review article
received: 2011-07-04

UDC 17:608

ON BIOTECHNOLOGY, PHILOSOPHY AND SOCIETY

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ABSTRACT

"On Biotechnology, Philosophy and Society" is structured as an exploration of the formation of the bio-political Apparatus, within the fields of bio-politics, biotechnology, and bio (tech) Art. The paper examines the ontology of biotechnology, the economic fundamentals of biotechnology and value systems in the biotechnological era. The paper also focuses on the political and economic spectrum, reflecting the socio-political consequences of the biotech revolution, and in this context looks into the connections between the organisation of bio-politics and bio-power along with the circumstances relative to the arts, sciences, and social struggles. One of the crucial aspects of this research is the analysis of how biotechnology is used for bio-political purposes, much in the sense of a political spectrum that reflects positions towards the social, economic and cultural consequences of the biotech revolution.

Key words: Bio-political Apparatus, Bio-politics, Ontology, Bio-technology, Bio Arts (Bio-tech Arts), Phenomenology, Geopolitics, Globalism, GMOs (Genetically Modified Organisms), GE (Genetic Engineering), Bio-Capitalism

SU BIOTECNOLOGIA, FILOSOFIA E SOCIETÀ

SINTESI

Il contributo "Su biotecnologia, filosofia e società", strutturato come un'investigazione della formazione dell'apparato biopolitico nella sfera di biopolitica, biotecnologia e bio(tech)arte, si propone di esaminare l'ontologia della biotechnologia, i fondamenti economici della biotecnologia e i sistemi di valore nell'era biotecnologica. L'articolo mette a fuoco anche il complesso politico ed economico che rispecchiano le conseguenze della rivoluzione biotech, e in questo contesto studia i collegamenti tra l'organizzazione della biopolitica e del biopotere, nonché le circostanze relative all'arte, scienza e lotta sociale. Uno degli aspetti cruciali di questa ricerca è l'analisi su come la biotecnologia venga usata a scopi biopolitici, quasi come un campo politico che riflette le posizioni verso le conseguenze sociali, economiche e culturali della rivoluzione biotechnologica.

Parole chiave: apparato biopolitico, biopolitica, ontologia, biotecnologia, bioarte (arte biotech), fenomenologia, geopolitica, globalismo, OGM (organismi geneticamente modificati), IG (ingegneria genetica), biocapitalismo

Our age has shown us that technology and society are mutually constituted. In an era when life sciences merge with information sciences, the world reveals new concepts and practices in biotechnology. In fact, for one of the crucial fundaments of the biotechnological era, the medium of DNA, it has become irrelevant whether the code is recorded as an information code onto a hard disk, is found online or is stored in an e-coli culture living in a Petri dish. The very fact that the code is transferable makes issues of storage less important, but the understanding of the concept of transferability especially important. We are in fact subjected to processes whose full impact is hard to comprehend; however, this very impact has yet to be revealed, as a phenomenological approach vividly conveys. The discourses in biotechnology are evolving, showing us that the latest theoretical and practical developments have the potential to cause a tectonic shift in our culture, where the world is experienced at the intersection of the engineered and the biological.

We have also began to understand that science and philosophy share motifs, metaphors and models with the arts. Historically, parallelisms between arts and sciences go a long way back, and can be traced at the beginning of the 20th century in the well known examples of Picasso and Braque coming up with the concept of Cubism at the same time as Einstein developed the concept of relativity. The influence of Henry Poincare's *Science and Hypothesis* on the artists of the age – especially in the chapters on the origins of geometry – seem to imply that the origins of Cubism are not limited to the arts. Namely, Poincare's emphasis on the unconscious processing of information bears a striking similarity to Einstein's and Picasso's introspection. The 20th century has also given us a fairly good understanding about the importance and functioning of visual thinking in both the sciences and arts. This has been thoroughly researched by the UK-based historian of science Arthur I. Miller in 'Insights of Genius: Imagery and Creativity in Science and Art', and more so in his book 'Einstein, Picasso: Space, Time and the Beauty That Causes Havoc'. In the 'Insights of Genius', Miller rightly notes that the joint question of both the arts and sciences has been how to interpret the unseen world and go beyond the conventional constraints of visual imagery and language to dramatically transform the concepts of visual imagery. The level of interaction between the arts, sciences, and technology has been steadily increasing over the past few decades, indicating the tendency of artists to assume the research roles normally attributed to scientists, enabled by their residencies at academic and scientific institutions (e.g. Joe Davis at MIT, Adam Zaretsky at Rensselaer Polytechnic Institute, Tissue Art & Culture Project at SymbioticA, School of Anatomy, University of Western Australia, etc.). Perhaps even more important than the actual mastery of scientific and technologic processes is the tendency of biotech artists to become highly aware of the necessity to collaborate with scientists and technologists. Both disciplines have a lot to achieve by collaborating with each other and conveying, in regard to the understanding of the fundamental concepts, methods and practices of living and physical systems, in a process that does not seem to be dry mathematical, but rather one that is driven by intuition and visual thinking, in both the arts and sciences.

