Biochemical Injections: Architecture as a Biotechnical Interface in a Postparametric Environment

MINA YANEY
Vienna University of Technology

EMBODIED INFORMATION

The Body as Informational, Corporeal, Force Field

What is an *organic body* capable of? Contemplating the *corporality of bodies* from a pre-discursive or phenomenological vantage point, one cannot help marveling at their openness for any directions of conception and conceptualization. Bodies are enigmatic in their pluralistic and repetitive *modes of existence* which have gradually emerged out of stellar dust. We are reminded of Spinoza's vigilant utterance that "nobody as yet has learned from experience what the body can and cannot do, without being determined by mind, solely from the laws of its nature insofar as it is considered as corporeal"[1] (Baruch Spinoza, *Spinoza: Complete Works*. Translated by Samuel Shirley and others [Cambridge: Hackett Publishing Company Inc, 2002], 280).

The body – taken to mean all *different* kinds of bodies, be they biological, geological, chemical, physical or even political – is both significant in its performative nature as well as in its philosophical scope. To put it more explicitly: the body intertwines *becoming* and *being*, history and presence as well as *difference, repetition*, and *identity*. Nietzsche's influential writings repeatedly addressed the notion of the body.

> The human body, in which the most distant and most recent past of all organic development again becomes living and corporeal, through which and over and beyond which a tremendous inaudible stream seems to flow; the body is a more astonishing idea than the old "soul". (Friedrich Nietzsche, *The Will to Power* [New York: Walter Kaufmann, 1967], 347)

Nietzsche's influence on postmodern and post-structural theory as well as theorizations of *the body* is beyond dispute. The Nietzschean background in French post-structural philosophers, who were involved with the notion of the body, such as Gilles Deleuze and Michel Foucault is essential and their influence continues to pervade contemporary conceptions of the body in an increasingly critical debate.[2] Although Deleuze never fully articulated a comprehensive theory of the body, he was certainly one of those poststructural theorists who advocated a philosophy of immanence and an ontology of embodied difference. He certainly sees the body as a differentiated repetition; or a *multiplicity*, to use his term.[3] Foucault on the other hand, as a political philosopher and historian, frequently attempted to capture the relation between human bodies and political power. He illuminated how political power and penal systems, in the modern age, have been primarily operating through the subjugation of bodies. In his widespread annotations on the *Panopticon*, contrary to the Sovereign regime, power is rendered as a de-individualized and de-institutionalized, diagrammatic mechanism of power relations, normalizing and controlling bodies devoid of external intervention.[4] In Deleuze's Book about Foucault, the former describes that "the abstract formula of Panopticism is no longer 'to see without being seen' but to impose a particular conduct on a particular human multiplicity" (Gilles Deleuze, *Foucault* [London: Minneapolis, 1986], 34).

It is thanks to Foucault's comprehensive treatment of the relation between the *physiological* and the *political* that we have comprehended how, from the beginning of the nineteenth century on, the notion of *biopower* coalesced around the manipulability of *populations* and *bodies* as novel scientific categories rather than classical juridical ones.[5] Equally enriching are his depictions on panoptical technologies of the body and the creation of docile and productive bodies as objects of power and disciplinary control.

I do not intend to discuss the body from a philosophical or political perspective. This would surpass the space here. Rather I wish to thematize the implications of the body's *variable modulation and interfacing capabilities* through technological intervention. I have, therefore, preliminary introduced specifically Deleuze and Foucault for their comprehensive politico-philosophical treatment of the body promises to be appropriately instructive for the following discussion. I shall elaborate more about their theories when contextually required.

Let me begin to read with them the notion of the body as a *plurality of immanent, irreducible, forces*. Certainly this conception of the body pertains to all different kinds of embodied entities as well. Such approach to the body, in both a Deleuzian and a Foucauldian sense, is clearly identifiable in Nietzsche's genealogy since he embraced part of the burgeoning roots of what would later flourish as Foucault's notion of *biopower* and Deleuze's ontology of *difference*. Indeed we find a support of such claim in Deleuze's annotations on the body in *Nietzsche and Philosophy* (1983).

> Every force is related to others and it either obeys or commands. What defines a body is this relation between dominant and dominated forces. Every relationship of forces constitutes a body- whether it is chemical, biological, social or political. Any two forces, being unequal, constitute a body as soon as they enter into a relationship. This is why the body is always the fruit of chance, in the Nietzschean sense, and appears as the most "astonishing" thing [. . .] Being composed of a plurality of irreducible forces the body is a multiple phenomenon, its unity is that of a multiple phenomenon, a "unity of domination". In a body the superior or dominant forces are known as active and the inferior or dominated forces are known as reactive. Active and reactive are precisely the original qualities which express the relation of force with force. (Gilles Deleuze, *Nietzsche and Philosophy* [London: The Alhlone Press, 1983], 40)

Apprehending embodied substance as such irreducible corporeal field which *displays* the relation and *performs* the negotiation between forces, renders *the body* as both a function of *political power relations* (Foucault) and as a developing multiplicity; a biochemical cohesive force field of *interacting differences* (Deleuze) which, in both cases, is notably open for re-modulation through technological and architectural interventions. Hence, it is the interface between *architecture, bodies, invasive technosciences,* and *political governance* that this paper intends to address. With this in mind, detouring briefly through the conceptualization of the body within *cyberculture*, shall bring us into the heart of the matter.

