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Abstract

This article examines a collection of "cybertrance" devices, originating in the 1960s and 1970s. These devices are based on the reappropriation of instruments from the academic world in order to place users in modified states of consciousness. They draw on the heritage of American cybernetics, and its mechanical philosophy, in order to explore what is machinelike in man. Their goal is to create unprecedented forms of experience by coupling body and machine, disturbing one by the other. The analysis focuses on the trajectories of objects, the circulation between theoretical elements from cybernetics and their technological reinterpretation in countercultural circles. Four ranges of devices are examined: the immersive multimedia installations of psychedelic culture, the flicker and its physiological effects, biofeedback devices, and the digital translations, in the world of computing, of these first analogical devices.

This article examines a collection of singular artifacts, originating in the 1960s and 1970s, which I call “cybertrance” devices. These devices are based on the reappropriation of instruments from the academic world in order to place users in modified states of consciousness, far from the ordinary mode of wakefulness. All of these inventions draw on the heritage of American cybernetics, and re-articulate the man-machine concept central to it: passing from neo-mechanistic theory to experimentations with coupling and prostheses, and from rational analysis to countercultural mysticism.

If these cybertrance devices literally dismantle the man-machine, using technology to disorder the senses, in no way do they seek to abolish what may be machine-like in people so as to restore a hypothetical primacy of nature. These devices use a certain idea of the man-machine, originating in cybernetics, as a resource for imagining how to gain access to unexplored potentialities of bodies, andnew means of perception to be created by coupling people and technologies. If the man-machine

has been dismantled, it is through the exploration of what is machine-like in people. We do not know everything that this body-machine can do, particularly when it is subjected to the effects of the stroboscope and the flicker, or to biofeedback loops.

This reappropriation of the cybernetic man-machine occurs in a gray zone of exchange between the university and countercultural practices. With our artifacts, the rational and tragic humanism of Wiener (Heims, 1980) has been replaced by technologies of the self, which entail “mystical” or religious dimensions, and invite us to break with ordinary states of consciousness. The existence of such a technological ensemble leads us to raise questions about the influence and the modes of dissemination of cybernetics beyond the boundaries of the techno-scientific field. My analysis focuses on the trajectories of objects, the circulation between theoretical elements and their technological reinterpretation. If cybernetics was able to serve as the resource discipline for these cybertrance experimentations, this is partially due to the original position on mechanism developed by cyberneticians. The contribution of cybernetics was not as much the reduction of living organisms to the machine, based on the pathways of classical mechanism, as the recognition of the complexity of the mechanics of living organisms, and of the heterogeneity of the functioning of people and machines. The logic of coupling and symbiosis is grounded in the observation of this heterogeneity, and its goal is to create unprecedented forms of experience by combining two machines and disturbing one by the other.

I will first define the contours of this technological ensemble of cybertrance devices, before analyzing the challenges that derive from the existence of such an ensemble for the historiography of the cybernetic movement and the interpretation of mechanism as it was understood by cyberneticians. Four ranges of devices will then be examined in detail: the immersive multimedia installations of psychedelic culture, the flicker and how its physiological effects are exploited, biofeedback devices, and the digital translations, in the world of computing, of these first analogical cybertrance devices. For each of these ensembles, I will examine the trajectories of their invention, while focusing on the nature of what can be transmitted from cybernetics to the object.

Delimiting the Domain of Cybertrance Devices

Three criteria can be applied to demarcate this post-cybernetic technological ensemble, which I designate as “cybertrances devices.” First, these artifacts can be characterized by their purpose,

which consists in deliberately placing the subject in states that disrupt ordinary wakefulness. Second, the devices can be distinguished by their singular socio-technological trajectories: these are devices that circulate between the military-academic complex and countercultural movements (Triclot, 2016).

Such a movement of reappropriation may seem counter-intuitive, because it is so common to associate counterculture with a technophobic position, or, at the very least, one of hostility toward the military-academic complex. Theodore Roszak's key work, *The Making of a Counter Culture*, which in 1969 propelled the very term of counterculture into the public debate, supported this interpretive framework, as its subtitle demonstrates: "Reflections on the Technocratic Society and Its Youthful Opposition." However, as the more recent studies of Markoff (2005), Turner (2006, 2013), and Pickering (2011) have shown, there were particularly active zones of exchange between the countercultural movements and the techno-scientific production of the 1960s and 1970s. Turner (2006) has shown in particular the importance of a figure, such as Stewart Brand, who established links between the university, art worlds, the commune movement, and psychedelia, while recruiting humans and non-humans in his undertaking, in the same way as a "Latourian entrepreneur."

The *Whole Earth Catalog* (1968-1972) is incontestably the collective work that best symbolizes this heterogeneous network, against the backdrop of which occurs the movement through which the artifacts I would like to analyze were transferred. Edited by Brand, the *Whole Earth Catalog* reviews the hand tools and intellectual tools intended for self-sufficient communes, which are one of the emblems of the countercultural movement. Side by side in the *Whole Earth Catalog* are notes focusing on authors such as Wiener, Ashby, Simon, Bertalanffy, and Buckminster Fuller, product reviews for adz and other farm implements, and even instructions for building your own geodesic dome. The cybernetic frame of reference played a decisive role in this zone of exchange. The very layout of the *Whole Earth Catalog* was inspired by cybernetic categories, with sections like "whole systems" and "communications" (Brand, 1971). Nevertheless, while the *Whole Earth Catalog* opens with direct references to cybernetic theories, it closes with sections such as "psychedelics," "altered states," and "mysticism," which present several cybertrance devices. This trajectory is characteristic of the reinterpretation of one part of cybernetics by this sector of the countercultural movement.

