The Triple Revolution*, p. 6.
40. Ibid., p. 9.
41. Ibid., pp. 10, 13.
42. Ibid., p. 11.
43. Cf. Ulrich Böckling and Eva Horn, eds, *Anthropologie der Arbeit* (Tübingen: Springer, 2002).
44. Karl Marx and Frederick Engels, *The German Ideology – Part One*, ed. by C. J. Arthur (New York: International Publishers, 1970), p. 53.
45. Cf. Uri Zilbersheid, *Die Marxsche Idee der Aufhebung der Arbeit und ihre Rezeption bei Fromm und Marcuse* (Frankfurt am Main: Peter Lang, 1986); Guy Debord's 'Ne travaillez jamains' could possibly be re-read differently in this context.
46. At any rate, we would like to thank Philip Sarasin for this indication.
47. Even works such as Leo Marx's classic *The Machine in the Garden* (also published in 1964) are legible in code as a reaction to the utopian dreams of Cybernation; probably just because he is not writing much about concrete technologies (cf. also Jeffrey L. Meikle, 'Leo Marx's The Machine in the Garden', *Technology and Culture*, 44:1 (2003), 147–59.
48. Gordon Pask, 'My Prediction for 1984', in *PROSPECT: The Schweppes Book of the New Generation*, ed. by Schweppes (Home) LTD and Hutchinson (London: Hutchinson, 1962), pp. 207–20. Regarding Gordon Pask, Ross Ashby, and the particularities of 'British cybernetic', cf. Andrew Pickering, *The Cybernetic Brain* (Chicago: University of Chicago Press, 2010), pp. 91–170 and pp. 309–77.
49. Ibid., p. 207.
50. Ibid.
51. Ibid.
52. Ibid., p. 218.
53. Ibid., p. 208.
54. Ibid., p. 210.
55. Ibid.
56. Ibid., p. 208.
57. Heinz von Foerster and Monika Bröcker, *Part of the World: Fractals of Ethics – A Drama in Three Acts* (Urbana-Champaign: Broecker, 2010), pp. 214–16.
58. Regarding the history of the BCL, cf.: Albert Mueller, 'A Brief History of the BCL: Heinz von Foerster and the Biological Computer Laboratory', in *An Unfinished Revolution? Heinz von Foerster and the Biological Computer Laboratory BCL 1958–1976*, ed. by Albert Mueller and Karl Mueller (Wien: Echoraum 2007), pp. 279–302; Jan Müggenburg, 'Biological Computer Laboratory: Zur Organisation und Selbstorganisation eines Labors', in *Jenseits des Labors*, ed. by Florian Hoof, Eva-Maria Jung, Ulrich Salaschek (Bielefeld: Transcript, 2011), pp. 23–44.
59. Based on Warren McCulloch, the term 'lively artifacts' aims at the double characteristic of cybernetic and bionic machines. As mimetic objects, they are on the one hand products of a cultural technique of mimesis, while they are characterised by their aesthetic and epistemic dynamic and are actively involved with generating a discourse as 'visual arguments' on the other. Cf. W. S. Mc Culloch, 'Living Models for Lively Artifacts', in *Science in the Sixties: The Tenth Anniversary AFOSR Scientific Seminar*, ed. by David L. Arm (Albuquerque: PN, 1965), pp. 73–83. Regarding the concept of 'lively artifacts' also see: Jan Müggenburg, 'Lively Artifacts', *Feedback: Weblog Publication of the Critical Theory Community* (Open Humanities Press 2013), <http://openhumanitiespress.org/feedback/science-technology/lively-artifacts> [accessed 6 January 2016].
60. If one believes Foerster's recollections, the machine was capable of changing into 2,156 inner states. Foerster in an interview with Paul Schroeder: 'Two steps, two lamps, two switches. You can't crack the code of that machine. Not to understand that. There are still people who do "psychoanalysis", yes? I maintain the psyche is more than two states input and two states output, so forget it.' Unpublished interview by Paul Schroeder and Frank Galuszka with Heinz von Foerster, 1997.