FROM CYBERCULTURE TO BIOTECHNOLOGY
Re-modulating the Body

Cyberculture predominantly circles around the implicit Cartesian assumption that living bodies are derivative manifestations of underlying *incorporeal informational patterns*. It takes a reductionist approach to material substrates. If the transcendental, immaterial realm of information is conceptualized as underwriting signs and syntax, then it is the immanent, material flesh which is conceived as the medium for cells, tissues, and organs *containing* the information. Accordingly, information is apprehended as discrete utterance which is entirely separable from its embodied form, yielding a dichotomy between body and information.[6] This decisive misconception originates from the mathematisation of automatic regulation apparatuses: an exemplary model of intelligibility which is based on the practice of representation. Along these lines we are witnessing since at least the late 1940s an ostensibly solid distinction between information and flesh culminating in a variety of research programs, popular virtual environments, and practical applications. A case in point is William Gibson's novel *Neuromancer* (1984) which constitutes one representative landmark in the cyberpunk genre which displays such crucial misleading premise.[7] In this tradition of a dualistic approach to information and materiality, distinguished researchers such as Marvin Minsky and Ray Kurzweil assert that we will be capable of uploading human memories to computer disks in the foreseeable future. However, there are numerous voices who insist on the indivisible unity and on the interdependence between body and information. In *How we Became Posthuman*, N. Katherine Hayles compellingly illustrates how information lost its body and how the liberal human subject is dismantled in cybernetic discourse. Hayles points at the danger of how disembodiment might be again re-inscribed into dominant concepts of subjectivity while explicitly articulating the indispensable notion of embodiment.[8]

Unlike in cyberculture however, in the realm of *biotechnology, embodied substance* and *information* correlate differently. They are significantly rendered as non-dualistically constituting one another. The body constitutes an embodied informational force field which is open for technological re-materialization. It is this reciprocity and co-adaptability between body and information which is worth to be closely considered from a post-parametric perspective of architectural embodiment. Let me, therefore, extend the introductory brief discussion, about bodies as corporeal information, by turning to the realm of biotechnology.

The official description of biotechnology encompasses "the collection of industrial processes that involve the use of biological systems. For some industries, these processes involve the use of genetically engineered micro-organisms."[9] We can capture the meaning of biotechnology more lucidly by thinking about it as plurality. That is because there is a profuse amount of *biotechnologies at work*.[10] This collection of technologies, harness attributes of cells, molecules, proteins, and microbes, such as their manufacturing, differentiation, fusion and propagation capabilities, to produce desired products. The ancient biotechnological methods of microbal fermentation, which are a form of *bioprocessing*[11,] are quite clearly represented by bread, cheese, bear, wine, and vinegar. The different breeds of animals and hybrid plants such as dogs and roses are equally familiar. In these earlier techniques, the literal meaning of the term "biotechnology" was indeed a technical utilization of biological processes toward a range of novel ends.[12] While these technologies have been industrially utilized, the most groundbreaking research is nowadays confined to biomedical applications. Nevertheless their gradual expansion to areas outside traditional medical technology is quite obvious due to a distinct politico-military interest in the opportunities for future Army applications.[13]

Let us briefly touch upon some pertinent research fields in biotechnologies and biomedical engineering which will be addressed in what follows. These fields include molecular biology, regenerative medicine, tissue engineering, synthetic biology and systems biology. Virtually all applications in biotechnology, ranging from drug discovery and development to the production of transgenic crops, are based on molecular biology. *Molecular or gene cloning*, which is the process of generating genetically identical DNA molecules, is foundational for molecular biology and is a decisive tool for biotechnology. This is because "virtually all cells speak the same genetic language, DNA from one cell can be read and acted on in another one - even a different cell type from a different species. This feature is what makes DNA the cornerstone of modern biotechnology." (Roxanna Guilford-Blake and Debbie Strickland, *Guide to Biotechnology 2008* [Washington: Biotechnology Industry Organization (BIO), 2008], 1)

Regenerative medicine is revealing new ways to stimulate the body's natural mechanisms to repair, maintain, re-grow and develop in order to heal previously irreparable tissues, organs or even regrowing limps. The body's different mechanisms for self-repair and maintenance includes many different proteins and various populations of stem cells that are capable of curing diseases and repair injuries. *Tissue Engineering* is one example of regenerative medicine. It combines advances in *cell biology* and *materials science* and is involved with growing semi-synthetic tissues and organs in the lab. The aim, here, is to grow whole organs comprising of different tissue types to substitute diseased or injured organs. Ultimately synthetic biology and systems biology are equally decisive branches of biology. The latter attempts to use biological data to generate prognostic models of cell processes, biochemical pathways and even whole organisms. Furthermore, systems biologists develop different biomathematical models as well as biosimulations to explain and simulate complex interactions in biological systems. Synthetic biology, on the other hand, uses such information in order to assemble and engineer new forms of genomes, cells and whole organisms (such as simple natural bacterium).

