

THE XENOTEXT, SO FAR

'Since Sputnik there is no nature. Nature is an item contained in a man-made environment of satellites and information. Goals have now to be replaced by the sensory reprogramming of total environments and DNA particles, alike.'

— Marshall McLuhan (*Culture Is Our Business*, 330)

Media art theorizes itself in terms of the production of boundary objects and the intermedial zones that they create. This has been true since at least Dick Higgins' classic 'Intermedia' manifesto of 1965 (revised in 1981 and reprinted in 2001) – but arguably much earlier – when he argued that Samuel Taylor Coleridge uses the term 'in exactly its contemporary sense' (52) in 1812. Higgins describes media art not in terms of the objects that fall 'between media' but as the fields of possibility that such objects describe between established media, as his 1995 Venn-style 'Intermedia chart' (50) demonstrates. The introduction to Oliver Grau's 2007 media art theory anthology, *MediaArtHistories*, proceeds in a similar manner, claiming an 'interdisciplinary and intercultural' space for media art, and providing its own 'enormous circle diagram' of the field as support (1-2).

In a similar vein, but from a critical perspective, communication studies concerns itself with intermedial border zones as sites of transition and reversal, and has done so since at least 1964, when Marshall McLuhan published *Understanding Media*. In Chapter 3, 'Reversal of the Overheated Medium,' McLuhan (1964) deploys economist and systems theorist Kenneth Boulding's notion of the 'break boundary' (49) to

describe the point where one system suddenly changes into another. Contemporary theories of circulation, such as the work of public culture theorists Dilip Gaonkar and Elizabeth Povinelli, as retrofitted for communication studies and cultural studies by Will Straw (2009), focus on 'a set of circulatory fields populated by myriad forms' (qtd. in Straw 23), which not only mediate but also help to create the interconnected matrices of the social.

The question that I return to with increasing frequency is this: to what extent, if any, do the intermedial encounters of avowedly interdisciplinary, but relatively stable, fields like media art and communication studies, staged through the boundary objects of media art, actually change the way that the fields themselves go about their daily business? Certainly McLuhan and Higgins saw each other as kindred spirits, as demonstrated, for example, when Higgins' *Something Else Press* republished Volume 8 of McLuhan's journal *Explorations* in 1967, under the title *Verbi-Voco-Visual Explorations* (McLuhan, 1967: ix). But such artifacts are few and far between. In communication studies, interest in media art, especially the poetic strain that Higgins exemplified and McLuhan championed, is in the minority. Conversely, as Grau (2007) observes, media art is still relatively unsupported by both the institutions of the art world and the academy, and is almost totally inaccessible to non-Western audiences. Yet, what would it mean for communication studies to take contemporary experimental media poetics seriously?

Friedrich Kittler (1990) has argued at length that the poetry of the avant-gardes, which so fascinated McLuhan, is eminently suited to address the materiality of media. 'The new sciences and technologies made it necessary [for poets] to renounce the imagination' (250). After it lost its monopoly on the production of hallucinatory media experiences to the more vivid images of motion pictures and the uncanny sounds of the phonograph, all poetry could do that was new was to comment on its own materiality. Isabelle Stengers (1997) provides a reminder that etymologically, a poet is a 'fabricator,' someone 'who gives themselves the freedom, and takes the risk, to invent and bring into

existence that which they speak of' (163). The reason that historical avant-garde and contemporary experimental poetry is a useful tool for thinking about technological form, then, is that it is itself technological form, and that it talks about that form continuously.

The major roadblock that prevents communication studies from paying more attention to media poetry and poetics is the general tendency to divide how we think about the world into what the hard sciences and social sciences are allowed to say with credibility, compared to what poetry (in its diminished capacity), along with what the other arts and humanities, are allowed to say with credibility. Science, for example, can style its actions as 'poetic' (Stengers, 1997), but it is much harder for a poet to claim that their work is 'scientific.' Christian Bök (2002) points out that science and poetry share a common history but an aparallel evolution: 'Whenever science gains the anonymous power to speak the truth about things, poetry seeks an eponymous refuge in the space of its own words' (15). Bruno Latour has written about this problem extensively, most directly in *We Have Never Been Modern* (Latour, 1993). His major point is that such 'Great Divides' between the territories of disciplines means that all sorts of boundary objects fall through the cracks, and the processes that create those hybrids remain 'invisible, unthinkable, unrepresentable' (34). In contemporary society, such objects are precisely those that are the most interesting and controversial; however, scholars are ill equipped to assess their significance as a result of the limited toolsets of a particular discipline, even an inter-discipline. As McLuhan observed, 'The problem with a cheap, specialized education is you never stop paying for it' (McLuhan and Carson, 2003: 531). In an era of skills-based, 'practical' education, we desperately need interdisciplinary thinkers, people to think about what is NOT been taken into account.

One relationship that really has changed since McLuhan's death is the one between biology and technology. During McLuhan's lifetime, technology was hard, external, massive, and fixed; contemporary technology is increasingly miniscule, soft, internal, and wet. Biology does figure into McLuhan's (1964) thinking about technology, but usually as

something that was in the process of being externalized: for example, he frequently wrote about electrical technology as an extended, living model of the human nervous system. However, McLuhan was also acutely aware that any such binary relationship could and would suddenly reverse itself. This principle appears in several places in McLuhan's writing, including in one of the Laws of Media, where something 'Reverses Into' its opposite, and in the reversible 'figure/ground relationship' that became one of his favourite probes after *Understanding Media* (Gordon, 1997: 307 ff.). As such, we need to read McLuhan through his own method, and think not about technology expanding and extending the human sensorium, but rather the way that it also insinuates itself into the biological.

Picking up, in part, from where McLuhan left off, Eugene Thacker (2004) argues in his writing on biomedica that the body was always a medium, and that the biological and digital domains inhere in each other. But Thacker is quite explicit that 'biomedica is also not about the relationship between the body and technology as a unilinear dichotomy' (14). The addition of a poetics of material media to that hybrid field provides a history and a framework for one possible elaboration beyond that dichotomy. Media always concern more than the 'successful' passing of a message from point A to point B. As theorists such as James Carey (2009) and John Durham Peters (1999) have argued, communicative acts have important social, ritualistic and even perverse and excessive elements that defy the instrumentality of both the modeling of the biological through software, and the use of molecular biology for computational purposes. How the communicative act transpires is important, as is the far-from-straightforward question of how its meaning will be construed. For Thacker (2004), the 'hallmark' of biomedica is that the moment of decoding or reception of recoded biological relationships makes qualitative changes to the social, protological and material contexts in which they occur. What counts as biology changes. What counts as computing changes. But if a specific instance of biomedica codes a poem according to a digital algorithm, recodes that algorithm into a biological relationship such as the genetic sequence of DNA,

and then decodes the results after RNA transcription, the poem may have changed; yet, so has what it means to be a poet, what it means to write poetry, what counts as an act of publishing, and how we think of poetry.