The exemplary trajectory of the *Whole Earth Catalog* leads us to the third and final characteristic of these cybertrance artifacts: they are regularly associated with religious and mystical experiences in the framework of psychedelic practices. Turner (2013) situates the mark of the reappropriation of

the progressism of the 1950s by the generation of the 1960s in this passage from a rationalist reflection on the construction of the democratic personality toward experiences of self-transformation. “Psychedelic media environments sought to break through the rational shell of the individual mind and help audience members travel down through the layers of their psyche into regions of which they had formerly been unconscious. […] Psychedelic art transposed the universal humanism of the Cold War into raw mysticism” (Turner, 2013: 284).
That such an alliance between technology and mysticism should become established in the wake of cybernetics should in no way be a surprise, however, given the extent to which modern technologies have given rise to religious interpretations from the Saint-Simonians to contemporary transhumanism (Picon, 2002; Lagrée, 2009). Likewise, the phenomenon of “New Age spirituality” is well documented in Californian high-tech communities in the early 1980s (Zandergen, 2012). The particularity of the technologies and practices I am presenting is that they are historically situated before this movement, in the 1960s and 1970s, at a moment of transition, when the reference to cybernetics was still particularly pertinent.

It is again Brand (1974) who expresses with the most precision, in his preface to a long interview with Gregory Bateson, the attraction that cybernetics exerted upon his generation and the new alliances cybernetics could establish: “I came into cybernetics from preoccupation with biology, world-saving, and mysticism. What I found missing was any clear conceptual bonding of cybernetic whole-systems thinking with religious whole-systems thinking. Three years of scanning innumerable books for the Whole Earth Catalog didn't turn it up. […] All I did was to increase my conviction that systemic intellectual clarity and moral clarity must reconvene, mingle some notion of what the hell consciousness is and is for, and evoke a shareable self-enhancing ethic of what is sacred, what is right for life” (Brand, 1974: 9).

This technological ensemble of “cybertrance devices” is based on a shared movement, which consists of a return toward the self, toward the bodies of subjects, of technologies created for other purposes. From this point of view, they fall within the scope of what Foucault (1982) calls “technologies of the self,” which he distinguishes from the technologies of production, technologies of systems of signs, and technologies of power. For some, they concern individual practices, for others rituals or community practices. As is true of Foucault’s technologies of the self, they are closely related to the fields of religion and philosophy. Yet they can be distinguished from the conventional techniques of the self (soul-searching, asceticism, penitence, confession) studied by Foucault in a completely different historical environment, in terms of their relationship to truth. In

“cybertrance devices,” it is no longer as much a question of constituting the truth of a subject through practices of verbalization or inscription, as in gaining access to other states of the self, which may be postulated as more authentic. The conjoined requirements expressed in “know thyself” and “care for the self” are not abolished, but they are directed toward practices that bring about a break with the ordinary self. As is the case for Foucault, these are semiotic techniques that were first mobilized as instruments of knowledge, but have now become part of the heterogeneous regime of machines in the guise of the automatic arrangement of signs, computers, and cut-ups. It is less a matter of expressing the subject than of “unexpressing” it, through the privileges conferred upon states that are not easily put into words.

Cybernetics and its Men-Machines

The study of this interface-zone between the military-academic complex and counterculture, with cybernetics acting as a coyote, entails several challenges. The first is linked to the interpretation of the mechanistic position within cybernetics itself, which is re-enacted through these artifacts. The cybernetic vision of the man-machine introduces indeed remarkable variations compared to the position of traditional mechanism. This conception, which insists on the heterogeneous functioning of living organisms and machines, as well as on the potentialities that result from their coupling, inspires these new technologies of the self.

Cybernetics was initially presented as a renewal of the position of classical mechanism, which aims to explain the behavior of living organisms based on models borrowed from the world of machines. The very definition of cybernetics as the “science of control and communication in the animal and the machine,” to cite the subtitle of Wiener’s 1947 essay, confirms this orientation. The notions of control and communication, which are interdependent because information is the instrument with which the feedback that regulates behavior is transmitted, seem to provide new models for explaining sophisticated forms of behavior of living organisms. New capacities, such as finding one’s way and pursuing goals in a changing environment, can be accounted for in completely mechanistic terms by means of information and feedback.

According to the core principle of the position expressed in the 1943 article, “Behavior, Purpose, and Teleology,” co-authored by Wiener, the physiologist Arturo Rosenblueth, and the engineer Julian Bigelow, there is no perceptible break from the viewpoint of functional analysis between

living organisms and machines. “A uniform behavioristic analysis is applicable to both machines and living organisms, regardless of the complexity of the behavior. […] The methods of study for the two groups are at present similar. Whether they should always be the same may depend on whether or not there are one or more qualitatively distinct, unique characteristics present in one group and absent in the other. Such qualitative differences have not appeared so far” (Wiener, Rosenblueth, Bigelow, 1943: 22).

The article by Wiener, Rosenblueth, and Bigelow does not directly address the man-machine question. The models presented, such as the torpedo that adjusts automatically to its target, are a reference rather to the animal-machine tradition. However, the difference between people and animals only appears to be a difference of degree in their organization. The article is literally a reiteration of La Mettrie’s position: “Would organization thus suffice for everything? Once again, yes; since thought is obviously developed by human organs […]. Let us boldly conclude then that Man is a Machine and that there is only one substance in the universe in diverse forms” (La Mettrie, 1731: 54-79). The article written by McCulloch and Pitts at the same time (1943) provides the necessary complementary information, showing that in its neuronal networks the biological brain possesses the calculating capacity of a universal Turing machine.

There is no doubt that cybernetics can be considered to be a renewal of the mechanistic position. In the manner of Descartes in section 203 of *The Principles of Philosophy*, cyberneticians support that “all things that are artificial, are also natural.” Contrary to Descartes, who could only base his reduction of the cognitive functions on automata used for entertainment, such as the “artificial fountains” described in his *Treatise on Man*, cyberneticians had at their disposal the concept of a universal machine and concrete incarnations, such as the first digital calculators. The machine is used as a model for living organisms, based on a lack of distinction between the laws of nature and artifice. It allows us to see at a large scale—in our hands as Descartes writes--, what is happening at a small scale, in an organism.