The contemporary approach to biotech is increasingly debated within mainstream media and scientific discourse. The spectrum of such controversial discussions ranges from human genome projects to anxieties about the implications of human cloning to claims about novelties in companies' pharmaceutical drug developments. Recently the *New York Times* announced the successful creation of a *synthetic living cell from scratch* by John Craig Venter.[14] These issues are clearly rendering a great deal of attention for bioscience and biotech industries as well as their increasing organization on a global level. Various areas of specialization in biotechnology, such as proteomics - which is revealing and studying the three-dimensional structure and functionality of proteins -, genomics and pharmacogenomics, induce both promising and frightening social impacts and provoke novel ethico-cultural debate and theorizing.

The underlying profound techno-scientific novelty is clearly based on a novel intermingling of the two, traditionally conceived as thoroughly separated, disciplines of *molecular biology* and *computer science*. They once held radically different views on the organic body. Nearly all contemporary biotechnological enterprises are inextricably intertwined with *bioinformatics* and *computational biology*.[15] Hence, with the introduction of biotechnological practices, we encounter an *informational model* which is not dichotomizing body and information because it does not *dematerialize* the embodied form as cyberculture does. Instead, biotechnology reveals a specific informatic paradigm which is intrinsically entangled with the organic notion of the body and its very materiality while informationalizing the corporeal substance and re-materializing its embodiment. This renders a revolutionary approach to technology in such a way that the intrinsic organic processes and capacities, inherent in the biological body itself, can be re-informed and manipulated yielding a "bio-machinic" intelligence and productivity. This technological *modulatability* of the biological body leads to profound implications on industrial applications, political economy, cultural and social practice as well as architectural embodiment while substantially blurring the boundary between *nature and design*. Can we anticipate a new *ethico-aesthetic order at a biomolecular level?*

The historical trajectory of biotech, as a science, as an industry, and as a cultural force, has been depicted by various scholars and writers whereas an ethnographic account of the arguably exemplary biotechnological invention to date (PCR), is discussed by Paul Rabinow.[16] Different pertinent literature circles around the increasing commodification of the biological and around the propagation of the genetic code in the pond of civilization. The gene is rendered as *wet* (in the test-tube), *dry* (coded on the computer) and *commercial* (patented).[17] With the recent dynamics in biomedicine, advanced stem cell research and biotechnology, there is a decisive issue about the way in which *human tissue* is turning into a saleable commodity possessing what Waldby and Mitchell call *biovalue*.[18] *Tissue economies* create various mechanisms for adding such value to the raw material of human tissue. Unremittingly the history of biotechnology is entangled with the simultaneous rise of economic neoliberalism as a political force and economic policy while relocating economic production at the *genetic, microbal, and cellular level*.[19] Hence, the core of contemporary postindustrial economy is lucidly based on the *transformation of biological life into surplus value*. This pivotal shift emphasizes the entanglement between biological, technoscientific, economical, political as well as social practices. Accordingly we are led to link such novel practices to architectural thinking as well as new forms of human embodiment and subjectivity.

Although these issues have triggered attention in cultural and art theory, social science, comparative literature as well as political theory and economy, a synthesis and examination within an architectural scope remains still undone. Such enterprise is indispensable in order to comprehend, theorize and synthesize a post-parametric biotechnological embodiment along with its cultural ramifications as well as power implications and applications. Apparently we will have to make crucial choices about what sorts of applications to embrace and which biomolecular systems to interface. It seems the possibilities will be qualitatively and quantitatively abundant and diverse as never before since biotechnologies have established a precedent that is transforming our politicoeconomical frameworks from *scarcity* into *surpus*. This transformation will indubitably revolutionize many cultural domains including industrial production as well as architectural thinking, practice, embodiment and empowerment.

BIOTECHNICAL INTERFACES
The Virtual, the Real, the Organic, and the Inorganic

The ongoing debate clusters, hence, around a *biotechnology-mediated* social interaction and its profound potential impact on political economy, new forms of human embodiment and subjectivity, considered through the lens of an architecture theoretical discourse. In doing so, I intend to emphasize the discursive necessity to fully incorporate biotechnologies, along with their practical applications and theoretical implications, into architectural debates and research.

How will bioscientific modalities of knowledge, technology, and economical practice provide a novel basis for architectural embodiment? We can begin to address this question by returning to Foucault's notion of biopower as well as to the new biopolitical quality that architecture assumes in the late eighteenth century. In an interview with Paul Rabinow in 1982, Foucault notes how in this time architecture shifted from its role of representing and maintaining a traditional and symbolic order as well as aesthetic hierarchies to a biopolitical apparatus of bodily governance. Architecture came to be part of a network of knowledge and practices constituting apparatuses via which individuals were formed, subjugated and governed.[20] Architectural apparatuses – such as workshops, barracks, prisons, and hospitals - have been deployed as devices for developing and perfecting such techniques of bodily production, subjugation, normalization and governance.