61. Cf. Philipp von Hilgers, 'Ursprünge der Black Box', in *Rekursionen: Von Faltungen des Wissens*, ed. by Philipp von Hilgers and Ana Ofak (Munich: Fink, 2010), pp. 135–53.
62. Ibid. For Ashby's term 'self-organization', cf. Ross Ahsby, 'Principles of Self-Organizing Systems', in *Cybernetics of Cybernetics*, ed. by Heinz von Foerster (Urbana: Future Systems Inc, 1995 [orig. pub. 1974]), pp. 232–44. Regarding the relationship of 'malfunction' and 'inspiration', cf. Peter Matussek, '"Stolpern fördert": Störfälle als Inspirationsquelle', *ZfK – Zeitschrift für Kulturwissenschaften*, 2 (2011), 63–72.
63. 'Media render [something] readable, audible, visible, perceivable, but with the tendency to erase themselves and their own constitutive involvement in sensousness and to become imperceptible, anesthetic.' Claus Pias et al., eds, *Kursbuch Medienkultur: die maßgeblichen Theorien von Brecht bis Baudrillard* (Stuttgart: DVA, 2000), p. 10, translation by J. M.
64. Stefan Rieger, *Kybernetische Anthropologie: eine Geschichte der Virtualität* (Frankfurt am Main: Suhrkamp, 2003), p. 17.
65. Albert Müller, 'The End of the Biological Computer Laboratory', in *An Unfinished Revolution?*, ed. by Albert Müller and Karl Müller (Wien: Echoraum, 2007), pp. 303–21.

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66. Cf. Von Foerster, 'Molecular Ethology'.
67. Ibid., p. 220.
68. Cf. Heinz von Foerster, 'Perception of the Future and the Future of Perception', *Instructional Science*, 1:1 (1972), 31–43 (p. 40).
69. Von Foerster, 'Molecular-Ethology', p. 230.
70. Von Foerster, 'Perception of the Future', p. 40.
71. 'A toaster should toast, a washing machine wash, a motorcar should predictably respond to its driver operations [...] Granted, that in some instances we may be not completely successful in producing ideally trivial machines. For example, one morning turning the starter key to our car, the beast does not start [...] Apparently it [...] revealed for a moment its true nature of being a non-trivial machine.' Ibid., p. 41. The cybernetic inheritance of newer black box concepts – e.g. with Bruno Latour and the 'Actor-Network Theory' – becomes especially clear with this quote.
72. E.g. Heinz von Foerster, 'Wissenschaft des Unwissbaren', in Heinz von Foerster, *Short Cuts*, ed. by Peter Gente, Heidi Paris and Martin Weinmann (Frankfurt am Main: Suhrkamp, 2001), pp. 139–81 (p. 166).
73. Von Foerster, 'Perception of the Future', p. 31.
74. Von Foerster, 'Molecular-Ethology', p. 234.
75. In *How We Became Posthuman*, N. Katherine Hayles worked out a constant issue within the 'first and second wave of cybernetic research' to which this shift of boundaries responds. According to Hayles, cyberneticists from Norbert Wiener to Humberto Maturana are in a perpetual dilemma: on the one hand, the insight grew ever stronger that man is only conceivable as one part of a highly complex network of technical and natural interactions and that his boundaries became more and more blurry. On the other hand, they vehemently tried to preserve man's status as autonomous subject in their theories and consequently to continue the liberal-humanist legacy to which they still felt committed. N. Kathrine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999), pp. 84–112 and pp. 131–59.
76. German original: 'sinn-voll'.
77. Walter Seitter, *Menschenfassungen: Studien zur Erkenntnispolitikwissenschaft* (München: Boer, 1985).
78. Ronald Kline, *The Cybernetics Moment* (Baltimore: John Hopkins, 2015).

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https://doi.org/10.1017/S1359135517000197 Published online by Cambridge University Press