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Permutation of the real: Greg Egan's reinterpretation of virtual reality

Permutacje rzeczywistości: nowe oblicze wirtualnej rzeczywistości w powieści Grega Egana

Streszczenie:

Artykuł stanowi szczegółową analizę przedstawienia motywu wirtualnej rzeczywistości w powieści „Miasto Permutacji” (1994) australijskiego pisarza science fiction Grega Egana. Celem analizy jest ukazanie sposobu w jaki współczesna literatura science fiction odzwierciedla zmiany w postrzeganiu rzeczywistości spowodowane wzrostem znaczenia cyberprzestrzeni oraz symulacji komputerowych w dzisiejszym świecie. Poprzez analizę tekstu powieści oraz źródeł krytycznych, autor artykułu wyjaśnia naukowe podstawy opisywanej przez Egana idei mnogości wszechświatów - tzw. „teorii pyłu,” oraz sposobu w jaki teoria ta może sugerować nieprawidłowość tradycyjnego rozgraniczenia między rzeczywistością a rzeczywistością wirtualną. Wyniki rozważań wykazują, że treść opisywanej powieści stanowi raczej swoisty eksperyment myślowy oparty na teoriach fizyki oraz ontologii kwantowej, niż literacką grę stworzoną głównie dla zabawienia czytelnika.

Hasła kluczowe: *Miasto Permutacji*, teoria pyłu, wszechświaty wielokrotne, ontologia kwantowa, rzeczywistość wirtualna, cyberprzestrzeń, programy samoświadome

Summary:

The article is a detailed study of the concept of virtual reality as portrayed in *Permutation City*, a 1994 novel by an Australian science fiction author Greg Egan. The objective of the argument is to show how contemporary science fiction literature portrays the shift in perception of reality brought about by the growing importance of cyberspace and computer generated environments in today's world. Detailed analysis of the original text and critical sources is used to explain the author's scientific claims behind the central to the novel "dust theory" of multiple universes, and how this theory might be used to discredit the virtual vs. real distinction. The results thus obtained show that the novel is more of a serious thought experiment based on actual theories of quantum physics and quantum ontology than just a literary game designed primarily to amuse the reader.

Keywords: *Permutation City*, dust theory, multiverse, quantum ontology, virtual reality, cyberspace, conscious software

1. Introduction:

The emergence of cyberspace as a major theme in science fiction literature

Long before virtual reality evolved into what is commonly understood by the term today, i.e. an immersive computer-generated environment, science fiction writers such as Ray Bradbury, Philip K. Dick or Daniel F. Galouye, had been utilizing the concept in their works in order to explore themes connected with ontological and epistemological status of reality.

With the emergence of the cyberpunk movement in the 1980s, the virtual became one of the most significant motifs in science fiction literature. In his "Preface" from *Mirrorshades*, the first anthology under the literary tag, Bruce Sterling mentioned such writers as Harlan Ellison, Samuel R. Delany, Brian Aldiss, J.G Ballard, Robert Heinlein, Philip José Farmer and Thomas Pynchon among the major influences.¹ More of a popular cultural phenomenon than a formal literary movement, cyberpunk deals with themes of invasion into human body and mind such as „prosthetic limbs, implanted circuitry, cosmetic surgery, genetic alteration, [. . .] brain-computer interfaces, artificial intelligence, neurochemistry – techniques radically redefining the nature of humanity, the nature of self.”²

The novel which defined the essence of the new aesthetics was William Gibson's *Neuromancer* published in 1984. It was in this book that the word "cyberspace" was used for the first time to describe "[a] consensual hallucination experienced daily by billions of legitimate operators, in every nation... A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data."³ From then on, the word coined by Gibson has been the basic term commonly used to denote "a globally networked, computer-sustained, computer-accessed, and computer-generated, multidimensional, artificial, or 'virtual reality.'"⁴

Another quintessential cyberpunk novel which dealt with artificial environments was Neal Stephenson's *Snow Crash* (1992), in which virtual reality is used as a means of infecting human minds with a virus. In this way, virtual reality seems "real" enough to affect the brain which, in Stephenson's rendering, is not much more than a biological computer which is susceptible to programming. The book draws on

¹ B. Sterling, "Preface from *Mirrorshades*", *Storming the Reality Studio*, ed. L. McCaffery, New York: Duke University Press 1991, s. 343-344.

² Tamže, s. 346.

³ W. Gibson, *Neuromancer*; New York: Ace Books 1984, s. 51.