This is the sort of terrain where truth is multiple, ambiguous, and controversial. This essay will now focus on one boundary object by one contemporary poet because it raises exactly the kinds of questions that we need to ask about in terms of media today; namely, some very basic questions about what communication is.

Christian Bök is one of the bestselling Canadian poets in recent years. His second book, *Eunoia* (2001) is very peculiar – really, the only book of its kind that could be written in the English language. Inspired by Georges Perec’s lipogrammatic novel *La Disparition* (translated into English by Gilbert Adair [1994] as *A Void*), which made no use of the letter *e*, *Eunoia* consists of five chapters each of which tells a story using only words that contain the same vowel (for example, ‘Chapter E’ contains only words where the sole vowel is *e*), nearly exhausting the lexicon of such words in the process. For Bök, there were several points to the *Eunoia* project: to excise all romantic metaphors of inspiration from his poetry, and to demonstrate that it was possible to produce something that is both beautiful and entertaining, while working under rigorous constraint. Bök has always been interested in the relationship between poetry and science. His doctoral dissertation, published as *Pataphysics: The Poetics of an Imaginary Science*, details the ways in which the two fields of cultural endeavour are normally positioned as mutually exclusive, as Bruno Latour and Steve Woolgar (1986) argue:

our observer incurred the considerable anger of members of the laboratory, who resented their representation as participants in some literary activity. In the first place, this failed to distinguish them from any other writers. Secondly, they felt that the important point was that they were writing about something, and that this something was ‘neuroendocrinology.’ Our observer experienced the depressing sensation that his Ariane’s thread had led him up a blind alley. (54).

In 'pataphysics in general, and in Bök's work in particular, science and poetry subtly inform and infest each other, changing cultural context in the process. Interestingly, Bök and Thacker both use the same figure to describe this process: the spiral (Bök, 2002; Thacker 2004). The Xenotext Experiment positions Bök's writing process as a kind of cultural laboratory, and his poems as individual experiments.

Bök's Xenotext Experiment is a project designed to assess the aesthetic potential of genetics in contemporary culture. It takes its name from the Greek prefix 'xenos,' or 'stranger,' which usually designates a difference between species. In the Xenotext Experiment, Bök takes William S. Burroughs' often-repeated aphorism that language is a virus from outer space literally (Burroughs and Odier, 1974); his 'xenotext' is 'an alien text.' The Xenotext Experiment itself is both simple and audacious: Bök is working to embed a poem into the DNA of another life-form in such a way that it will actually write further poems as it grows.

As its etymology suggests, the Xenotext Experiment is a boundary object *par excellence*. Susan Leigh Star and James R. Griesemer (1989) define 'boundary objects' as those objects 'which both inhabit several intersecting social worlds ... *and* satisfy the informational requirements of each of them' (393). They are solid enough to be recognizable in each of the worlds that they inhabit, yet plastic enough to take on different local meanings; as such, they serve as a means of translation between realms of human endeavour (Star and Greisemer, 1989). Boundary objects are produced by collaborations between theorists, amateurs and sponsors (including funding bodies and institutions), some of whom share common goals. For many, participation in the endeavour to create or preserve something is sufficient motivation. For others, such participation 'is only the beginning of a long process of making arguments to professional audiences and establishing themselves as "experts" in some theoretical domain' (Star and Griesemer, 1989: 408-09). Thus, scholarly publications are also a type of boundary object; key articles create 'obligatory passage points' between fields (Star and Griesemer, 396). As such, the acts of writing about embedding a poem into a strand

of living DNA and modeling the process through software created a series of boundary objects before any 'wet' biology actually took place.

There are actually a number of precedents for the Xenotext Experiment in science, art, and literature. (Novelty is not a major criterion for Bök's aesthetics. As the example of *Eunoia* demonstrates, his standard operating procedure is to find a really good idea that has never been developed to its full potential, then execute it in a more thorough and sophisticated manner than anyone else has.) These fictions, thought experiments, and actual experiments are all border objects that collectively constitute a recognizable and active interzone between media art, poetry, biology, astrobiology, software modelling, science fiction, religion, and communication studies. On *Star Trek: The Next Generation*, Season 6, Episode 20 (1993), 'The Chase,' the Federation, the Klingons, Romulans, and Cardassians are all racing to decipher a message that has been encoded in the DNA of all humanoid species in the Alpha Quadrant (Frakes). 'The Chase' was inspired by another science-fiction text, Carl Sagan's 1985 novel *Contact*, where humans discover a message from a much older alien race embedded deep within the value of pi. Sagan, of course, was a scientist as well as an author of fiction; the ideas in *Contact* also appeared in Sagan and I.S. Shklovski's 1966 book *Intelligent Life in the Universe*.

Other scientists have also given this idea serious consideration for decades. Hiromitsu Yokoo and Tairo Oshima's 1979 paper 'Is Bacteriophage [Phi] ϕ 174 DNA a Message from an Extraterrestrial Intelligence?' argued that 'biological media should not be neglected as possible information exchange systems between interstellar civilizations' (148), and that there are even some likely places to begin looking. Bacteriophage phi ϕ 174 was the first DNA-based genome ever sequenced. This virus appears in the extremely common and hardy *E. coli*, which, over the years, has become one of the cellular media of choice for biopoets. From the perspective of Yokoo and Oshima in 1979, artificially modifying bacterial DNA in such a way that it could simultaneously reproduce and carry an intelligent message encoded in its base sequence was still decades away. By that point, they were quite confident that launching

an encoded microorganism to other stars would be well within reach. But why would they bother?

‘Biological media,’ argue Yokoo and Oshima, ‘have certain advantages over electromagnetic waves’ (148). Unlike telecommunications media, biological messages embedded in hardy microorganisms that automatically reproduce themselves could quickly cover an entire planet and persist for very long periods after their delivery. Other standard problems encountered in telecommunications, such as frequency, bandwidth, the direction and directivity of antennas, and even theoretical competition with the noise of an alien society’s own electromagnetic communications, do not arise with biological media. Yokoo and Oshima (1979) believed that if the carrier microorganism was carefully matched to its environment, it would be possible to eliminate errors introduced into the message during replication (149-50). Though the rest of Yokoo and Oshima’s theories have proved surprisingly prescient, their dream of noise-free communication is something of a fantasy.