ONTOLOGY OF BIOTECHNOLOGY

We are certainly witnessing the advent of biotechnology today, which creates a definitive sense of urgency concerning the task of understanding it and the ways by means of which it shapes contemporary society. Numerous ontological questions about the nature of biotechnology come into being, such as is the case with the "technological determinism", which is characterised by looking into biotechnology as a tool or artefact, which exists for the achievement of certain objectives desired by humans because of its determinant effects and contexts of use. However, the complexity of developments in biotechnology renders technological determinism inappropriate because of the already established complex relations between biotechnology and society. Its production processes and values promise to have the most profound epilogue in terms of how they directly relate to the understanding and programming of life itself. Eugene Thacker says that in biotechnology ontological questions immediately fold into questions that are social, economic and cultural. According to Thacker, biotechnology is directly linked to globalism, since today it takes place on a global level, whether in terms of exchanging biological information, controlling epidemics, deterring biological attacks or the standardisation of intellectual property laws (Thacker, 2006). The point stated above clearly points out that bio-capitalism is very much dependent upon the outcomes of globalism. Namely, the growth of financial capital generated by the field of biotechnology as well as the governmental funding which matches it, purely position it as one of the pillars that globalism thrives on. The generated profits determine largely the relationship between the developed world and the 'third world', which include the expansion of biotechnological international companies into the third world, the rampant collection and patenting of biological materials of indigenous populations, etc. The situation we have today is a proof that biotechnology is the outcome of a complex and socially situated process. According to Biljker, Pinch, and Hughes, various political, socio-cultural, and economic forces shape the options that are suggested for technology in general. The designing of the entire process therefore undergoes various stages, including the removal of alternative technological options. Therefore it is not only that the technology impacts on society but also that the technology is itself already the outcome of complex and subtle processes or indeed that technology is itself already socially constructed (Biljker, Pinch, Hughes, 1987). This argument is strengthened by the actual utilisation of a certain technology, which is often used differently than was imagined or intended by its creators, making obvious the reciprocal nature of the relationship in which technology and society co-construct each other.

Although they are quite valuable, the above-mentioned views do not fully explain the entire range of developments in biotechnology. It is therefore necessary at this point to turn to phenomenology, which makes the above noted approaches obsolete (for the phenomenologist, technology is a condition of society). In this respect phenomenology offers a variety of approaches provided by Heidegger, Dreyfus, Borgmann, Winograd and Ihde among others, with a common view that technology and society co-constitute each other by comprising each other's reciprocal and ongoing condition or possibility for being what they are. In this respect we can point to Martin Heidegger's phenomenology as a fundamental critique of the technological attitude, underlining the necessity of another beginning of thinking (Heidegger, 1977) and Albert Borgmann's technological attitude, as manifested in our contemporary relationship with particular technologies (biotechnology is of particular concern). For Heidegger, technology is not just an artefact but it already emerges from a prior technological attitude towards the world (Heidegger, 1977). Heidegger claims that "just as an essence of a tree is not itself a tree that can be encountered among all other trees, so the essence of technology is not itself something technological". What Heidegger refers to at this point is the isolation of a particular "understanding of being" that makes technology possible. Heidegger's view (and the view taken by phenomenology generally) is that the society and technology co-constitute each other and are in a permanent condition of being what they are. Heidegger identifies Plato's articulation of *techne* as the foundation upon which contemporary technology builds. Therefore Heidegger insists on a certain isolation of a particular understanding of being, which allows for the existence of any technology. For Heidegger, technology has a dual significance: as an extreme danger threatening man to enter into a more original revealing, but also as a redeeming power (The Question, 337), which is there for man to recapture the original essence of science (The Question, 333), making "techne" the originating and final point of human existence. In particular, he identifies Plato's articulation of *techne* as the foundation upon which contemporary technology builds. This creates for us the paradoxical situation in which *techne* represent the beginning and end, an overwhelming threat to human existence. Heidegger defines the essence of modern technology as *gestell* or enframing. According to Heidegger, enframing refers to the urge of humans towards revelation of *aletheia* (truth) as ever-present. For Heidegger, enframing is the essence of modern technology because modern technology is rooted in *techne*: it is a means of sourcing true forms and ideas that exist prior to the figures we perceive. According to Heidegger, enframing is a determining action, from which the essence of all history is derived.