However, one of the interests of the brand of mechanism developed by cybernetics is that its position changes over time. Likewise, by analyzing the discussions within the group of cyberneticians, we can see a movement away from this initial position, which reduces life to a machine, toward a second point of view according to which, due to the complexity of the modes of organization of living organisms, the relationship in the model linking living organisms and machines is reversed. One of the first documents bearing witness to this reversal is a letter from Von

Neumann to Wiener on November 29, 1946. Von Neumann describes the findings of Turing, McCulloch, and Pitts as “devastatingly general” (Von Neumann, 2005: 278), because we know in principle that the cerebral function can implement programs as a computer does, but we do not know anything about the way in which that actually occurs. Worse, the complexity of biological functioning is beyond our current means of logic. This argument leads Von Neumann to reverse the relationship in the model: “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” (*General and Logical Theory of Automata*, 1951: 311).

His 1956 *The Computer and the Brain* presents what seems to be the most fully developed version of the position that was being sketched out in 1949: the fundamental heterogeneity of the modes of functioning of the computer and the brain must be acknowledged. Nothing guarantees that the logical means being deployed to understand cognition, inspired by how computers function, enable us to gain access to the massive amounts of statistics and parallel calculations that characterize the human brain. Reversing the relationship in the model linking living organisms and machines, cybernetics can be linked with some of the critiques of mechanism. For instance, we can think of the critique of Cartesian mechanism by an author like Georges Canguilhem: “We have rarely attempted to understand the very construction of the machine by examining the structure and the functioning of the organism […]. The model of the living organism-machine is the living organism itself” (Canguilhem, 1967: 101-113). Canguilhem proposes, moreover, an alliance with the cyberneticians, and with what he calls “bionics, that is, the very clever art of information that undertakes the study of living nature” (127). Canguilhem’s position differs, however, from that of the cyberneticians, in so far as the latter do not abandon the principle of a mechanistic explication of the behavior of living organisms and people, but argue in favor of complexifying the models.

This position, which emphasizes the heterogeneous modes of functioning of humans and machines, is most likely one of the main legacies of cybernetics. It informs the alternatives to AI, such as J.C.R. Licklider’s “man-computer symbiosis” and Douglas Engelbart’s “augmented human intellect,” whose porosity with some of the countercultural values is manifest. Beyond this academic heritage, the symbiotic mechanism proposed by cyberneticians also appears to be an incitement to explore original zones of experience, through the coupling between this complex man-machine, with its unexplored potential,and new processes likely to profoundly modify its functioning. Our cybertrance objects thus function as disruptive prostheses, which use the machine

against itself and deliberately disturb the logic of homeostatic control.

Cybernetic Disseminations

The second challenge in analyzing this technological ensemble of cybertrance devices is linked to the historiography of the cybernetics movement, because an important paradox characterizes the history of cybernetics. On the one hand, cybernetics has indisputably enjoyed a very widespread success, in the scientific world as well as with the general public. Its terminology, including information and feedback, has spread to countless fields of knowledge, well beyond its initial focus in mathematics, theoretical physics, and engineering (Segal, 2003). It provided the theory behind the technological, computer, and telecommunications systems that make up the infrastructure of the contemporary world. Its legacy is therefore immense.
On the other hand, it is clear that the cybernetics movement, as embodied by its first American group, did not survive beyond the mid-1950s, and that it failed in particular to become part of the institution as a new academic discipline of its own, as it had originally hoped. This failure of the cybernetics group to become a science can be explained by reasons linked to the personal histories of its exponents (Conway and Siegelman, 2006), and the transformations that were affecting the politics of science in the United States at the dawn of the cold war due to the commitments it created (Heims, 1991). There was also a drop in the intellectual productivity of the original cybernetics paradigm, which was confronted in particular with the increasing power of the competing paradigm of artificial intelligence (Dupuy, 1994; Triclot, 2008). The latter would become nearly synonymous with the institutionalization of computing as the academic discipline of computer science, as it acquired its autonomy vis-à-vis electrical engineering (Boden, 2006). Histories of cybernetics, then, have regularly insisted on the rapid marginalization of the cybernetics paradigm in American universities.

Nonetheless, just as the central core of first-order cybernetics was melting down, its dissemination became exceptionally widespread in scientific and technological disciplines, as well as in popular culture. Its disintegration was perhaps favorable to its multiple appropriations, with the cybernetics signifier remaining available for all kinds of interpretations. Our cybertrance devices are part of this vast movement of uncontrolled dissemination of cybernetics, which occurred at highly diverse levels of intellectual and conceptual rigor. Andrew Pickering has coined the expression “nomad science” to describe this mode of being of cybernetic theorization (Pickering, 2010).

The precise heritage of cybernetics is therefore particularly difficult to assess, because of the extremely diverse ways in which it has been reappropriated, including sometimes the most complete misinterpretations of it. But misinterpretation remains a kind of statement and reference, which deserves to be analyzed in that capacity. The cybernetics label conveyed contradictory values and significations in the discursive space of the 1950s and 1960s. For example, in the French context, cybernetics as Couffignal defines it as the “art of rational organization,” that is, a kind of ancestor of operational research and management sciences–which would be very active in Francophone cybernetics societies–, does not have much in common with Lacan’s structuralist cybernetics, which are articulated around the idea of the code, gleaned from Shannon, via the mediation of the mathematician Guilbaud (Triclot, 2013; Le Roux, 2007).