Barely a decade after Yokoo and Oshima theorized that it would be possible to embed messages in DNA, artists, writers and scientists started doing just that. In 1990, Joe Davis began embedding tiny works of art into the DNA of *E. coli*. His ‘Microvenus’ is a minimalist piece of visual poetry that evokes both the Germanic rune for life and a line drawing of the female genitalia. He calls such creations ‘infogenes,’ and has designed them ‘to be translated by the machinery of human beings into meaning, and not by the machinery of cells into protein.’ His plan was very much in line with Yokoo and Oshima’s work; he wanted to replicate ‘infogenes’ (Gibbs, 2001: 5) by the trillions and then shoot them into space.

In 1998, proclaiming that ‘biological processes are now writerly’ (Kac, 2005: 254), Brazilian poet and visual artist Eduardo Kac (2007) unveiled his *Genesis* project, one of a series of proposed ventures into a field he calls ‘biopoetry.’ Kac’s *Genesis* translates a Biblical verse (‘Let man have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moves upon the earth’) into Morse code and embeds it into the DNA of *E. coli*. Kac then ‘edits’ the text by expos-

ing the gene to radiation and documenting the random mutations. Bök's uncharitable description of Kac's work demonstrates that even among fellow travellers, the production of boundary objects can and does generate controversy:

it does not seem radically different from the act of inserting a copy of the Bible into the saddlebag of a donkey, and then letting the donkey wander on its own through a minefield. I think that, if possible, the inserted text must change the behavior of the donkey in some profound way, perhaps converting it to Christianity, if you like' (Ball, 2009: 51).

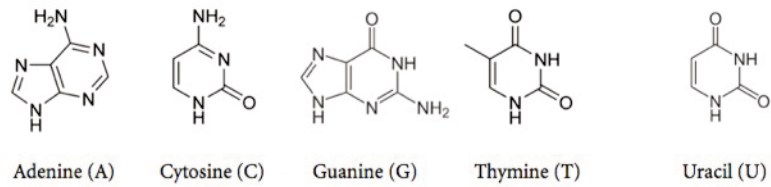
Regardless of Bök's disdain, the results of Kac's *Genesis* have been presented as a gallery installation featuring projections of live cultures, still images, and artifacts, such as a pastiche of the Rosetta stone, with the verse expressed in English, Morse and DNA codons, both before and after the mutation. Precisely because of Bök's disdain, the size and value of this zone of boundary objects continues to increase, as documents and other objects multiply in response.

In 2003, Pak Chung Wong encoded the lyrics to 'It's a Small World (After All)' into a strand of DNA inside *Deinococcus radiodurans* (Wong, Wong, and Foote, 2003), an organism discovered in the 1950s while scientists were irradiating canned food in order to see if they could prolong its shelf life. The food still rotted, but the scientists became interested in *D. radiodurans* because it survived. It can actually repair its own DNA so quickly that it can survive 1000 times the dosage of gamma radiation needed to kill a human being instantly; some biologists have even suggested that an ancestor of this organism must have evolved in outer space, possibly on Mars (Pavlov, Kalinin, Konstatinov, Shelegedin, and Pavlov, 2006). Language is a virus from outer space. Wong and his colleagues are interested in this process as a means of preserving cultural heritage for some unimaginable posterity: 'organisms ... on Earth for hundreds of millions of years represent excellent candidates for protecting critical information for future generations' (Wong, Wong and Foote, 2003: 98).

Bök's Xenotext Experiment differs from all of its precedents in several important respects. All of the aforementioned projects are interested in using biological media as a storage container for pre-existing texts. Most of the predecessors of the Xenotext Experiment also imagine the possibility of the faithful transmission of information. Bök, however, sees his work as a starting point, not a goal. In the Xenotext Experiment, the host organism responds to the sequence grafted into its genome by expressing this gene in the form of a benign protein that is itself a new text. In other words, the microorganism that Bök has implanted will become the co-author of a new poem.

Wikipedia usefully tells us that 'The main role of DNA molecules is the long-term storage of information' (Wikipedia contributors, 2010). What Bök is doing is using DNA to store his own information. To understand how this is possible, recall the film *GATTACA*, which depicts a future where privileged humans are genetically engineered. The title is a word made up of four letters: A, C, G, and T, which stand for adenine, cytosine, guanine, and thymine, the four nucleotides that are the major components of DNA. Nucleotides appear in sets of three called *codons*. Bök begins by selecting twenty-six codons and assigning one codon to a letter of the alphabet. But DNA is also a set of blueprints for how to build a particular kind of body. DNA does not just replicate itself through a process called transcription; the codons in DNA are translated into instructions for the creation of amino acids, used to build proteins. In DNA, each of the nucleotides is translated into another during RNA transcription: adenine translates to uracil (which stands in for thymine); thymine translates to adenine; guanine translates to cytosine; and cytosine translates to guanine. (See FIGURE 1.)

Transcription is much like a newspaper cryptogram, except that instead of one set of letters being gibberish and the other being meaningful, both sets are meaningful. Because there is a codependent biochemical relationship between any preliminary DNA sequence and its resultant RNA sequence (which creates the string of amino acids in the protein), Bök's two poems must also be codependent in order for his project to work. He is therefore always writing two poems at the same



DNA REPLICATION					
DNA:	Adenine (A)	Thymine (T)	Cytosine (C)	Guanine (G)	GTA GCG CTA ATC
	↓	↓	↓	↓	↓
DNA:	Thymine (T)	Adenine (A)	Guanine (G)	Cytosine (C)	CAT CGC GAT TAG
mRNA TRANSCRIPTION					
DNA:	Adenine (A)	Thymine (T)	Cytosine (C)	Guanine (G)	GTA GCG CTA ATC
	↓	↓	↓	↓	↓
mRNA:	Uracil (U)	Adenine (A)	Guanine (G)	Cytosine (C)	CAU CGC GAU UAG

(Nucleotides, showing DNA replication and mRNA transcription)

FIGURE 1

time – poems that are mutual ciphers of each other.