With regard to our relationship with technology, Albert Borgmann takes up a 'free' position, opposed to the 'enframed' position taken by Heidegger. Although Borgmann generally agrees with Heidegger that modern technology is a phenomenon that tends to frame our relation with things, he nevertheless argues that modern technology frames the world for us in terms of its devices. He understands this to be the point at which modern technology as devices conceals the full referentiality of the world and the necessary effort for the devices to be made available for use (Borgmann, 1984). This is the way in which devices "de-world" our relationship with things by disconnecting us from the full actuality of things. Borgmann therefore generally points towards the emergence of a device-based mood, due to our increasing reliance on devices that relate us to the world in a manner characterised by disengagement. He also gives a dire warning that our moral obligation is not to settle mindlessly into the convenience that devices may offer us but, on the contrary, points to Heidegger's argument that we may become devices of our devices (Borgmann, 1984).

Heidegger's concept of enframing can be deciphered today by using Eugene Thacker's trinity of 'encoding, recoding, decoding' as representing the primary activities of biotechnology. Today the dissemination of the biological through information networks on demand or due to necessity creates a new situation in which we apprehend the biological in digitally-intermediated terms as a digitally packaged commodity. Thacker points to notions of the biological stock being simultaneous comprised of property and information, as having the traits of materiality and immateriality and as existing as deployments of life, which are being, shifted from body to body, body to code and code to body. Thacker also sees this tripartite division in politico-economic terms. In a sense, encoding is synonymous with production, for it is by means of the process of encoding the biological that the biotech industry is able to accrue profits (as intellectual property, as a proprietary database or software). Recoding is then synonymous with distribution (and its related term, circulation), for the practices of bioinformatics, database management and computer networking are predicated on the ability of biological information to be widely distributed and circulated. Finally, decoding is synonymous with consumption in the sense that – in a medical sense at least – it is in the final output or re-materialisation of biology that biological information is used, consumed, or incorporated into the body (Thacker, 2006).

Don Ihde's post-phenomenological position stands in stark contrast to Heidegger's phenomenology of technology and represents its deep critique in regard to its very genesis – the genesis of technology. Ihde defines post-phenomenology as an inquiry into ways in which technology is embodied. His post-phenomenology sheds new light on the relation that is being established between humans and technology. By focusing especially on the bodily condition, it succeeds in providing a meaningful taxonomy, providing an account of many everyday technology relations in a manner that can facilitate our considerations of the social and ethical implications of information technology. Ihde characterises four different I-technology-world relations in terms of 'embodiment' relations, 'hermeneutic' relations, 'alterity' relations and 'background' relations (Ihde, 2002). Basically, the "lived body" becomes immersed in technologically designed environments.

In order to gain a better understanding the phenomenological position on technology it is worth referring to Max van Mannen's division of "lived experience" into the categories of: "spatiality" (referring to the "lived space"), "corporeality" (referring to the "lived body"), "temporality" (referring to the "lived time") and "relationality" (referring to the "lived other").

We can deduce that biotechnology structures society but equally that society forms biotechnology. The characteristics of these interactive processes are engrained into the general modus operandi with regard to standard processes and practices in biotechnology as well as in accepted modes of thinking about biotechnology. In its response to the positions stated above, the research is almost certain to impact our opinion on social and ethical implications of biotechnological developments in view of the bio-political concerns about various uses of biotechnology in economy, government, education, culture and art.