> "In each of these settings the general aim was a 'parallel increase in the usefulness and docility' of individuals and populations. The techniques of disciplining bodies were applied mainly to the working classes and the subproletariat, although not exclusively, as they also operated in universities and schools. (Hubert L. Dreyfus, Paul Rabinow, *Michel Foucault: Beyond Structuralism and Hermeneutics* [Chicago: The University of Chicago Press, 1982], 135)

Extrapolatingly, architecture is construed as the invention and deployment of biopolitical apparatuses used to regulate and normalize the bodies submitted to them in order to increase their usefulness. This positivistic urge of increasing bodies' usefulness, through their very subjugation, is based on a modern capitalist approach which was informed by the economical concept of scarcity based on demand and supply. In the case of prospective biotechnology-mediated societies, we assume a shift to *material surplus*, since our technologies would cluster around the manipulation, propagation, intensification and management of infinite productive and reproductive forces of living matter. This shift would render forcing human bodies to increase their usefulness, with the aid of architectural apparatuses, as redundant. There would be no point in increasing the usefulness of humans in societies which are saturated of resources. This move may lead to the continuation of the historical change of architecture's identity. Perhaps architectural embodiment would continue its transformation from a *system of representation and symbolic order* to a *biopolitical apparatus of governance and control* to a new form of architectural embodiment. Can architecture become a perpetually, variable, organic force field, an environmental body, which has neither the task of representation nor governance? Perhaps it would create organic governance in the sense of governing the conditions of exchange between bodies and environments. We are accordingly led to ask: Can we specify architectural approaches in which biotechnics may amplify, augment, recombine and interface different life forces, forms of vitality, and transformative productivity, governing the emergence of environmental bodies of habitation? Considering any embodied agent as corporeal information, which can be biotechnologically (re-)modulated and interfaced, opens up a vast ethico-aesthetic field for a biotechnologically elicited design from within as opposed to the modern concept of mechanically imposing static buildings from without. How can we conceive such biotechnological architectures which are based on harnessing manufacturing capabilities and forces of natural dynamics in order to emerge, endure, interact and regenerate?

Rudiments of answers to such questions are clearly identifiable in different biotechnological approaches. Let us further examine how we can imagine such biotechnological emergences which are based on determining the threshold conditions under which an architectural body might self-assemble and variably change in accordance with environmental fluctuations and interactions. To make my argument more accessible, I shall introduce two different instances which embody a *biotechnological interfaciality* in which the *virtual, the real, the organic and the inorganic* are inextricably interwoven. The heuristic samples I wish to discuss are:

(1) The notion of Biomedia

(2) Tissue Engineering and the topological body which is a biomedical field in regenerative medicine.

(1) *Biomedia* is based on two disciplines which are indissociably connected with biotechnological practices: *bioinformatics* and *biocomputing*. In the instance of bioinformatical applications we encounter a computing model which is making use of computer technology in order to model the complexity of biological structures such as DNA sequences and the amino acids the sequences are likely to produce while modeling how different parts of the protein will fold into different three-dimensional structures. In

the other instance of *biocomputing* or DNA-computing, the biological dynamic itself is the operational, and calculating informatic intelligence. Through the combinatorial possibilities inherent in DNA, its biochemical dynamics can be utilized to perform very specific types of calculations in a test tube. With these two approaches, we realize how the computational can simulate molecular dynamics and model biological structures while the biological can be technologically utilized in order to execute, through its inherent biomolecular dynamics, computational calculations. This twofold dynamic renders a significant reconfiguration of the relation between the *biological and the technological* while rendering the biological as a potential technological tool. It, hence, depicts the significant character of the concept of *Biomedia* as intertwining information with embodied substance.

> A key component to the questioning of biotechnology is the attention paid to the ways in which biomedia consistently recombine the medium of biomolecular systems with the materiality of digital technology. The biological and the digital domains are no longer rendered ontologically distinct, but instead are seen to inhere in each other; the biological "informs" the digital, just as the digital "corporealizes" the biological. (Eugene Thacker, *What is Biomedia*? [Minneapolis: University of Minnesota Press, 2004], 7)

Accordingly we may touch upon the most crucial question that biotechnology is based on. How can selected features and dynamics, in organic bodies or in nature, be geared toward novel medical, industrial, and economic ends? These ends are applications in different fields ranging from regenerative medicine, genomics, genetic diagnostics, drug development as well as in material industries (biomaterials, biomimicry). Hence the body is rendered as a medium which inheres an intrinsic technological ability to rematerialize and redesign itself from within through its entanglement with a re-informing computational intelligence which re-modulates the body's force field. One may argue that this approach is a literally post-mechanical approach which renders technology not as an externalized tool which mechanically controls and manipulates the natural resources from outside. Rather, it dissolves the technological tool which now operates from within while using the biological process, its flesh as well as the digital intelligence in a coalesced mode. The *body*, as embodied information, and information, as disembodied corporeality are mutually affecting each other. The process and the product are, therefore, rendered as intertwined. Unlike physico-virtual augmented spaces, in which the physical is translated into disembodied data without re-informing the physical, the biotechnological medium never leaves the mode of embodiment. Hence, data and flesh are oscillating in a relation of mutual adaptation while dissolving their ontological dichotomy.