There are 7 trillion, 905 billion, 853 million, 580 thousand, 6 hundred and 25 (7,905,853,580,625) ways to pair up all of the letters in the alphabet so that they mutually refer to each other. All Bök has to do is find one of these ciphers that works in such a manner that when he writes a poem using one of the letters in the pair, it produces a second poem using the other letter. No poet in history has ever done this. Bök is not, however, performing this search manually; he wrote a program in Perl into which he can input a cipher for a program to search the whole English lexicon for all the word-pairs that appear in that cipher. Yet there are more constraints for this writing project. First, the poem has to be about the relationship between language and genetics. Second, the artificial gene that he fashions cannot impair the functioning of the microbe in any way, or mutate it (like Wong et al. [2003], Bök plans to use *D. radiodurans* as his single-celled co-author because it is extremely hardy). In order to make this all work, Bök speculates that he may have to begin by looking at existing harmless proteins for something that is almost meaningful, and then work backwards in order to ‘reverse engineer’ his poem. Here again, the microorganism is emerging as a collaborator in the process of authorship.

In order to keep track of the ciphers most likely to produce a successful result, Bök numbers all of his experiments, and identifies them by codon-pairs that define the cipher. In the cipher ING-ARY 786, for example, I corresponds to A, N to R and G to Y; 786 is the total number of words in this cipher’s lexicon. (See FIGURE 2.)

Along with each alphabet cipher, Bök keeps notes on the way that the creation of words works: ‘abased,’ for example, is also ‘iciest’; ‘binary’ is also ‘caring,’ and ‘bin’ is also ‘car.’ In another cipher called WOR-VIT 190, the imagist poem ‘tidal / words of life / copy song’ corresponds to ‘roads / vital in song / pick life.’ These are, he emphasizes, starting points. After hundreds of experiments over several years, Bök has yet to find a cipher that produces more than 786 words, and most of those words are less than five letters long. As a result, he expects that the final poem will have to be less than twenty words long; his initial estimate was 200.

Ing-Ary 786

ALPHABET: a b c d e f g h i j k l m n o p q r s t u v w x y z
XENOCODE: i c b t s w y l a q v h p r u m j n e d o k f z g x

a	=	i
abased	=	iciest
able	=	ichs
ad	=	it
ae	=	is
ar	=	in
are	=	ins
at	=	id
ate	=	ids
aw	=	if
awe	=	ifs
bad	=	cite
banjos	=	cirque
bars	=	cine
bhut	=	clod
bice	=	cabs
bid	=	cat
bide	=	cats
bids	=	cate
big	=	cay
bin	=	car
binary	=	caring

etc.

(ING-ARY 786 – a cipher tested as a candidate for *The Xenotext*)

FIGURE 2

In spring 2011, Bök settled on a cipher called ANY-THE 112. (See FIGURE 3.) This cipher allowed the writing of an as-yet unpublished short lyric poem of fourteen lines in length, beginning with the lines ‘any style of life / is prim,’ and ending with ‘my myth / now is the word / [blank line] / the word of life.’ RNA transcription enciphers the poem into a new 14-line text, beginning ‘the faery is rosy / of glow,’ and ending ‘we wean / him of any milk / [blank line] / any milk is rosy.’ While the conclusion of the first poem self-reflexively alludes to the hubristic act of its own encoding, the opening and final lines of the second poem are literally significant. Biologists often include the red fluorescent protein ‘mCherry’ as part of the genetic sequences that they construct, because, when the protein is built by the organism, this gene causes the protein to fluoresce. The conclusion of the enciphered poem, therefore, self-referentially invokes the physical process that ostensibly provides an index of its creation.

After settling on a cipher and encoding the sequence by hand, Bök simulated the resulting protein on a supercomputer at the University of Calgary’s Institute for Biocomplexity and Informatics (IBI) using Rosetta software, which simulates the folding of proteins. This is one of the hardest problems in biology. How proteins fold is poorly understood, given the sheer number of options available, but the folding pattern is always the same for any given protein. The software makes a best guess, so a successful simulation does not guarantee successful results. After simulation, Bök sent his specifications to DNA 2.0, a company in the United States, which then manufactured the gene and sent it back to IBI in the form of a plasmid. Biologists at IBI then took the gene sequence and transplanted it into a strain of *E. coli* in March 2011.

Beginning on March 31, 2011, the following notes appeared in Bök’s Twitter feed:

‘The Xenotext’ works! The x-P13 gene (for making Protein 13) has caused *E. coli* to fluoresce red in test-runs. Now onward to *D. radiodurans*! (31 March 2011, 4:29 PM EST)

Any-The 112

ALPHABET: a b c d e f g h i j k l m n o p q r s t u v w x y z
XENOCODE: t v u k y s p n o x d r w h i g z l f a c b m j e q

(ANY-THE 112 – the cipher used to write the poems for *The Xenotext*)

FIGURE 3

Art Spiegelman now knows about 'The Xenotext.' (1 April 2011, 3:19 PM EST)

'The Xenotext' causes its microbes to twinkle like the remotest galaxies in the void: <http://j.mp/gSS6nK> (1 April 2011, 3:19 PM EST).

The link in this last tweet led to a microphotograph. (See FIGURE 4.)

Shortly before these tweets appeared, Bök had been informed by IBI that the *E. coli* bacteria were fluorescing, signifying that successful RNA transcription had occurred. However, as Umberto Eco (1976) noted wryly many years ago, the best definition of the sign is that it is anything that can be used to tell a lie. In terms of indexical signs, where there is smoke, there is not always fire; likewise, where there is a rosy glow, there is not always a complete protein. That these tweets appeared over April Fool's Day only compounded the impending irony.

In April 2011, Bök travelled to the Bury Art Gallery in Manchester to install a large model of Protein 13 (approximately two metres across), constructed out of MolyMod components (the Lego of molecular modeling tools), a process that took over a week of work. (See FIGURE 5.) During this period, and in part, because of this installation, the Xenotext Experiment continued to receive a great deal of publicity from both the scientific and popular presses. In 2009, Bök became the first poet to have his work featured in the pages of the prestigious science journal *Nature* (Zala, 2009); the *New Scientist's* 'CultureLab' blog featured the Xenotext Experiment (Condliffe, 2011). Bök had discussed The Xenotext Experiment in popular arts media, namely on *Q*, CBC Radio's (2010) national magazine show; and 'The Strand' on BBC World Service radio was the first media broadcast to feature the full working text of the two poems in the Xenotext Experiment (BBC Radio, 2011). All of this popular exposure, in addition to various interviews, magazine features, and Bök's own descriptions of the Xenotext Experiment's success on Twitter and the Poetry Foundation blog *Harriet* (Bök, 2011b; Bök, 2011c), meant that when a problem occurred, the stakes were already high.