The transition of biology from a life science to an information science (assisted by the integration of biology and informatics) fosters various new debates on ethical, economic, political and cultural realms, investigated through various bio-semiotic, phenomenological, post-structural and other lenses, aimed at investigating the newly created socio-political system in which new modes of regulation management and control are predetermined by effectively unifying the natural with the synthetic. Additionally, the convergence of biotechnology with communication technologies in a global network certainly allows for the articulation of academic and public discourses that investigate the changing scope of global power relations as well as governance policies. The merging of information technologies with biotechnologies has the power to change the core nature of global relations as well as various elements therein by proliferation of global intellectual property policies, as well as by the developing of genomic databases (e.g. the DNA Databank in Japan, GenBank in the US, etc.).

Although there is a long historic line of thought leading to modern biotechnology, we can define it today as the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services. Its major discoveries belong well and truly within the parameters of the twentieth century. The culminating point around issues of biotechnology was the start of genetic engineering and in particular James Watson's and Francis Crick's 1953 discovery of the structure of DNA[1] and Cohen and Boyer's 1973 discovery of the recombinant DNA technique by which a section of DNA was cut from the plasmid of one E. coli bacterium and transferred into the DNA of another. However, as paradoxical as it might seem, this development had even been delayed, due to the fact that major discoveries had been overlooked for substantial periods of time, such as was the case with Gregor Mendel's findings about heredity from 1865/6, which were not revisited until the beginning of the twentieth century. The same is true for the 1953 discovery of the DNA structure, since it had been overlooked for decades. In fact, in April 1953, the scientific paper in which James Watson and Francis Crick presented the structure of the DNA-helix, describing it as a "structure [having] novel features, which are of considerable biological interest". This is an obvious understatement and certainly doesn't come anywhere close to the true significance of the discovery, best defined in a later explanation given by Francis Crick in more dramatic terms: "We have discovered the secret of life". This latter statement seems to be closer to the true revelation of *aletheia* (truth) as for the past 50 years we have been experiencing constant breakthroughs, all of which have the discovery of the DNA structure as their core. This position naturally created a response from the cultural field when Gordon Rettray Taylor wrote the "Biological Time Bomb", in which Kornberg's discovery of the biochemical replication of the viral gene was seen as a doomsday scenario. The publisher warned that within ten years you would be able to marry a semi-artificial man or woman, change your memories, live up to hundred and fifty years and choose the sex of your children – if the scientific revolution didn't destroy us first. This was the age when art – and especially the moving image – has followed a history of involvement with science fiction (and here we should remember not only Star Trek, but also Woody Allen's 'Sleeper', a genre which would be continued later with Cronenberg's 'The Fly', 'Matrix', etc.).

By looking into the past and forecasting the future, the US artist George Gessert says: "From the 18th through the 20th centuries technological developments led to revolutions. I think that in the 21st century change

1 James Watson and Francis Crick shared the Nobel Prize in Physiology or Medicine with Maurice Wilkins in 1962 for accomplishing to solve one of the most important of all biological riddles.

will be generated less by technological developments than by their unintended consequences such as climate change, species loss and ecological collapse. A key role of art will be to produce ways of thinking and feeling that point toward more sustainable economic and social systems".

Rifkin's warning about the price which we have to pay for the development of biotechnology and genetics presents the gamut of issues which we will have to face as society, especially with the engineering of new life forms, the creation of cloned beings, the engineering of beings even before they are born and the patenting of the genetic pool of indigenous populations. In this respect we certainly find ourselves at a stage of development in which we are able to ask more questions about economy, politics and culture than we have answers.

ECONOMIC FUNDAMENTS OF BIO-TECHNOLOGY

In "The Global Genome: Bio-technology, Politics and Culture" Eugene Thacker depicts a cultural system, which is being constructed according to the rationale of economic benefit. He refers to the political economy of the genetic body, understanding life as reprogrammable, instrumentalised and networked. Thacker addresses the mobility of biology across media in which production, distribution and consumption define the contemporary model of biology and life itself.

Economic benefits – alongside economic incentives – play a large role in the development of biotechnology. We are currently able to detect a certain political economy encompassing biological advances. According to Chase-Dunn, Kawano and Brewer, international economic integration today (trade and investment globalisation) is relevant for understanding the economic consequences of biotechnology. If financial instability or environmental problems cause the world economy to stagnate or if conflicts increase to the point that economic production and exchange are greatly reduced, comparative advantages due to biotechnology would be postponed and international diffusion would have a greater chance to reduce technological rents.