If we take seriously the uncontrolled dissemination of cybernetics beyond the original circle of those who participated in the Macy Conferences, the whole issue is to determine what of cybernetics is transmitted. Cybernetic dissemination was not limited, indeed, to concepts like information and feedback. Artifacts charged with theory were also in circulation, as were pluridisciplinary styles of research, notably with interfaces between the social sciences and engineering sciences, or even what Pickering designates as the “ontological theater” of cybernetics, that is, a certain image of the brain as an operational organ rather than a medium of representation (Pickering, 2011). There was also literary dissemination, which is the subject of part of Paul Edwards’s 1996 study.

Our artifacts thus oblige us to fully embrace this question of “what of cybernetics is transmitted,” even in its most unexpected developments and ones the most contrary to its original spirit. While Claude Shannon (1956) attempted to erect a barrier between the solid scientific notions and what he called disparagingly the “cybernetic bandwagon,” (not without contributing to it himself), this boundary became increasingly difficult to establish, as soon as we moved away from the original cybernetics group. Among the various cybernetic disseminations, the historiographical hypothesis that something like a certain image of the cybernetics man-machine may have been circulating should be taken seriously.

Technological objects are produced in social and cultural contexts charged with values and desires (Cassou-Noguès, 2014: 21-23), which shape the trajectories of invention (Latour, 1992). For example, concerning the case of personal computing, Markoff (2005) has shed light on the influence of the context of Californian counterculture in strategic decisions. A comparison of the technological developments in computer science in the United States, France (Mounier-Kuhn, 2010), and the Soviet Union (Gerovitch, 2002), over the same period of time helps illuminate these

projections of the imagination, and the influence of social worlds in the trajectories of invention.

Immersive Environments

The first series of cybertrance artifacts is provided by what can be called immersive multimedia installations. These devices cover a very broad spectrum of objects and practices, which range from the world of art, like the psychedelic installations of LSD Art, which was showcased on the cover of *Life* in September 1966, all the way to the most popular spinoffs that include light shows at rock concerts.

In any case, it was always connected with light systems, which were often combined with sound installations, so that users would be immersed in a bath of sensations, most of the time non-figurative ones. The goal of these installations, as was regularly repeated, consisted in simulating the experience of psychedelic drugs by other means. “We try to vaporize the mind, says a psychedelic artist, by bombing the senses” (Joel, 1966: 61).

The parties organized by the Merry Pranksters, the group of the writer Ken Kesey, one of the main promoters of the dissemination of LSD on the West Coast, represents one of the most highly accomplished versions of these immersive systems. The Pranksters’s practices, as they have been documented by Tom Wolfe (1968), mobilized technological means that are above all related to the reappropriation of the technologies commercially available--albeit very expensive--at the time. For example, the Pranksters’s bus was equipped with an audio system that could record and directly manipulate sound, and could introduce effects of feedback, lag, and distortion. These techniques aimed to dissolve the initial signification of the soundtrack into a non-figurative experience. The visual techniques, whether for light shows or in the combined use of projectors and the stroboscope, aimed to achieve the same effects.

These techniques are particularly interesting, because they combine real-time forms of manipulation of image and sound, by means of analogical techniques, with the construction of immersive environments for users. In this way, they were very similar to the first contemporaneous virtual reality systems (Sutherland, 1965) and the first video games (Triclot, 2012). The architecture of these installations reinforced the immersive dimension, with projection systems on the ceiling for spectators lying on their backs.

Fred Turner positions these environments, which he calls “democratic surrounds,” in the continuity of the modernist museological innovations of the 1950s, best embodied in the exhibition “The

Family of Man" held at the MoMA in 1955. This exhibition was characterized by a non-hierarchical principle of hanging the photos throughout the exhibit space, which permits visitors to construct the meaning of what they perceive. According to one critic, this approach produces a sort of "interactive, three-dimensional film," in which the construction of meaning is obtained through a stroll in space (Turner, 2013: 107).

These "democratic surrounds" are the expression of a scientific and political project, which was moreover particularly common among the participants from the human sciences who attended the Macy Conferences, whose goal is to promote non-authoritarian and democratic individuals, capable of establishing by themselves the signification of the media contents they receive (Heims, 1991). According to Turner, the immersive environments of the 1960s and 1970s were derived from these same museographic techniques. But the modernist rationalism of the 1950s was replaced by new logics of self-experimentation and disordering of the senses, seeking the keys to open the "doors of perception," to allude to the title of Huxley's influential work (1954) that recounts his experiences with hallucinogenic drugs.

At the junction of modernist museography and psychedelic installations Stan VanDerBeek's Movie-Drome constitutes a particularly remarkable system (Sutton, 2015). In its original form, the Movie-Drome was a multi-projector installation that produced a collage and superimposed images from the news on the dome of a repurposed grain silo. VanDerBeek (1966) imagined the generalization of these movie-dromes, as a kind of new, real-time cinema, in which the sequences would be generated automatically from a network of computers connected to data banks.

VanDerBeek's logic consists in designing a new visual regime to cope with the flow of information, to offset the effects of media techniques by additional technical sophistication. "My concern is for a way for the over-developing technology of part of the world to help the under-developed emotional-sociology of *all* the world to catch up to the 20th century … to counterbalance technique and logic--and to do it now, quickly…" (VanDerBeek, 1966).

This undertaking was at the crossroads of his insistence on building an autonomous personality —"each member of the audience will build his own references from the image-flow"--, and his promotion of a new kind of disruptive sensorial experience: "certain things might happen if an individual is exposed to an overwhelming information experience."

Although cybernetics is not explicitly mentioned in his manifesto, a parallel can be drawn between the use of computers and networks in VanDerBeek's system and the heritage of cybernetics. As was the case for many others involved in these immersive installations, VanDerBeek had direct relations

with the technological and scientific world, and in the late 1960s made several films and computer animations with means provided by Bell Labs.