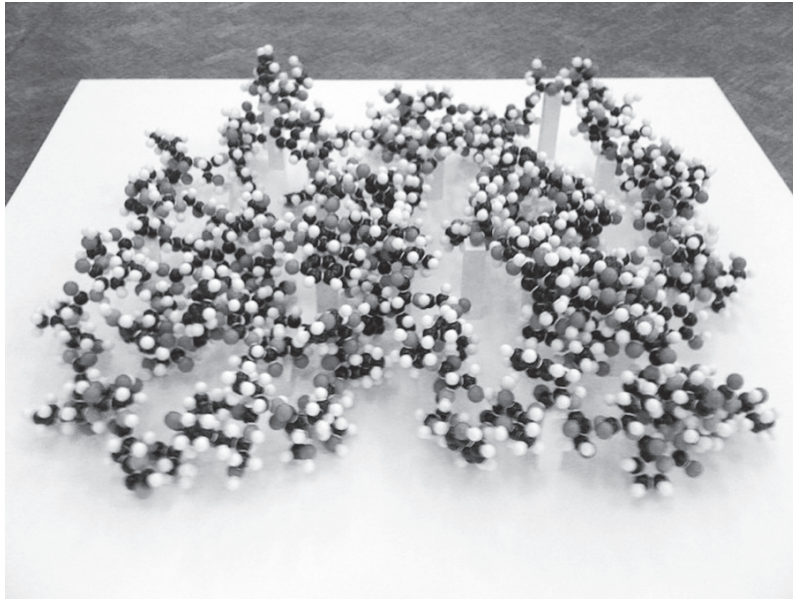
(Microphotograph of *E. coli* fluorescing in the presence of Protein 13)

FIGURE 4

In the third week of April 2011, Bök was notified by IBI that despite the fact that the *E coli* were fluorescing, Protein 13 was not expressing itself properly. The lab ran an electrophoresis (i.e. made a gel) to determine the final protein's size, and it came to about half the expected length. Since the mCherry fluorescent tag is about the same length as the strand of the protein containing the poem, Dr. Sui Huang of IBI (an expert in the field of systems biology, who succeeded Bök's initial partner in the experiment, Dr. Stuart Kauffman, when he retired) reported that the poem was being destroyed, though he was unsure of why or when. Huang did hypothesize that it was possible that the repetitive subsequences of the poem-embedded gene may have caused problems in interpretation – that is, the bacteria may have interpreted the presence of the poem as a retrovirus that it had to exclude. A successful artificial gene sequence has to reflect the codon-usage bias of the host organism; that is, the sequencer must ensure that there are not any superfluous subsequences that are being interpreted as other kinds of instructions. In this first attempt, Bök chose to ignore the difficulty of the manufacturing process while composing the sequence. DNA 2.0 does not like manufacturing genes where more than ten bases repeat. This constraint has important implications for anyone trying to encipher a text: one is that if only nine bases are repeated, then the poem could not repeat a 3-letter word, which makes many standard poetic effects impossible.

As of this writing, Bök is trying an alternate enciphering method that eliminates many of the repetitions in the original version by changing the way that spaces are encoded in the poem (Bök, 2011a). (See FIGURE 6.) The worst-case scenario would be that the poem itself is flawed, and that there is no way to encipher it, which would mean beginning from scratch. Instead of producing the first bacterial co-author, Bök has produced the first bacterial literary critic.

So what would McLuhan's media poetics allow us to glean from the Xenotext Experiment and its cousins? McLuhan's most famous insight is that understanding communication requires us to pay attention to the materiality of media as well as (and often instead of) its



(MolyMod sculpture of Protein 13 at Bury Art Gallery, April 2011)

FIGURE 5

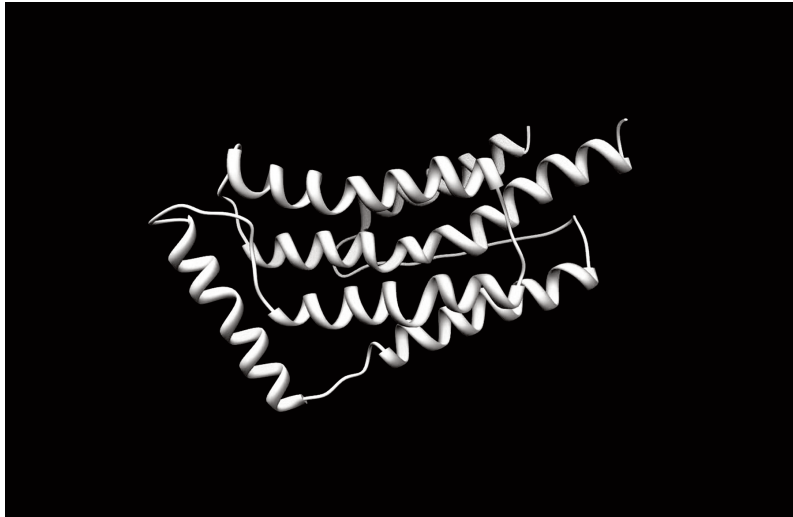
content. Materiality is not just the hardware or the packaging, as Will Straw (2009) notes, but also

the materially embedded character of cultural expression, its inscription (as with writing) or iteration (as with performances) within arrangements of technologies, bodies and physical structures. Media forms ... provide the contours in which cultural expression is contained and shaped; media forms store or transmit this expression in culturally pertinent ways' (21).

But as McLuhan and Wilfred Watson (1970) put it in *From Cliché to Archetype*, new media environments (say, the alphabet itself, in the case of *Eunoia*, or the DNA inside of *D. radiodurans* in the case of the Xenotext Experiment) are 'invisible and invincible' (175) until new artistic styles and probes bring them to the public's attention. We need to make them visible because it is not the historical context that enables the understanding of a given work of art, but the work of art that provides a context which allows us to understand a given historical situation (Žižek, 2004).