The possibility of the economic benefits that can be provided by biotechnology has had the close attention of successive US governments for more than thirty years. The re-establishment of American economic hegemony is certainly tending to base itself on developments in the biotechnologies and information technologies. Several studies have been commissioned by the US Congress to compare the competitiveness of the US with that of European countries and Japan. In 1984, a study demonstrated that the United States has huge advantages over possible competitors; accordingly, it embraced additional funding (private and public) for biotechnology. These findings coincided with an actual change in terms of the acquisition by the United States of an increasing share of world biotech markets from 1992 onwards.

Christopher Chase-Dunn, Richard Niemeyer and Juliann Allison point out to the fact that since the early 1980's several major efforts have been made to study the development of the biotechnology sector within the United States:

> The creation of new technologies, as well as the science involved in their production, is essential to the development of long-term economic growth and international competitiveness.
> No new area of science or technology holds greater promise or potential for long-term economic growth than biotechnology.
> Relevant data regarding biotechnology must be gathered so as to develop timely and accurate statistical measures of the economic scope and size of the US biotechnology industry, the level of growth, trade and performance in biotech markets, the level of R&D and venture capital both in use by and available to biotech companies, as well as the nature of existing and potential barriers to future growth. Data of this nature will play an essential role in the ability of lawmakers and policy analysts to effectively promote the future growth and development of the US biotechnology industry (Chase-Dunn, Niemeyer, Allison, 2006).

The contemporary debates about genetically modified organisms and the pro- and contra- stances of protagonists and activists in this battle that we are witnessing possess an argumentative character that seems to be above all political and economic as blocs of countries line up according to their strategic requirements. Currently the United States, Argentina, Brazil, and Canada have 99 per cent of total global acreage devoted to GM crops. We can also say that the Chinese government supports plant biotechnology (one of the reasons being that China has to feed almost 20% of the world's population but only possesses 7% of the world's cultivable land). China has adopted a promotional policy towards biotechnology by taking a leading role between Asian and developing countries in the research and adoption of plant biotechnology. According to a recent study on the global diffusion of plant biotechnology (Runge, 2004), it is second only to the USA in terms of the amounts it invests in crop biotechnology research. Its robustness makes it an important player in the biotechnological field, one able to conceptualise and realise independent policies. However Europe's moratorium on the approval of new GM imports and its other anti-GM regulations worry the farmers and ministers of developing countries, who fear the loss of Europe as a market. Paarlberg says that "these regulations are the single most powerful force in implementing GM--free crops around the world. According to Paarlberg, not one African country outside of South Africa has approved any GM crop for commercial planting (Paarlberg, 2008). Paarlberg's opinion about European regulation being of utmost importance for the African countries certainly seems plausible as Europe represents the primary market for African products. We can also point to the situation in Asia in which only GM cotton has been legalised for cropping, strongly benefitting China, Indonesia and India, by reducing the amount of crop spraying required. Meanwhile, opponents to the use of GMOs propose a worldwide moratorium. In terms of this proposal, Paarlberg argues that the acceptance of this position would only hurt developing countries, as GM crops could make the difference between poverty and prosperity due to GM crops being pest-resistant, drought-resistant and/or nitrogen-fixing and as such able to slow the chronic increases in hunger and agricultural poverty that afflict sub-Saharan Africa, caused by factors such as insects destroying up to 45 per cent of the maize crop in Kenya every year.