In the case of psychedelic installations, like those of the Pranksters and the USCO collective, any reference to cybernetics may seem to be, on the contrary, more distant. For example, the term "cybernetics" never appears in the Merry Pranksters's activities documented by Wolfe, although the notion of "feedback" is one of the most common terms found in the texts that speak about their technological installations.

The connection to cybernetics is, however, more direct than it would appear to be, both technologically and ideologically. Indeed, among the organizers of this new genre of immersive shows, Stewart Brand was in a good position: he belonged to the Kesey group and was at the interface between technoculture and counterculture. Before even coordinating the organization of the Acid Tests, which are the emblem of West Coast psychedelic culture, Brand had experimented with his own multimedia shows in the exhibition "America Needs Indians," which presented a photographic project completed at Indian reservations, in the style of modernist museography.

In fact, cybernetics played a pivotal role in the intellectual construction of Brand, who discovered the discipline during his biology studies at Stanford. He refers to it abundantly, whether in the prefaces of the *Whole Earth Catalog*, or in the articles he writes about the emerging field of computing and the works of Bateson (Brand, 1974). Wiener's essay *The Human Use of Human Beings*, also figures among the first works presented in the *Whole Earth Catalog*, in a note that stresses its direct impact on Brand's own project: "Its domain is the whole earth of the mind," writes Brand about Wiener's book (Brand, 1972: 9).

Cybernetics seems to be in Brand's writing the key for a science of systems, with strong emphasis on environmental issues (Kirk, 2007). This discipline leads to a sort of reversal of rational thought by itself: "a rigorous scientific refutation of the notion that rational science is adequate to save us" (Brand, 1974:10). His statement is rooted in Bateson's own celebration of paradoxes: "A paradox is a contradiction in which you take both sides – both sides. Each half of the paradox proposes the other. I think that it is so that if you wear out one of these paradoxes you embark on a sort of voyage, which may include hallucinations and trance, and all that sort of stuff. But you come out knowing something you didn't know before, something about the nature of where you are in the universe. [… Avoiding paradox] is the insanity of Twentieth Century America, the Twentieth Century Occident" (Brand, 1974: 31).

As far as technology is concerned, Brand argued in favor of autonomous and decentralized practices. The statement that opens his article about the playful culture of laboratories—"computers are coming to the people, that's good news, maybe the best since psychedelics" (Brand, 1974: 39) --

is representative of his celebration of personal computing, which was still far from reality when the article appeared. Not only was this personal computing opposed to computer control, but in this liberation of technological autonomy was played out a form of moving beyond thought and rational techniques toward mysticism. The computer became an instrument of self-transformation, just as the reading of cybernetic texts was.

The transfer was not, however, limited to an ideological influence, which would explain the reappropriation of communication devices as trance machines, based on audio-visual feedback. The immersive installations are rooted in veritable transfers of technology. This is true in particular of the stroboscope, a key device for psychedelic performances, celebrated by Wolfe as a machine for the dissociation of the personality.

Gerd Stern from the USCO collective, which specialized in multimedia installations, explains in detail how the strobe was reappropriated. The stroboscope was, indeed, at the beginning, a laboratory instrument that was developed in the 1920s by Harold Edgerton (Bruce, 1994). It was originally a technology for analyzing the efficiency of engines, before being used to study movement. Stern describes his meeting with Edgerton after a performance at MIT: “With the strobes and the overload with the three motorcycles going, after our performance at MIT, we got a phone call from this professor who first developed the strobe and who worked with [Jacques] Cousteau and who was head of the department at MIT. His name was Harold Edgerton. […] He said, ‘This strobe you have is puny. Next time you have a performance, I'll lend you a real strobe,’ and he took us into his laboratory, and he showed us these enormous strobes, and he gave Michael some circuitry. […] He said, ‘I didn't really enjoy the performance, but I understand what you're trying to do. If you want to use a strobe, at least get a powerful strobe’” (Stern, 2001: 85).

Here we have a particularly clear example of how a laboratory instrument was reappropriated as a cybertrance device. While the strobe has no particular connotations as a cybernetics instrument, even if it comes from MIT, where Wiener was a professor, it has, on the other hand, been used recurrently in neurophysiology, particularly by Grey Walter, one of the major figures in British cybernetics. As for Stern, several years later, he would publish one of his poems in Von Foerster’s journal *Cybernetics*.

Revelation by Flicker

If the stroboscope constitutes one of the emblematic devices used in psychedelic installations, the

use of flashing lights and the flickering effect has given rise to particular experimentations. The flicker machine was regularly used in combination with the dropping of LSD, and Burroughs advised Ginsberg to experiment by combining both of them (Geiger, 2003).
The theory concerning the neurophysiological effects of the flicker machine was largely, or ,as far as Burroughs is concerned completely, taken from the work of William Grey Walter, *The Living Brain*. A canonical cybernetics text, this work written for the general public and published in 1953 contains a chapter titled “Revelation by Flicker.” The chapter presents Walter’s research on the use of the flicker machine as a means for acting on the rhythm of the waves produced by the brain, which were discovered and analyzed using an electroencephalogram.
“In 1946 we found that the information contained in EEG records could be greatly increased by subjecting the brain to rhythmic stimulation, particularly by the flickering of a power-light in the eyes, open or closed. […] At the end of the war, easy and accurate flicker was attainable by employing an electronic stroboscope […]. With the fresh technique, strange patterns, new and significant, emerged from the swift scribbling of the pens in all channels of the EEG” (Walter, 1953: 86-87).