The Xenotext Experiment is a wake-up call to the surprising and sometimes controversial possibilities of biotechnology. It is also about the way that cultural expression – poetry, in this case – is shaped by the forms that it takes, and the ways that it is transfigured when it stops being words on a page. A poem inside a strand of DNA is not the same as the same letters written on a page or displayed on a screen, but DNA with a poem embedded in it is also quite remarkable. What should interest us is not the content of any of the projects that I have mentioned (which ranges from perhaps banal to not-yet-written) but rather the shift in perspective that simultaneously forces a reconsideration of what we mean when we talk about 'biology,' 'media art,' 'poetry,' 'communication studies,' and culture itself.

Thinking about cells, molecules, proteins and genes as surfaces for reading and writing – in other words, as media – has all kinds of interesting implications. One of them is the ongoing need to rethink what it means to be an author. McLuhan was fond of citing Wyndham Lewis's

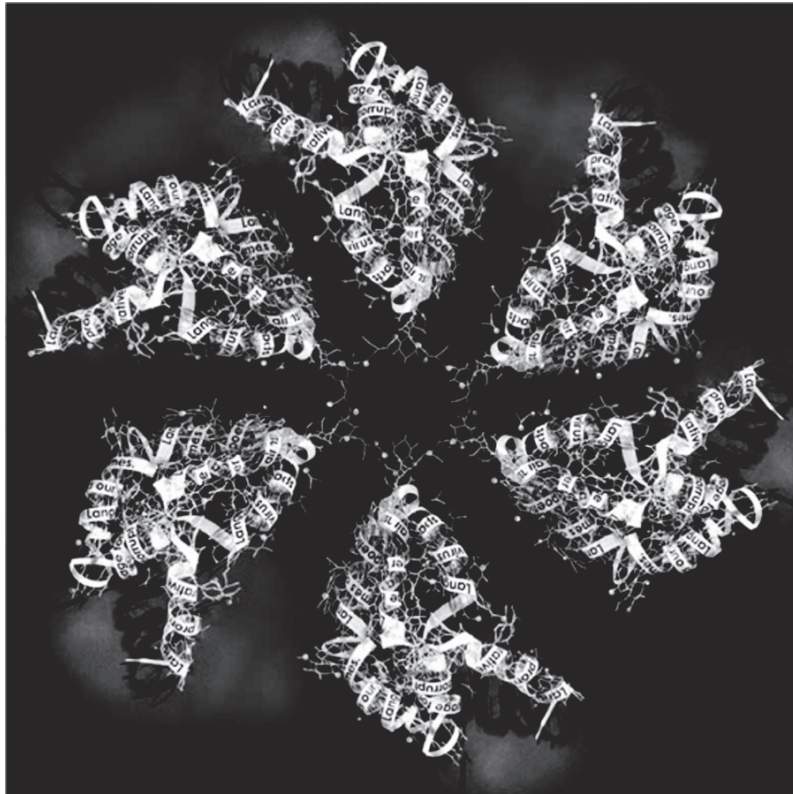


(Computer simulation of the backbone for Protein 13, second version)

FIGURE 6

epithet for writers, ‘The Apes of God,’ as a way of pointing out the dual nature of writing as a divine act of the creation of worlds, and as a base imitation of another’s creative process. The Xenotext Experiment embodies both aspects. This is not a poetry for romantics or auteurs; you cannot make biopoetry alone. The Xenotext Experiment already involves a variety of collaborators: its technological expertise was initially supplied by systems biologist Stuart Kauffman, a MacArthur Fellow and the author of many books, including *Reinventing the Sacred: A New View of Science, Reason, and Religion*. Kauffman’s work involves developing mathematical models to explain possible sources of emergent order during the origins of life. Since the inception of the Xenotext Experiment, Kauffman has retired, and has been replaced on Bök’s project by Dr. Sui Huang (though Bök recently [late 2010] learned that Dr. Huang is departing IBM for Seattle, presenting another possible roadblock to his project’s completion). Visual artist Eveline Koliijn has provided some of the aesthetic expertise for the project, producing a portfolio of silkscreen prints based on work from the Xenotext Experiment to date, along with a sculpture based on the radioresistant protein in *D. radiodurans*. (See FIGURE 7.) Perhaps most crucially, the microorganism itself is an active collaborator, potentially writing – but currently redacting and editing – new poems itself through the process of RNA transcription.

What is important, and what falls away, in the Xenotext Experiment depends on which social world is regarding the object. To date, the poems themselves have played a relatively minor role. Bök has not actually published them in print, only described them; the only time they have been performed on broadcast media is on BBC’s ‘The Strand’ (2011). I believe that part of the Xenotext’s popular and scientific success is due to the poetry being in the background. Few, if any, interviewers ever ask about the poems because the general public does not care about poetry, except as a sort of inoculation against encountering more poetry; according to BookNet Canada, only 0.12 percent of total market sales in Canada in 2010 were poetry (Fresh Air, 2011). This is also, conversely, what allows prominent poets like Lisa Robertson to publicly discount



(Sculpture of the protein for radioresistance in *D. radiodurans*)

FIGURE 7

the significance of the Xenotext Experiment, as happened at *North of Invention*, a recent conference on contemporary Canadian poetry at the University of Pennsylvania (Kelly Writers House, 2010). The division of knowledge that Latour (1993) describes in *We Have Never Been Modern* is in full effect, not despite, but as compensation for, what projects like the Xenotext Experiment imply about what is now necessary to produce socially meaningful poetry in a contemporary milieu.

The division of knowledge in the academy between disciplines is not the only issue. As Star and Griesmer (1989) imply, institutions and funding bodies are also actively involved as gatekeepers in the constitution and maintenance of boundary objects. Bök started seeking funding for the Xenotext Experiment from SSHRC in 2005, but only received a SSHRC Research Creation grant in 2008. This long and frustrating process of supplication is documented in 'Pemosapien: Christian Bök and His Quest To Write A Living Poem,' a nonfiction comic which originally appeared in *Unlimited* magazine in 2008. In the last three frames, Bök dismisses the literary substance of various poems he's performed that were generated by various possible ciphers as 'Pretty bad. These are just ways of showcasing this for grants or something.' After being rejected by a periwigged arts council jury, who are banging a gavel and proclaiming 'Won't Sell! Won't Finish! Science Fiction!', the author thinks to himself 'idiots ... fucking idiots' (Johnson, 2008: 51). (See FIGURE 8.) What is actually occurring, though, is not a failure, but the difficult negotiation of protocols between social worlds, which indicates that the boundary object is actually functioning as a kind of bridge. Star and Griesemer (1989) conclude that 'protocols are not simply the imposition of one world's vision on the rest; if they are, they are sure to fail' (414). Because of the Xenotext Experiment, a poet can simultaneously inhabit the social worlds of public intellectuals, scientists doing post-graduate level biology and computer programming, celebrities, media theorists and slightly rumped, grumpy Tintin-like cartoon characters, as well as the more usual realms of artists and academics. But these worlds, and the people and objects that make the constitution of boundary objects like the Xenotext possible, also make demands that change