Aside from Robert Paarlberg's argumentation that the tide has already turned for food and feed crops and the example of Monsanto not going ahead with the program of GM maize, rice, or soybeans in China, a brief analysis will demonstrate that dedicated resources to support biotechnological industries exist all around the world. According to Burrill and Company, an industry investment bank, over $350 billion has been invested in biotech since the emergence of the industry with global revenues rising from $23 billion in 2000 to more than $50 billion in 2005. Proving the point that biotechnology is a global phenomenon, practically all regions of the world have shown strong growth trends, with Latin America recording the greatest growth. It is important to note that the advent of biotechnology has occurred with the collapse and shift of economic and political systems in most of the socialist economies (the Soviet Union and Eastern Europe), the change of the economic systems in the non-aligned countries as well as in China and the opening up of India to multinational companies. This very impressive growth of the biotechnology and the newly acquired markets tend to be accelerated by the use of other technologies such as new production software, bio-informatics, Internet technologies, surveillance technologies, etc. This development is additionally followed by the setting up of contemporary labour processes across the globe (e.g. in Costa Rica, Thailand, Indonesia, India, etc.) and by sectioning their different parts or stages according to the necessities of the market and international production network monopolies. However, as early as 2007/8, this accelerating development – as often occurs in the cycles of capitalism – ended up in a reversal of fortunes of biotech companies. This was of grave importance, but, additionally, it is not only the economic impact, which was of consequence. When reflecting on the above noted issues about the development of bio-capitalism in genetics, biotechnology, and synthetic/artificial life, we should have in mind Jeremy Rifkin's nagging question "At what cost?", as well as other important questions about the new genetic commerce which brings about more troubling issues than any other economic revolution in history, and the risks involved in the designing of more perfect animals and humans (Rifkin, 1998). Genetic engineering remains a contested subject with the development of gene therapies, stem cell research, cloning, and genetically-modified food. The last several decades have made us more aware of the complex structures and processes involved in biotechnology, addressing issues as diverse as the social and political context surrounding biotechnology; the relationship between ethics and biotechnology (e.g. the ethical implications of genetic engineering); the background to scientific processes, their essence, and their spectacular nature; the complex relationships between science and culture; and the politics of the discipline of biotechnology. In an interesting observation, Eugene Thacker has inverted Timothy Leary's notion that computers are the drugs of the 90s, saying that 'for the biotech industry, drugs are the computers of the 21st century'. This creates for us a significant paradigm shift.

Patenting started to become an important issue in biotechnology when the US Supreme court decided that an oil guzzling microbe developed by General Electric was patentable. This signalled a high demand for chemical and pharmaceutical companies in regard to patenting life forms. Various patents concerning about gene sequences, human and animal cell lines, indigenous genes and knowledge have been contested and ultimately accepted by the courts. A somewhat paradoxical situation occurs at the very core of patenting procedures. In order for patents to go though the European and US patent offices, biotech companies claim that the GMOs they produce are fully artificial and consequently not found in nature. Eugene Thacker says that this claim is the foundation for fulfilling the patentability criteria in the United States and the European Union: that patents be "new, useful and nonobvious". Those against genetic patents argue that by definition "life itself" cannot be subject to patent laws because "life itself" is synonymous with "nature", or something that already pre-exists human intervention. The claim that a genetic sequence or GMO is artificial underscores the "tech" part of the biotech: it is in some non-trivial way the result of human intervention, industry and technology. But we also see another contradictory claim emerging from many of the very same companies that are ostensibly in the business of patenting and licensing. This claim is the exact opposite of the first: that these new, useful, and non-obvious inventions are "natural" and thus safe for the environment, for the human body, for agriculture and for medical application.

This situation in terms of patenting has been addressed with a cultural response which was provided among others by the US artist Diane Ludin with her project i-BPE (iBiology Patent Engine). The project was originally based on the surrealist game "Exquisite Corpse" offering Internet users a framework to build a resource against the distressing militarism inherent within the US patenting system today. That framework is a text-based interface that asks users to begin building a patent. The patent can be built from scratch or by using a sample from the United States Patent and Trademark Office's database of currently granted patents (Ludin, 2008).

On another level, it is worth noting that some current developments in biotechnology are revolutionary due to the general access to biotechnological tools enabled through various DNA DIY Kits. Foundations such as The KlaasKids Foundation and the State of California DNA Laboratory have created a Do-It-Yourself DNA Collection Kit using common household items, in which parents can sample and store their children's DNA with total confidence but without the unnecessary expense of purchasing commercial DNA kits which cost between $5.00 and $20.00 per child (Klass Kids, 2012). Other DNA DIY kits include those offered by chemists that allow the paternity of children to be established without the usual recourse to the legal system.

The Internet also proves useful in regard to promoting DNA Ancestry Projects (Genetic Geneaology, 2012), Social Networking web sites such as 23 and Me (23andMe, 2012), as well as offering professional sites for the more advanced in DNA research, such as: GenBank®, which is the NIH genetic sequence database (GenBank, 2012) and the Basic Local Alignment Search Tool (BLAST, 2012), which finds regions of local similarity between sequences comparing nucleotide or protein sequences to sequence databases and calculates the statistical significance of matches.