Having the roughly exemplified concept of Biomedia in mind, we are now ready to turn to a more demonstrative application in the field of *regenerative medicine* which combines *stem cell science and tissue engineering*. In doing so, we shall subsequently continue to capture what may be named *biotechnical interfaces*. Regenerative medicine is perceived as a kind of refined model of earlier biomedical technologies such as prosthetics and organ transplantation. Having mentioned prosthetics and organ transplantation, which both underwent a surge of development after World War II, we localize the first precursors of biotechnical interfaces. That is to say this period witnessed a war-driven invention of new materials and first large scale industrial production of prosthetic substitutes for missing organs and bodily functions. Hence, we encounter first signs of the emergence of mechanical, optical, acoustic and electrical interfaces which govern the conditions of exchange between biological and machinic systems. Consequently and most notably, interdisciplinary endeavors began to cluster around ways of interfacing the machinic with the biologic. Such interfaces include artificial joints, plastic lens implants, hearing aids, pacemakers, cardiovascular devises, dialysis machines, and the heart-lung machine. As noted, these approaches began to interface biological with mechenical systems but nevertheless, they were still based on a mechanistic assumption: the fundamental equivalence between the organ and the machine. Hence, they constituted a sort of *pre-biotechnical interfaciality* which was predominantly based on the invention of automata and a concomitant mechanistic theory of biology, as philosopher of science Georges Canguilhem argued in his classic 1992 study on the *machine and organ*.[21] The most significant point to note here is that these biological models were based on a mechanistic and metrical representational approach.[22] This approach worked with a static morphological form whereas, according to Canguilhem, the other branch of late nineteenth century biology was concerned with *experimental embryology.*[23] This branch was increasingly involved with understanding and intervening in the organismal development and *morphogenesis of form* as process. Hence, we note that there is a differentiation between a mechanisticalmetrical, and a *morphogenetical-topological* view of the biological process which is fundamental for the understanding of *biotechnical interfaces*.

(2) Tissue engineering (TE) is concerned with precisely this topological reconstruction of three-dimensional living organs and tissues in vitro, from the cellular level up, in order to then transplant them back into a patient's body. Tissue engineering, which is a kind of successor of reconstructive medicine and in vitro cell and tissue culture, seems to prove somewhat germane to architectural thinking by virtue of its effect of fostering all kinds of cross-disciplinary alliances between biologists, materials scientists and chemical, mechanical as well as electrical engineers. Now we have entered a mode which circles around a *'realtime' genesis of form* from within rather than imposing form from outside through its metrical representation.

As we have discussed in the notion of Biomedia, the technological intelligence is dissolved while operating from within and intertwining form with morphogenesis. In the instance of growing organs, there is a threedimensioal biodegradable scaffold utilized wherein cells are placed drop by drop. Once in place, the natural intelligence of *self assembling* takes over and the cells gradually fuse to each other while creating more complex tissue structures and simultaneously the scaffold breaks down. The process of seeding takes place, is controlled, and manipulated through a bioreactor which sensitively governs the conditions of growth while affecting and stimulating the tissue in order to fold into a particular morphological form with particular cellular properties. Through this continuous biochemical, mechanical or electromagnetic variation of force fields, within the bioreactor, the tissue becomes continuously re-morphable while determining the tissue's density, compressibility, elasticity, organ morphology and form.

Even if this approach is still in the confinement of biomedical research, it provokes to think about potential manufacturing techniques where such an approach might be utilized for designing novel self-assembled materials and structures. This would render an entirely novel approach to the notion of "the object". Consequently we recognize a revolutionary technicophilosophical shift. The form is not imposed but rather induced or catalyzed from within through the inherent processes and their environmental conditions. The tissue is in a mode of perpetual (re)modulation. As philosopher Gilbert Simondon writes, "To mould is to modulate definitively; to modulate is to mold in a manner that is continuous and perpetually variable."[24] This approach is describing a decisive feature of the biotechnical interface. Even if this approach constitutes an experimental architectural or design thinking, it is indubitably invading the discourse ultimately through tendencies in Bioart or ornamental Biotechnology[25] while rendering a possibility of a novel approach to the artifact along with own methods of abstraction, simulation, modeling and fabrication. In the notion of biotechnical interfaces, *the virtual, the real, the organic and the inorganic* are infleshed within a mode of continuous re-morphing; a perpetual dialogue with the environmental dynamics, changes and fluctuations. We imagine biochemical atmospheric couplings which surface as spatio-temporal biological habitats; as multiplicities of exchange, endurance and regeneration. We may think design as a Deleuzian becoming in relation to living systems while opening up the opportunity to think outside of an anthropomorphic, human centered, design, enunciated through differentiating, variable and temporal *atmospheric interfaces.* This move might be conceived as a definitive demise of the Cartesian object, as Gilles Deleuze describes in *The Fold.*

> This new object we can call *objectile*. As Bernard Cache has demonstrated, this is a very modern conception of the technological object: it refers neither to the beginnings of the industrial era nor to the idea of the standard that still upheld a semblance of essence and imposed a law of constancy (the object produced by and for the masses), but to our current state of things, where fluctuation of the norm replaces permanence of law; where the object assumes a place in a continuum by variation. (Gilles Deleuze, *The Fold: Leibniz and the Baroque* [London: The Athlone Press,1993], 20)

DESIGN AS BIOCHEMICAL INJECTION
Conclusions and Questions

The biotechnological diagram, hence, opens up the following: the commodification of the entanglement of *the virtual, the physical, the organic and the inorganic* signals profound political as well as ontological questions about the very organization, constitution and reconstitution of an entirely novel ethicoaesthetic order on a molecular level. Reyner