Pickering interpreted this use of the flicker as one of the paradigmatic experiences of the “ontological theater” of cybernetics: “In different ways, the sixties and cybernetics shared an interest in the performative brain, with technologies of the decentered self as a point of exchange. […] Just as I conceive of cybernetics as ontology in action, playing out the sort of inquiries that one might associate with a performative understanding of the brain, one can equally see the sixties as a form of ontological theater staging the same concerns, not in brain science but in unconventional forms of daily life” (Pickering, 2011: 82).
In Walter’s theory, brain waves are interpreted as the expression of a scanning mechanism that the flicker would disturb, which could lead to the production of endogenous images. Beyond the explanation proposed for this phenomenon, the chapter in Walter’s study is written in a spirit of enthusiasm. The formula “the flicker proved to be a key to many doors” does not constitute a direct allusion to the title of Huxley’s *The Doors of Perception*, published only a few months after *The Living Brain*; nevertheless, it must have resonated in the ears of readers. All the more in that Walter does not deprive himself of associating the flicker with mystical elements, likening epileptic fits to religious phenomena, and presenting the flicker as a means of access to a new form of consciousness: “Oddly enough it is not in the city, but in the jungle conditions, sunlight shining through the forest, that we run the greatest risk of flicker-fits. Perhaps, in this way, with their slowly swelling brains and their enhanced liability to breakdowns of this sort, our arboreal cousins, struck

by the setting sun in the midst of a jungle caper, may have fallen from perch to plain, sadder but wiser apes" (Walter, 1953: 92-93).

The same formula "revelation by flicker" was directly paraphrased by Brion Gysin, in his article published in 1962 in Olympia magazine, about his invention of the Dreamachine with Ian Sommerville. Yet it was no longer simply a matter of the monkey becoming human, but of human beings "becoming something more than a man," and gaining access to new forms of perception (Gysin, 1962: 115).

The Dreamachine is one of the most elaborate objects in the cybernetic imaginary of the machine that was passed on to counterculture. It is a rudimentary device invented by Ian Sommerville, a young mathematician who was at that time the partner of Burroughs. In response to a request by Gysin, Sommerville found a simple way to reproduce Walter's experiments. Indeed, the Dreamachine consists of a simple slotted cardboard cylinder. When a strong light bulb is inserted in the cylinder, and it is placed on a turntable at the appropriate speed, it produces flashes of light. Observed with eyes closed, the Dreamachine generates patterns of light, which can resemble the abstract forms produced by hallucinogenic drugs.

Gysin gives suggestive descriptions of them, which are related to his own preoccupations as a painter: "the fluctuating elements of flickered design support the development of autonomous 'movies,' intensely pleasurable and, possibly, instructive to the viewer. What is art? What is color? What is vision? These old questions demand new answers when, in the light of the Dreamachine, one sees all of ancient and modern abstract art with eyes closed" (Gysin, 1962: 114-115).

The 1962 article provides the genealogy of the invention, which is developed in more detail in his interview with Terry Wilson (Gysin, 1982: 141). Gysin first experienced a natural flicker effect, in the bus, on his way to Marseille, with his eyes closed, the light was interrupted by a curtain of trees. Gysin owes thanks to Burroughs for having found the key to this phenomenon: in response, Burroughs offered him Walter's text, which presents similar cases. The goal of the Dreamachine is thus to artificially reproduce this natural experience.

The story does not stop there, for Gysin attempted several times to market this invention he had patented. He believed that the Dreamachine was destined to become common in households, where as a small dispenser of daily ordinary trances it would replace the television. His contacts with the business world, in particular with the representatives of Columbia, would never be successful, and the Dreamachine would remain a device confined to the world of art.

Of all of the technotrance devices, the Dreamachine is undoubtedly the one with the most direct

cybernetics genealogy, via the exploitation and the reappropriation of Walter's work. The Dreamachine is fully integrated in of the culture of immersive environments. Gysin had already, with the help of Sommerville, and even before the Dreamachine, participated in the creation of light shows, for the group Domaine Poétique. According to him, these performances can be compared to the logic of an "Expanded Cinema." "It was some of the first experiments done with two projectors, the soft focus fade-ins and fade-outs passing back and forth from one to the other, and it was a continuous light show, in fact very much part of the whole early movements of the light show. We started it about 1960, doing things with just a small projector in one room. […] I was surrounded by an image that was partly projected onto me" (Gysin, 1982: 63).
However, it is difficult to evaluate the exact contribution of cybernetics to this kind of performance. If, on the one hand, the reference to Walter played a decisive role in the design of the Dreamachine, we must not conceal the aleatory nature of this encounter. Not only was Gysin's experience of the flicker effect the fruit of complete chance, an experience he only took to be significant vis-à-vis his own pictorial preoccupations, but his encounter with Walter's text is again based on the fact that Burroughs had happened upon it by chance himself at a secondhand bookseller on the banks of the Seine, near the Beat Hotel, rue Gît-le-Coeur. Here, there is no form of systematic transmission, but rather what resembles a series of happy coincidences.

Nonetheless, all of these events fall within a framework, which rendered this series of happy coincidences significant. It is here that the notion of a cybernetics man-machine imaginary is useful. The reference to cybernetics through the question of communication and control is, indeed, important in the work of Burroughs and Gysin. In *The Soft Machine, Cybernetic Fiction*, David Porush, proposes a reading of what he calls Burroughs's "techno-paranoia." "Those authors who fear in their worst moments of paranoia that the machines are out to get them, find, as William Burroughs does that their identities are inextricably tied up in machinery […]. Inevitably, they discover that their resistance to a so-called 'autonomous technology' involves the invention of some counter-method, some guerrilla counter-technique, which itself is mechanical" (Porush, 1985: 13). The case of the Dreamachine fully participates in this Burroughs-like strategy of a counter use of cybernetics, turning the ideal instrument of communication and control into a disruptive system, which brings to light zones of experience that are uncontaminated by language. The famous literary technique of cut-ups, which Burroughs borrowed from Gysin, belongs to the same imaginary: treat language as a material substance, in the same way as the painter, to do away with the logic of communication.
"Burroughs's tactic of finding refuge in a language which aspires to silence through a kind of