BIOTECHNOLOGY AND THE ARTS – SCIENCES VS. HUMANITIES

The relationship between biotechnology and the Arts can justifiably be seen as a curious one, as we can currently only observe the tip of the iceberg. Still lurking in the depths are some of the most difficult unresolved questions arising from the breakdown of communications in society, such as the issue of the relationship between the arts and the sciences, which has plagued humanity throughout the greater part of the twentieth century. This was described by the author C. P. Snow as the rift between "Two Cultures" in his celebrated 1959 lecture series of that title. However, Snow also saw in this breakdown a chance for humanity: "The clashing space of two subjects, two disciplines, two cultures, – of two galaxies, so far as that goes – ought to produce creative chances. In the history of mental activity that has been where some of the breakthroughs came. The chances are there now. But they are there, as it were, in a vacuum, because those in the two cultures can't talk to each other. It is bizarre how very little of twentieth century science has been assimilated in twentieth century art."

Generally speaking, people have been educated either in the sciences or humanities – but not both. This task of bridging the gap between the disciplines is therefore made very difficult, as in the analysis of both one has to deal with the essence, spectacle and background of scientific processes, the aesthetic qualities of works of art, the complex relationship of science and culture, as well as the social and political context surrounding art and biotechnology.

Biotech art has a prominent place with regard to bridging this quite obvious gap from the "two cultures" of modern society – the sciences and the humanities. Snow sees the breakdown of communication between the two cultures of modern society as a major hindrance to solving the world's problems of art and science – along the interface of the biological (which is both "ultimate objectivity" in the hands of science – "biological facts" – and "ultimate subjectivity" as the most intimate seat of personal feeling and emotion – the irreducible humanist bastion of "feelings").

This complexity is further accentuated since one has to take into account the fact that biotechnology also addresses biopolitical issues, the ethical implications of genetic engineering, the relationship between ethics and biotechnology, etc.

The artistic strategies presented through various approaches regarding our reflection upon power relations (bio-political conflicts in the real and virtual worlds increasingly involve governments; NGOs and corporations), including such diverse factors as: energy control; the choice of fuel materials; alternative energy sources; nuclear energy; the control of the biological; the inheritance and programmability of life; ecological visualisations; food miles entropy; the causes and consequences of global environmental change; carbon offsets; eco footprints; the sustaining of the environment; macro and micro ecology; current topics in applications of microbiology in biotechnology; the dimensions of live matter; the relation to the relation to life, genetically modified foods; death; and appearance, etc.

Indeed, biotech art is a wide-ranging subject, building on both the arts and sciences (biology and biotechnology), with abundant material coming from both cultures. Therefore biotech artists have been seen as instrumental in bridging this gap between the arts and sciences. Joe Davis, the American artist and pioneer of biotech art, believes that Snow's perspective is outdated: "The two can no longer be absolutely separated. Like science, art is a quest for knowledge. Few recall that for thousands of years, art was a principal instrument used by *Homo sapiens* to undertake the Apollonian search for secrets of God and nature. Only in recent centuries have special injunctions been adopted which proscribe artistic activities that might be confused with research and scientific inquiry. Students of art in our own era will generally have no idea that artists contributed to the invention of mathematics, astronomy, chemistry, physics and biology. This constructed separation of art and science has left little room for individuals who work outside contemporary frameworks of thought and language. Scholars of the humanities now acknowledge that this separation of arts and sciences was an artificial one perpetuated by centuries of history that turned metaphysics into the foundation of all things artistic. Yet, the machinery of this historical artificiality and its categories has assumed a kind of *de facto* reality. Until we can learn to think without the modern classifications of art and science, it will be difficult to encounter borderlines, interspaces and hybrids" (in interview with the author).

Davis goes on to say that he believes that the arts have been slowly moving away from this division for at least several decades: "I am simply too impatient to wait for art to fully recover its former scope. I would rather explore a role that still remains unknown to us: neither as an artist nor as a scientist (designations I consider exchangeable in my personal practice). An artist-scientist is both free enough to tackle absurd questions and disciplined enough to be scientifically rigorous about the way the work is carried out. There is a chance, where it is possible to both dream *and* act, that opposition between Romantic and Constructivist notions can finally be resolved. In the first century BCE, Marcus Vitruvius, the great Roman artist and architect and namesake of Leonardo da Vinci's *Vitruvian Man* wrote that a student of art '... should be a good writer, a skilful draftsman, versed in geometry and optics, expert at figures, acquainted with history, informed on the principles of natural and moral philosophy, somewhat of a musician, not ignorant of the sciences both of law and physic, nor of the motions, laws, and relations to each other of the heavenly bodies. Since, therefore, this art is founded upon and adorned with so many different sciences, I am of the opinion that those who have not, from their early youth, gradually climbed up to the summit, cannot, without presumption, call themselves masters of it.' I look at this history with wonder and awe and I hear pronouncements that we will never again hold such greatness in our grasp. But I recognize that greatness is only a matter of will and I think about it every time I meet an artist who says, 'I decided to become an artist because I hate math.'"