(Excerpt from *Poemosapien* by Nickelas Johnson)

FIGURE 8

what it means to be a poet, and what it means to write a poem. As Isabelle Stengers (1997) remarks in *Power and Invention*, accusations of ‘failure’ are ideologically marked:

the successive failures that some sciences encounter in creating an object capable of mutually arousing, articulating, and implying the interests of a community could be in themselves *interesting*. The failure is, potentially, as a consequence of its irreversibility, an apprenticeship: one could, but one can no longer, think that ... But, very often, those who propose a new attempt, a new foundation, consider the failures as errors, ideological deviations, and so on; that is, the failures are related to the inadequacy of those who encountered them. (89, emphasis in original)

Regardless of whether or not Bök succeeds in the encoding of the poems written with ANY-THE 112, or another cipher, or whether it is remembered as a Wellesean hoax or a Duchampian success through failure, such negotiations will continue to occur, as bridges between these social worlds come and go. The only real failure is in ignoring the implications of the attempts.

And what of the readers? Who is this message for? Will they ever find it? Does it matter? At the heart of the Xenotext Experiment is a set of basic problems about the nature of communication itself. In *Speaking Into the Air*, John Durham Peters (1999) describes the history of thinking about communication as a spectrum that ranges between the longing for perfect understanding, and the risk of total loss of meaning. The idea of using bacteria to communicate with alien intelligences merely underlines problems that are always present in any communicative act: the risk of reaching out, and the real possibility of failure. What if a vastly more intelligent species (either in outer space, or in some unimaginable moment in our own future, for instance, if humanity is replaced by a race of intelligent raccoons) discovers our message to them and successfully translates it? O. B. Hardison (1989) describes the likely outcome with this analogy in *Disappearing Through the Skylight*: we can communicate with monkeys, but mostly do not bother very

often because we have discovered that monkeys mostly want to talk about kittens, getting their tummy rubbed, and where the next banana is coming from. Imagine being the monkey in that scenario; that is where humanity stands in the conversation with aliens (Hardison, 1989). Moreover, that is the best-case scenario; if pessimists like Stephen Hawking and Glen David Brin are correct, our attempts to communicate with aliens are most likely to result in wholesale destruction or slow digestion in some unimaginable extraterrestrial gullet (Brin, 1983; Leake, 2010).

The Xenotext Experiment also raises some intriguing questions about how we should ‘read’ the natural world, or where we should even begin to look, if everything is potentially an inscribed surface. What is at stake is a fine balance between perception and paranoia. Again, there is a long history of writers wondering what new forms of technological media might allow us to decode messages, and what it would mean if we actually found a message. In a 1919 essay called ‘Primal Sound,’ the poet Rainer Maria Rilke asked,

[w]hat if one changed the needle and directed it on its return journey along a tracing which was not derived from the graphic translation of sound but existed of itself naturally – well, to put it plainly, along the coronal suture, for example’ (2001: 23).

What if? New strategies for reading emerge all the time, many of which have little or nothing to do with the writer’s intent because language is inherently excessive and routinely frustrates any attempts to fix meaning. In the Philip K. Dick short story ‘The Preserving Machine’ (1971), a character named Doc Labyrinth is looking for a way to safeguard works of classical music against various kinds of possible catastrophes. He builds a machine that turns music scores into animals and sets them loose in the wild, only to discover later that they have mutated, and that when he attempts to decode the original pieces of music, they too have transformed in unexpected and discordant ways. Stengers (1997) argues that the ‘hero’ of experimental literature is neither the scientist nor the phenomenon that they investigate, but rather the connection between

them that the scientist-writer is able to claim because of the experiment. What is converted in the process is once again neither scientist-writer nor phenomenon, but the apparatus which gives the experiment its sense ... in the process of this connection, it converts enemies into allies (164).

'Artists,' insisted Ezra Pound (1922), 'are the antennae of the race' (73). Marshall McLuhan (1964) picked up on Pound's broadcast and retuned it for his own purposes, but doing so transformed him as a scholar and a person, and helped bring a new discipline into existence. As scholars, artists, theorists, journalists, scientists, and members of the public collectively strive and squabble to bring new media art objects into existence, it would be wise to pay attention to the ways that this process is transforming us.

REFERENCES

- Ball, Jonathan. (2009). "I Foresee That I Will Be Able to Write Two Poems – I Just Don't Know Yet Whether or Not They Might Merit Preservation in an Organism for the Next 6 Billion Years": An Interview with Christian Bök.' *The Believer*, 7.5, 47-54.
- BBC Radio. (2011, June 1). 'Beginners, Christian Bok and Alela Diane.' *The Strand*. BBC World Service. URL: <http://www.bbc.co.uk/iplayer/episode/poogvpk/The_Strand_31_05_2011/>.
- Bök, Christian. (2001). *Eunoia*. Toronto: Coach House Books.
- . (2002). 'Pataphysics: The Poetics of an Imaginary Science'. Evanston: Northwestern University Press.
- . (2011a, April 2). 'Christian Bok, Experimental Poet [Twitter Feed]'. Twitter.com. URL: <<http://twitter.com/#!/christianbok>>. [April 2 2011].
- . (2011b, April 10). 'The Untimeliness of the Xenotext'. *Harriet the Blog*. The Poetry Foundation. URL: <<http://www.poetryfoundation.org/harriet/2011/04/the-untimeliness-of-the-xenotext/>>. [April 10, 2011].
- . (2011c, April 2). 'The Xenotext Works'. *Harriet the Blog*. The Poetry Foundation. URL: <<http://www.poetryfoundation.org/harriet/2011/04/the-xenotext-works/>>. [April 2, 2011].
- Brin, Glen David. (1983). 'The 'Great Silence': The Controversy Concerning Extraterrestrial Intelligent Life.' *Quarterly Journal of the Royal Astronomical Society*, 24, 283-309.
- Burroughs, William S., and Odier, Daniel. (1974) *The Job: Interviews with William S. Burroughs*. Revised and enlarged edition. New York: Grove Press.
- CBC Radio. (2010, June 23). 'Christian Bok on the Xenotext Experiment'. *CBC Books*. URL: <<http://www.cbc.ca/books/2010/06/christian-bok-on-the-xenotext-experiment.html>>. [June 23, 2010.]