babbling and spastic spontaneity (I refer to the cut-up method), emerges more coherently in this light. […] His cut-up method has a sound cybernetic basis. The way to degrade the message is to widen the bandwidth, allow more noise, increase the number of chances or contingencies, randomize. […] Here, Burroughs is clearly playing the guerilla's role of a counter-technician, saboteur, the role of Bill Lee who turns the mechanics of the machine against itself in a positive feedback loop that ends in the machinery of language dismantling itself" (Porush, 1985: 110).
These techniques are then closely connected to the split in the cybernetic imaginary, as it is described by Cassou-Noguès (2014), between the automated factory, as the figure of complete control, an omniscient government based on calculations, and the prosthesis, as the augmentation of people. But compared to Wiener, the meaning of the prosthesis has been transformed from the rational augmentation of human capacities to the disordering of our senses.
The performative dimension of Burroughs's and Gysin's work—"art is doing," according to the slogan used by both – resonates itself with the ontological theater of cybernetics described by Pickering. The trajectory of happenstance that links Walter to the Burroughs, Gysin, and Sommerville trio seems to be activated, then, by the underlying structures of the man-machine cybernetic imaginary.

Biofeedback

The third major class of post-cybernetic countercultural technologies of the self is provided by the vast ensemble of biofeedback devices or systems. These devices are on the verge of becoming the prostheses of a body whose performances can be artificially modified by coupling it with a machine.
Biofeedback devices consist in recording a modality of bodily activity, such as the heartbeat, muscular currents, or the electroencephalogram, and returning it in another visual or sound form accessible to users. We can find here, once again, the stroboscope as a visualization device for the electroencephalogram.

These devices are used for various purposes. Generally speaking, biofeedback devices aim to control internal activities, through a learning process, and are found in many medical applications, such as the one for treating urinary incontinence. But another road brings us closer to trance devices and falls within the scope of instrumented meditation. Some of the most spectacular performances were achieved in the realm of avant-garde music. That is the case of Alvin Lucier's performances

(Music for Solo Performer, 1965), which used eletroencephalography to make percussive instruments resonate, and Richard Teitelbaum's Spacecraft (1966), inspired by his reading of *The Living Brain*, which creates a musical performance based on the expression of the inner states of musicians.

"The unusual sensations of body transcendence and ego-loss that occurred in this music – and in related biofeedback experiences – seemed aptly described in a statement written several hundred years ago in the Jewish mystical texts of the Kabbalah: in the state of ecstasy a man 'suddenly sees the shape of his self before him talking to him and he forgets his self and it is disengaged from him and he sees the shape of his self before him talking to him and predicting the future.' With five musicians simultaneously engaged in the same activities – electronically mixing intermodulating with each other and issuing from the same loudspeakers – a process of non-ordinary communication developed guiding individual into collective consciousness, merging the many into the One." (Teitelbaum, 1974: 37-39).

These devices exist at the boundary between laboratory instruments, often created by specialized companies, and popular electronics. The devices are not in fact extremely complicated to make: the November 1971 issue of *Popular Electronics* invites its readers to build "muscle whistlers," which can transform muscle latency into sound signals. Meanwhile, the *Whole Earth Catalog* reviewed a range of biofeedback devices readers could buy directly from the manufacturer.

These biofeedback devices are characteristic of a "mixed science," at the interface between academic work and new age gurus, which participates in the dissemination of the devices well beyond the laboratory toward counterculture, and the wider realm of popular culture.

In an article that chronicles the history of the movement, Donald Moss (1998) describes as follows the meeting that led to the creation of the first research society that studied biofeedback: "the group that gathered in Santa Monica was fascinating in its diversity, ranging from 'the hardest nosed operant conditioners to those in white robes.' The Eastern spiritual influences were strong, as was the humanistic emphasis on the unfolding of new levels of human potential. […] Yet methodology and rigorous psychophysiological research received equal emphasis. Biofeedback seemed to be a meeting point where high technology and the higher levels of consciousness could meet."

Biofeedback incontestably has its historical roots in the wake of the cybernetics movement. The theoretical vocabulary, and even more the ontological theater of the body-machine, shaped the movement, and its founding articles were presented at cybernetics conferences. The biofeedback movement promoted new forms of objectification of the self, which bridge the gap between internal and external states. Internal states of the body appear in the form of spatialized external states that

are publicly communicable, and can be manipulated, in kinds of practices that anticipate today's vogue of the quantified self. By coupling the body and the machine, biofeedback makes it possible to build an instrumented experience of the body as if it were a machine, which makes theoretical cybernetics--that is more or less speculative--turn toward forms of technologies of the self focused on self-control or ecstasy.

Computer Translations

One of the decisive elements of the cultural history of computing stems in turn from the effects of these countercultural innovations on the discipline and its productions. One part of American computer science in the 1960s and 1970s thus falls within the scope of this alliance between cybernetics and counterculture.

The first and most visible phenomenon is linked to the circulation of forms. It is as if the ensemble of inventions I have analyzed, which were based on analogical signal processing and modification operations, were translated into digital computational systems. This is particularly obvious in the case of the logic of immersive environments, which find in the paradigm of virtual reality, with the research of Ivan Sutherland, as of 1965, a channel for further intensifying their engagement with images. To the immersion in a sensory and audiovisual environment, virtual reality adds forms of interaction directly controlled by the user, rather than by only the creator of the immersive environment.

Sutherland's own texts insist on the revolutionary dimension of this technology for the subject: "The Ultimate Display," a talk on VR in 1965, promises nothing less than "a looking glass into a mathematical wonderland," and the production of a new kind of knowledge (Sutherland, 1965). The "doors of perception" metaphor is not very far away.