Banham showed how the first and second *Machine Ages* have introduced the typology of small scale machines and their penetration into domestic life. He argued that the First Machine Age was "the age of power from the mains and the reduction of machines to human scale." This change, which had occurred only at the end of the nineteenth century, began with electric cookers, vacuum cleaners, the telephone, the gramophone, the tape recorder, mixers, vacuum cleaners and all those other mechanized aids to gracious living that have pervaded and permanently altered the nature of domestic life and certainly the very dynamics of society and culture. The Second Machine Age was differentiated from the first and characterized by Banham as "the age of domestic electronics and synthetic chemistry" which was at its peak in the 1950s and 1960s when the prosperous consumer society arrived. In this Age, "highly developed mass production methods have distributed electronic devices and synthetic chemicals broadcast over a large part of society. Television, the symbolic machine of the Second Machine Age, has become a means of mass communication dispensing popular entertainment." (Reyner Banham, *Theory and Design in the First Machine Age* [New York: Praeger Publishers, 1967], 11)

Analogously, the digital revolution resulted in the commodification of the bit and has, hence, extended the physical with the dimension of the virtual culminating in the deployment of physical-virtual interfaces and in what Lev Manovich calls "*augmented space*".[26] Along these lines, the prospective forms of novel architectural, urban, and artifactual typologies, which may emerge within a *postparametric* Biotechnological Age, need to be critically considered and comprehensively theorized. How might such compositions reinform our domestic landscapes, manufacturing processes as well as the built environment as an open-ended and perpetually variable whole? How might biotechnological artifacts and architectures be thought within the notion of *biopower* after having ceased to operate as biopoitical apparatuses of governance, control, and normalization? And how will be the biopolitical translated into the realm of the molecular? How will such identity influence the dwellers' subjectivities as the boundary between *culture* and *nature* becomes increasingly macerated? How will biotechnological environments affect our spatio-temporal perceptions as they get extended with the technological manipulability of the biological? In other words, how can we appropriately theorize a *bio-panopticism*? How can we imagine design as an *agent of mediation* between nature and culture, given that the former and the latter are both subject to perpetual change?

One may imagine in-vitro culture environments that grow, biochemically and electrochemically interact with other bodies, including human's, while co-evolving with man and animal or architectures that may grow to provide carbon fixation[27] or temporal human and nonhuman territories. Our ethical and moral codes might have been extended into the realm of the inhuman. The animal or inhuman might be likewise interfaced with human environments and participate in the creation of mutual architectures in accordance with their biochemical transmutations as well as mutual conveniences; a bio-rhythmic dance of concealment and unconcealment. *Bioelectrical cars* enveloped with *biotechnical skins* with integrated biosensors that would conduct environmental scans while generating and distributing corresponding biochemical particles that would participate in nourishing, growing and cleaning bio-habitats. According to different research fields, we can anticipate the transformation of the combustion engine into a *protein based bioelectronic device*.[28] The most promising thing is, in short, that biotechnologies might capacitate us to leave both a carbon-free as well as a fertile, nurturing and creatively cleaning *ecological* footprint while generating new artistic, social political and analytical practices.

My assumption is that biotechnology might prove to be a considerable greater force for reshaping architectural embodiment and society than any prior revolutionary discoveries in science because these decisive biotech changes are predominantly introduced and operating on a local dimension throughout medical practices and multiple other intertwined discourses which are more tangible and pertinent to man than any industrial introduction of technological novelty has ever been. These technologies are pervading the very intimacy of the human body, hence, the human brain as well. Referring to research in *neuroscience* and *neurobiology*, the *human body and the brain* "constitute an indissociable organism, integrated by means of mutually interactive biochemical and neural regulatory circuits […] mental phenomena can be fully understood only in the context of an organism's interacting in an environment." (Antonio R. Damasio, *Descartes' Error: Emotion, Reason, and the Human Brain* [New York: Avon Books, 1994], xvii)

Drawing on John Eberhard's recent work[29], which attempts to capture the interface between architecture and neuroscience, biotechnological architectural structures might indeed trigger, within our biological organisms, an increased functional harmony. Our biological interactions with such biotechnologically grown and growing structures may lead, accordingly, to a smoother intertwinement between *biological bodies and natural environments*.

> All connections between neurons can be increased or decreased based on experience, and even the total number of neurons can change in certain areas of the brain due to changes in experience and physical interaction with the environment. This change in brain structure in response to environmental changes is greatest during development, but surprisingly and remarkably, this environmentally induced structural plasticity continues throughout life in all mammals. (John Paul Eberhard, *Brain Landscape: The Coexistence of Neuroscience and Architecture* [New York: Oxford University Press, 2008], xiv)

Evidently our underlying utilitarian ethical frameworks might prove in great need for appropriate refinement based on an integrative approach to all kind of different life forms on the planet. Furthermore, the era of biotechnology indicates a turn from our scientific models of representation to nonrepresentational models in which data and flesh are oscillating in a relation of mutual adaptation. With the profound implications of biotechnology, more than before, we need to be sensitive, responsive, and aware of the entanglement and fluidity of the living system we are part of. The diverse possibilities of biochemical couplings, intensifications and propagations may create novel environmental structures and corresponding novel modes of embodiment based on cognitive and somatic *difference*. Novel forms of differentiating architectural bodies might compose new modes of socio-political unities while undermining a totality through their continuous and perpetual variability within univocity. Gilles Deleuze writes in *Difference and Repetition*:

> The essential in univocity is not that Being is said in a single and same sense, but that it is said, in a single and same sense, of all its individuating differences or intrinsic modalities. Being is the same for all these modalities, but these modalities are not the same. It is "equal" for all, but they themselves are not equal [...] The essence of univocal being is to include individuating differences, while these differences do not have the same essence and do not change the essence of being – just as white includes various intensities, while remaining essentially the same white. (Gilles Deleuze, *Difference and Repetition* [New York: Columbia University Press, 1930], 36)

Perhaps a biotechnological coalesced mode between culture and nature might render a different and variable modality of a postparametric embodiment. If according to McLuhan's thesis, the current binary code constitutes our invisible environment, then it seems quite plane to anticipate a *counter-environment* in which the binary code becomes visible through its very inscription in the organic flesh. I wish to examine how architectural thinking and theorizing might change within a biotechnological modality in which the biological becomes technologically mutable while values, signs, and power, that exist across disciplines and political economic culture, enter a mode of fluidity – To put it simply: *can we grow our homes*?

ENDNOTES

1 "However, nobody as yet has determined the limits of the body's capabilities: that is, nobody as yet has learned from experience what the body can and cannot do, without being determined by mind, solely from the laws of its nature insofar as it is considered as corporeal. For nobody as yet knows the structure of the body so accurately asto explain all its functions, not to mention that in the animal world we find much that far surpasses human sagacity, and that sleepwalkers do many things in their sleep that they would not dare when awakeclear evidence that the body, solely from the laws of its own nature, can do many things at which its mind is amazed." Baruch Spinoza, *Spinoza: Complete Works*. Translated by Samuel Shirley and others (Cambridge: Hackett Publishing Company, Inc, 2002), 280

2 Rosi Braidotti, Elizabeth Grosz, Moira Gatens, and Patricia Clough have been critically involved with Deleuze's writings on the body.

3 "When a body combines some of its own distinctive points with those of a wave, it espouses the principle of a repetition which is no longer that of the Same, but involves the Other – involves difference, from one wave and one gesture to another, and carries that difference through the repetitive space thereby constituted." Gilles Deleuze, *Difference and Repetition* (New York: Columbia University Press, 1930), 23

4 See Michel Foucault, *Discipline and Punish: The Birth of the Prison* (New York: Vintage Books, 1979), 195-228

5 In the sixth volume of *The History of Sexuality* Foucault focuses on the regulative controls of the living. The technologies of the body and the creation of docile and productive bodies, as object of power and disciplinary control, is analyzed in detail in *Discipline and Punish* (Chapter 7). Michel Foucault, *Discipline and Punish: The Birth of the Prison* (New York: Vintage Books, 1979)