- Condliffe, Jamie. (2010, June 23). 'Cryptic Poetry Written in a Microbe's DNA'. *CultureLab: Where Books, Arts and Science Collide*. URL: <<http://www.newscientist.com/blogs/culturelab/2011/05/christian-boks-dynamic-dna-poetry.html>>. [May 4 2011.]
- Dick, Philip K. (1971). *The Preserving Machine and Other Stories*. London: Gollancz.
- Eco, Umberto. (1976). *A Theory of Semiotics: Advances in Semiotics*. Bloomington: Indiana University Press.
- Fresh Air. (2011, April 9). 'To Read or Not to Read: Fresh Air Considers the State of Poetry in Canada.' *Fresh Air*. URL: <<http://www.cbc.ca/books/2011/04/to-read-or-not-to-read-fresh-air-considers-the-state-of-poetry-in-canada.html>>. [April 11, 2011].
- Gibbs, W. Wayt. (2001). 'Art as a Form of Life.' *Scientific American*, 284.4, 40-41.
- Gordon, W. Terrence (1997). *Marshall McLuhan: Escape into Understanding*. Toronto: Stoddart.
- Grau, Oliver. (2007). *MediaArtHistories*. Cambridge: MIT Press.
- Hardison, O. B. (1989). *Disappearing Through the Skylight: Culture and Technology in the Twentieth Century*. New York: Viking.
- Higgins, Dick, and Higgins, Hannah. (2001). 'Intermedia.' *Leonardo*, 34.1, 49-54.
- Johnson, Nickelas. (2008). 'Poemosapien: Christian Bök and His Quest to Write a Living Poem.' *Unlimited*, 7 46-51.
- Kac, Eduardo. (2005). *Telepresence and Bio Art: Networking Humans, Rabbits and Robots*. Studies in Literature and Science. Ann Arbor: University of Michigan Press.
- . (2007). *Media Poetry: An International Anthology*. Bristol; Chicago: Intellect.
- Kelly Writers House. (2010). *North of Invention: A Canadian Poetry Festival*. Philadelphia. University of Pennsylvania. URL: <<http://writing.upenn.edu/wh/archival/events/northofinvention/>>.
- Kittler, Friedrich A. (1990). *Discourse Networks 1800/1900*. Stanford: Stanford University Press.

- Latour, Bruno. (1993). *We Have Never Been Modern*. Cambridge: Harvard University Press.
- Latour, Bruno, and Woolgar, Steve. *Laboratory Life: The Construction of Scientific Facts*. Princeton: Princeton University Press.
- Leake, Jonathan. (2010, April 25) 'Don't Talk to Aliens, Warns Stephen Hawking.' *The Sunday Times*. [Online edition.] URL: <http://www.timesonline.co.uk/tol/news/science/space/article7107207.ece> [December 12, 2010].
- McLuhan, Marshall. (1964) *Understanding Media: The Extensions of Man*. Signet Books (2nd ed.). New York; Scarborough: New American Library.
- . *Verbi-Voco-Visual Explorations*. (1967). New York: Something Else Press.
- . *Culture Is Our Business*. (1970). New York: McGraw-Hill.
- McLuhan, Marshall, and Carson, David. (2003). *The Book of Probes* (1st ed.). Corte Madera: Gingko Press.
- McLuhan, Marshall, and Watson, Wilfred. (1970). *From Cliché to Archetype*. New York: Viking Press.
- Pavlov, Anatoly K.; Kalinin, Vitaly L.; Konstantinov, Alexei N.; Shelegedin, Vladimir N.; and Pavlov, Alexander A. (2006). 'Was Earth Ever Infected by Martian Biota? Clues from Radioresistant Bacteria.' *Astrobiology*, 6.6, 911-18.
- Perec, Georges. (1994). *A Void*. (Trans. Gilbert Adair) London: Harvill.
- Peters, John Durham. (1999). *Speaking into the Air: A History of the Idea of Communication*. Chicago: University of Chicago Press.
- Pound, Ezra. (1922). 'Paris Letter: December 1921.' *Dial*, LXXII.1, 73-78.
- . (1934). *ABC of Reading*. New Haven: Yale University Press.
- Rilke, Rainer Maria. (2001). 'Primal Sound.' *The Book of Music and Nature: An Anthology of Sounds, Words, Thoughts*. (Eds. David Rothenberg and Marta Ulvaeus). Middletown: Wesleyan University Press. 21-24.
- Sagan, Carl. (1985). *Contact: A Novel*. New York: Simon and Schuster.
- Sagan, Carl, and Shklovskiĭ, I. S. (1966). *Intelligent Life in the Universe*. San Francisco: Holden-Day.

- Star, Susan Leigh, and Griesemer, James R. (1989). 'Institutional Ecology, "Translations" and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39.' *Social Studies of Science*, 19.3, 387-420.
- Stengers, Isabelle. (1997). *Power and Invention: Situating Science*. Minneapolis; London: University of Minnesota Press.
- Straw, Will. (2009). 'The Circulatory Turn.' *The Wireless Spectrum: The Politics, Practices and Poetics of Mobile Media*. (Eds. Barbara Crow, Michael Langford, and Kim Sawchuck) Toronto: University of Toronto Press. 17-28.
- Thacker, Eugene. (2004). *Biomedica*. Minneapolis: University of Minnesota Press.
- 'The Chase'. (1993, April 26). Episode 20 [Season 6]. *Star Trek: The Next Generation*. Los Angeles: Paramount Television.
- Wikipedia contributors. (2010). 'DNA.' *Wikipedia*. URL: <<http://en.wikipedia.org/wiki/DNA>>. [April 3, 2010.]
- Wong, Pak Chung; Wong, Kwong-Kwok; and Foote, Harlan. (2003). 'Organic Data Memory Using the DNA Approach.' *Communications of the ACM*, 46.1, 95-98.
- Yokoo, Hiromitsu, and Oshima, Tairo. (1979). 'Is Bacteriophage [Phi]x174 DNA a Message from an Extraterrestrial Intelligence?' *Icarus*, 38.1, 148-53.
- Zala, Krista. (2009). 'Q&A: Poetry in the Genes.' *Nature*, 458.5, 35.
- Žižek, Slavoj. (2004). *Organs Without Bodies: On Deleuze and Consequences*. New York; London: Routledge.