Likewise, the first visual productions of computer art were greatly inspired by the psychedelic imagery of light shows. These affinities can be explained by the mode of production of images that favors the drawing and animation of abstract forms. This is especially true of the pioneering works of the Whitney Brothers, whose raga-based choice of musical accompaniment is a reference to the entire psychedelic imaginary (Whitney, Lapis, 1965). The transfers also function in reverse: Leary and Burroughs participated in video game projects in the early 1980s. Burroughs was also involved in computer-generated image works, in collaboration with Roger Holden. These images, which Holden calls "cybernetic cut-ups," extend the disruptive logic of the processes used in the 1960s : produced from repetitive patterns taken from the canvasses of Burroughs, these stereographic

images dissimulate hidden messages. We rediscover here an obsession for reversing the logic of control, and the self-destruction of the paranoid computer machinery. “These images allow for a direct altered state of visual perception just as the Magic Eye images do. However, rather than simply entice you with just a dolphin or 3-D heart, the cybernetic cut-up images can be used to experience directly certain information processes of the mind” (Holden, 2010).
The systems that most completely implement the properties of these cybertrance instruments, while shifting them in the direction of the digital machine, are undoubtedly video games. The latter not only appear as immersive environments with considerable captivating power, but also as biofeedback devices. Indeed, they are based on a loop between the production of images on the screen and the players’s gestures, fuelling in real time the translation of one sensorial modality (gestural) into another (audiovisual). Based on the programming of *Spacewar* in 1962, an entire ensemble of forms and practices constituting the continuation of cybertrances by other means (Triclot, 2011) was developed in the first computer science laboratory.
Brand himself was not wrong in 1969 to celebrate *Spacewar* and the computer science of man-machine interfaces as “the best news since psychedelics.” Video games constitute the privileged vector of diffusion of these cybertrance devices, based on the twofold condition of a regression of their psychedelic charge, except in one specialized sector of production, and an individualization of the practice, which moves away from the communal dimension of a considerable number of cybertrance explorations.

This multitude of translations into computer media of the experimentations conducted with cybertrance devices has the interest of making us reassess the legacy of cybernetics for American computer science. As a scientific movement, cybernetics can be characterized as having simultaneously experienced an exceptional public diffusion, attested by the objects and practices I have described, and a rapid decline, marked by the end of collective research under the aegis of the Macy Foundation.
One way of interpreting this rapid decline of the core group of cybernetics, proposed by Jean-Pierre Dupuy (1994) in particular, consists in arguing that cybernetics was a victim of the competing program of Artificial Intelligence. The latter was led by a new generation--that of figures like McCarthy and Minsky-- students of the cyberneticians, who broke with the original paradigm. The direct descendants of cybernetics, like Heinz Von Foerster, who would be at the origin of the self-proclaimed “second-order cybernetics,” in which Dupuy himself was a key player, found themselves incontestably marginalized in the scientific landscape of American computer science.

Nonetheless, this reading leads us to underestimate other paradigms in the history of computer science, which appear to be alternatives to classical Artificial Intelligence, developed by Minsky and consorts, and that have important links to cybernetics. Such is the case of J.C.R. Licklider's "man-computer symbiosis" program (1960), and Douglas Engelbart's "augmented human intellect" (1962). Both of these programs draw on the same sources: the memex, the machine imagined by Vannevar Bush in the immediate post-war period for processing information, but also the typically cybernetic insistence of Wiener and Von Neumann on the differences, and hence the complementarities, between people and computers.

Both Licklider and Engelbart had hope for a new "form of life"–the expression is Engelbart's–, which would generate innovative forms of thought through its coupling with the interactive computer: "the hope is that, in not too many years, human brains and computing machines will be coupled together very tightly, and that the resulting partnership will think as no human brain has ever thought" (Licklider, 1960).

These two programs extend the key elements of Wiener's cybernetics. Yet from their reflections on the differences in kinds of thought — mechanical and biological —, we proceed to a quasi-prosthetic use of the computer, in the logic of continuous coupling which is that of the man-computer symbiosis: the "living together in intimate association, or even close union, of two dissimilar organisms," according to Licklider's definition.

Even as they aim primarily at new modes of instrumentation of rational thought, with computer programming considered to be the priority application, these techno-scientific programs possess at the same time very strong countercultural resonances, as Markoff has shown. The circulation exceeds simple ideological transfer: Engelbart's team was, for example, invited to try out LSD in the framework of the International Foundation for Advanced Study, an organization dedicated to the chemical expansion of the creativity of engineers and located on the same campus as Engelbart's group (Markoff, 2005: 65).

A cultural history of American computing thus leads to a reevaluation of the contribution of cybernetics: its expulsion from the program of classical AI does not eliminate the other effects of its legacy, particularly in the programs launched by Licklider and Engelbart. The latter constitute a point of exchange between cybernetic perspectives and the countercultural movement. Video games, developed in the university subsequent to academic research on man-machine interfaces, constitute a particularly interesting case of heterogeneous objects: they drew on the state of the art of emerging computer science, recycled the operating principles of technotrance devices, and made cybernetics drift toward a form of life based on an intimate relationship with the computer.

Conclusion

This tour through the cybertrance artifacts of the 1960s and 1970s has enabled me to make emerge a singular technological ensemble that has not, to my knowledge, been identified and studied as such. These artifacts have the value of being situated not only at the intersection of the techno-scientific world and counterculture, but also at the tipping point between the analogical operations of signal processing and their digital translations in computer science laboratories. Cybernetics constitutes a zone of exchange where not only operating concepts and styles of research are in circulation, but also an imaginary of the machine, in which the individualized prosthesis thwarts control instruments. Our devices belong to this cybernetic man-machine imaginary, but transform the prosthesis into a disruptive technology of the self, pushing Wiener's science into unexpected fields, where it is less a question of supplementing or supplanting the regulations of the human machine than of disturbing them by design.

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