6 See Jennifer Daryl Slack and Fred Fejes, eds., *The Ideology of the Information Age* (Norwood, N.J.: Ablex Publishing Company, 1987), for writings examining the implications of the contemporary conception of information. The inclination to ignore materiality in communication technology has been valuably depicted in the following works: Friedrich A. Kittler's *Discourse Networks*, 1800-1900, translated by Michael Metteer (Stanford: Stanford University Press, 1990), and Hans Ulrich Gumbrecht and K. Ludwig Pfeiffer, eds., *Materialities of Communication*, translated by William Whobrey (Stanford: Stanford University Press, 1994).
7 William Gibson, *Neuromancer: Remembering Tomorrow* (New York: Ace, 1984)
8 See N. Katherine Hayles, *How we Became Posthuman: Virtual Bodies in Cybercpace* (Chicago: The University of Chicago Press, 1999) William Gibson's classic cyberpunk novel *Neuromancer* (1984) renders an emblematic - and much cited – provocative imagination of contemporary and future relationships between bodies and information. Cyberculture and new media are evidently circling around the notion of the informatization and transfer of the physical into virtual datascapes while delivering virtual data into geographical landscapes to the ubiquitous interfaces encircling its users. As Manovich depicts the resulting effects of augmentation, surveillance and monitoring are based on translating physical space and its dwellers into data while "*cellspace technologies* work in the opposite direction: delivering data to the mobile physical space to dwellers." Evidently there is a mono-directional flow of data from the physical to the virtual and a loss of consideration towards the profound interrelation between information and embodiment. As Katherine Hayles describes in the prologue of *How we Became Posthuman*, there is a tendency to "think of information as a kind of bodiless fluid that could flow between different substrates without loss of meaning." She is attributing this tendency partly to Alan Turning (Turning Test) who argued in his paper "Computer Machinery and Intelligence" that machines can think. A definition of information formalized by Claude Shannon and Norbert Wiener, which conceptualized information as a distinct entity from the substrates carrying it, was a further influence in ignoring the entanglement between information and embodiment.
9 D. Stansfield and Pamela K. Mulligan, *A Dictionary of Genetics* (New York: Oxford University Press, 2006)
10 The list of different biotechnologies in research and practice is endless. I would like to name some of them, just for the sake of bringing to mind the rich diversity of biotech. In the discussion I will refer to some of these in more detail: bioprocessing technology, cell culture, plant cell culture, insect cell culture, mammalian cell culture, recombinant DNA technology, cloning, molecular or gene cloning, animal cloning, protein engineering, biosensors, nanobiotechnology, microarrays, DNA microarrays, protein microarrays, tissue microarrays, whole-cell microarrays, stem cell technology, molecular cloning, microarray technology, antisense and RNA interference, genomics, structural genomics, functional genomics, proteomics, bioinformatics, systems biology, synthetic biology, recombinant protein therapeutics
11 Bioprocessig is the oldest of the biotechnologies. The living cells most commonly used are one-celled micro-organisms, such as yeast and bacteria; the biomolecular components used include DNA (which encodes the cells' genetic information) and enzymes (proteins that catalyze biochemical reactions). Roxanna Guilford-Blake and Debbie Strickland, *Guide to Biotechnology 2008* [Washington: Biotechnology Industry Organization (BIO), 2008], 18
12 Robert Bud, *The Uses of Life: A History of Biotechnology* (Cambridge: Cambridge University Press, 1993)
13 National Academy of Sciences, *Opportunities in Biotechnology for Future Army Applications* (Washington: National Academy Press, 2001)
14 On May, 21 2010, the *New York Times* has reported, in the article *Synthetic Bacterial Genome Takes Over a Cell,* the groundbreaking biotechnological breakthrough which was conducted by J. Craig Venter. Known as one of the genome pioneers he has successfully proceeded in his endeavors to create synthetic life, by synthesizing an entire bacterial genome and using it to create a synthetic cell from scratch, which he described as "the first self- replicating species we've had on the planet whose parent is a computer. This is a philosophical advance as much as a technical advance" he said, suggesting that the synthetic cell raised new questions about the nature of life itself. *New York Times*. [Late Edition (East Coast)]. New York, N.Y.: May 21, 2010. pg. A.17
15 Ken Howard, *The Bioinformatics Gold Rush, Scientific American*, July 2000, pp. 58–63; Aris Persidis, Bioinformatics," *Nature Biotechnology* 17 (1999): 828–830.
16 Paul Rabinow, *Making PCR - A History of Biotechnology* (Chicago: The University of Chicago Press, 1996) Rabinow conducts here an ethnographic account of the invention of PCR (The polymerase, chain reaction – "which is the exemplary biotechnological invention to date") which has decisively influenced the field of molecular biology through specifying and extending the ability to identify and manipulate genetic material.
17 Eugene Thacker, *The Global Genome: Biotechnology, Politics, and Culture* (Cambridge: The MIT Press, 2005)
18 Catherine Waldby and Robert Mitchell, *Tissue Economies* (Seattle: University of Washington Press, 2006)
19 Melinda Cooper, *Life as Surplus: Biotechnology and Capitalism in the Neoliberal Era* (London: University of Washington Press, 2008)
20 Paul Rabinow, *Essential Works of Foucault (1945- 1984)*, 349
"What I wish to point out is that from the eighteenth century on, every discussion of politics as the art of the government of men necessarily includes a chapter or a series of chapters on urbanism, on collective facilities, on hygiene, and on private architecture. Such chapters are not found in the discussions of the art of government of the sixteenth century. This change is perhaps not in the reflections of architects upon architecture, but it is quite clearly seen in the reflections of political men."
21 Georges Canguilhem, *Machine et Organisme. In La connaissance de la vie* (Paris: Vrin, 1992), 124- 59
22 Reuleaux's science of the machine was referred to as kinematics. He provided physiologist and inventor

Étienne-Jules-Marey the first systemic theorization of the machine including its laws of motion and composition. Marey was looking at ways to combine mechanics with organs' metabolism and the principle of energy-conservation which is governing the organ. Marey's work - ranging from biomedical, photographic to cinematographic devices – inspired many technologies including prosthetics and arguably organ transplantation. See Franz Reuleaux, *The Kinematics of Machinery: Outline of a Theory of Machines* (New York: Dover, 1963)

23 Embryology is the branch of biology that studies the formation and development of living organisms.

24 Cited and translated in: Melinda Cooper, *Life as Surplus: Biotechnology and Capitalism in the Neoliberal Era* (London: University of Washington Press, 2008), 113

25 Eduardo Kac, *Signs of Life: Bio Art and Beyond* (Cambridge: The MIT Press, 2007), 43-55

26 In what Manovich calls "augmented space", he depicts an architectural mode in which the physical space is "overlaid with dynamically changing information." Lev Manovich, *The Poetics of Augmented Space Visual Communication*, 219.5 (2006):219

27 Carbon fixation is the reduction of carbon dioxide through living organisms.

28 "From 1975 to 1995, scientists in the former Soviet Union participated in a governmentsponsored program to leapfrog the West in computer technology by exploring protein-based bioelectronics. [...] Much of the research in biomolecular protein-based devices has focused on bacteriorhodopsin, a protein discovered in the early 1970s that has unique photophysical properties, as well as thermal and photochemical stability. Natural selection has optimized bacteriorhodopsin for lightto-energy conversion, and the evolutionary process has thus generated a native material that is particularly suited for a number of computer and data-storage applications." See National Academy of Sciences, *Opportunities in Biotechnology for Future Army Applications* (Washington: National Academy Press, 2001), 25

29 See John Paul Eberhard, *Brain Landscape: The Coexistence of Neuroscience and Architecture* (New York: Oxford University Press, 2008)