On the other hand, the British artist Gina Czarnecki doesn't believe that the gap is being bridged as much as is now being argued, made credible again and being seen as an important and interesting space. According to Czarneck, there never really was a gap but just the perception of one. She believes that there is increasing awareness of the need for both specialists and generalists in any field. She says: "Science, technology, culture, innovation and their associated socio-political drivers are interrelated and there is an increased acknowledgement of the mutual evolution and the spaces between. However, one of my concerns in the UK is education, and whilst it appears we are heading to a place where the space between art and science is being increasingly professionally acknowledged, and therefore will grow, the education system is sprouting specialist secondary schools which gear themselves to be specialists in maths and computing, sciences, or humanities. My children at ten will have to make a decision on what path they take and it becomes vital that alternative models of what people can do are there for these children rather than the division and classification of thinking" (in interview with the author).

Gary Cass, the Australian biologist turned artist, is absolutely convinced that most of the world's universities, the bastion of all knowledge, have recognised the value of cross disciplinary research and that includes the arts sciences crossovers. "My new workshops focus on not only artistic creativity but the scientific creativity. The science world is recognising the need for their world to become more creative. To deal with an unknown future and the possible problems we as a society may face, we will need the sciences to become more creative. And of course this may involve the meeting of two diverse cultures like the arts and sciences. I believe we have bridged the gaps, albeit slightly, but it is a great start in the right direction. Further acceptance of the arts by the sciences and especially the science funding bodies, in particular the need for philosophical viewpoints and creativity are definitely required. But it will also require the arts to accept scientific beliefs and position". (in interview with the author.)

Finally, it is worth listening the voice of the pioneer of biotech arts Joe Davis who believes that "society is struggling to integrate new knowledge in life sciences into older frameworks. Scaffoldings that support religious, legal, corporate and other social/economic structures will inevitably have to be reconfigured."

O BIOTEHNOLOGIJI, FILOZOFIJI IN DRUŽBI

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POVZETEK

Prispevek »O biotehnologiji, filozofiji in družbi« kritično obravnava najnovejša dogajanja na področjih biopolitike, biotehnologije in biotehnološke kulture in umetnosti, preučuje njihove teoretične temelje ter sledi poteku njihovega razvoja v zadnjih dveh desetletjih 20. stoletja.

Besedilo je strukturirano kot raziskava znotraj biopolitike, biotehnologije in bio(tehnološke)umetnosti. Osredotočena na politični in ekonomski spekter, raziskava odseva družbeno-politične posledice biotehnološke revolucije in v tem kontekstu preučuje tudi povezave med usklajenostjo biopolitike in biomoči ter okoliščine, ki zadevajo umetnost, znanost in družbeni boj, pri čemer biotehnološko kulturo predstavi skozi širok nabor izkušenj in vplivov.

Namen prispevka je predvsem razjasniti novo družbeno matriko delovanja, ki se je očitno pojavila z razvojem številnih sil v biotehnologiji in povzročila aktualne ekonomske (biokapitalistične) in kulturne spremembe (biokultura, bioumetnost).

Članek spregovori tudi o bio(tehnološki)umetnosti, saj so umetniki že precej zgodaj začeli ustvarjati z biotehnologijo in so v odziv na razvoj dogodkov na področju biopolitike in biotehnologije razvili tudi pomembne diskurze.

Cilj prispevka je jasno ponazoriti oblikovanje globalnega biopolitičnega aparata, ki tako vsebuje nove vektorje moči v odnosu do družbenih, političnih, ekonomskih in administrativnih mehanizmov, kot tudi strukture znanja, ki so sposobne ustvarjati, ohranjati, pa tudi uničiti sodobno družbo.

Ključne besede: biopolitični aparat, biopolitika, ontologija, biotehnologija, bioumetnosti (biotehnološke umetnosti), fenomenologija, geopolitika, globalizem, GSO-ji (gensko spremenjeni organizmi), GI (genski inženiring), biokapitalizem

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