⁴ M. Benedikt, "Cyberspace: Some Proposals", *Cyberspace: First Steps*, ed. M. Benedikt, Cambridge: The MIT Press 1991, s. 122.

linguistics, history, sociology and philosophy to present an original theory of the beginnings of language, based on such seemingly distant things as the ancient Sumerian language and binary code.

Lisa Mason's novels *Arachne* (1990) and *Cyberweb* (1998) present another vision of virtual reality called "telespace." Mason describes a future in which the legal system is completely based on cyberspace, and all investigation and business proceedings take place online.

There are numerous other examples of books which draw on the theme of the virtual such as *Hardwired* (1986) by Walter John Williams, Orson Scott Card's *Ender's Game* (1991), or *Headcrash* (1995) by Bruce Bethke, but very often they present the theme only as a tool used to focus on other issues. Recent examples of such novels include also Richard K. Morgan's much acclaimed *Altered Carbon* (2003) and *Broken Angels* (2004).

Most frequently raised aspects of simulated reality are the influence on the condition of the human body and mind, as well as the redefinition of the concepts of space, identity and human relations. There are two main reactions to cyberspace that prevail in contemporary literature and criticism: "[o]ne of them is rejection of the fake, leading to a backlash against electronic culture. [. . .] The other reaction is one of skepticism regarding the concept of real life and its alleged authenticity."⁵

The objective of this article is the presentation of the ways in which virtual reality might undermine the validity of the real, as presented in the novel *Permutation city* by an Australian science fiction writer Greg Egan.

2. The author and his novel

Considered the most prominent figure of Australian science fiction literature, Greg Egan is not only a science fiction writer and author of scientific articles on relativity, black holes and quantum mechanics, but also a successful computer programmer. His hard science-fiction stories and novels e.g. *Quarantine* (1992), *Permutation City* (1994) or *Diaspora* (1997) deal with such themes as consciousness, virtual reality and quantum ontology.⁶ As he said in an interview for *Eidolon* in 1994, his novels are "concerned with the way the universe might actually work."⁷ In his approach he undertakes to present "issues that originally seemed

⁵ M.-L. Ryan, "Cyberspace, Virtuality and the Text", *Cyberspace Textuality, Computer Technology and Literary Theory*, ed. M.-L. Ryan, Bloomington: Indiana University Press, 1999, s. 90.

⁶ Greg Egan, "Wikipedia: The Free Encyclopedia, <http://en.wikipedia.org/wiki/Greg_Egan> [odczyt: 3.03.2006].

⁷ *An Interview with Greg Egan. Counting Backwards From Infinity*, "Eidolon" 15 lipca 1994, s. 42-45.

completely metaphysical, completely beyond the realms of scientific enquiry, actually becom[ing] part of physics.”⁸

The John W. Campbell Award winning *Permutation City* is set in the future where copying human personality and translating it into computer software, referred to as a Copy, has become possible. One of the main characters, Paul Durham, is a programmer and an insurance salesman, who allows himself to become scanned and copied onto a computer, in order to conduct experiments on Copies’ consciousness and the nature of virtual simulation in general. The protagonist’s mind “becomes analogous to computer software, literally becoming composed of zeros and ones, mimicking the computational and connectionist models of psychology.”⁹

According to Durham’s “dust theory”¹⁰ the universe is just one out of an infinite number of possible configurations of the same data. Following his idea, he designs a cellular automaton¹¹ universe, which is supposed to run endlessly after the hardware on which it is being computed is shut down. Part of Durham’s simulation is *Permutation City*, designed as an environment for Copies. Another simulated environment is the *Autoverse*, that is, a smaller universe, where strict and consistent laws of physics apply. The *Autoverse* planet *Lambertia* is seeded by Durham’s collaborator, Maria Deluca, with a primitive form of virtual “life” called *A. Lamberti*. The bacterium possesses the potential for evolution and Durham hopes that one day it can provide the inhabitants of *Permutation City* with an opportunity to explore alien life.

Paul’s experiment succeeds, when he runs his “Garden-of-Eden Configuration” (i.e. a state of the system which isn’t a result of any previous state), and the virtual inhabitants of *Permutation City* live in peace for millennia until intelligent creatures evolve on *Lambertia*. When Copies contact the creatures and try to explain their origin to them, the *Lambertians* reject the idea of being created by humans as irrational. Their denial of *Permutation City*’s existence causes the whole simulation outside of the *Autoverse* to implode, so that Copies are forced to evacuate to yet another pocket universe.

However, It is not the plot that makes *Permutation City* truly interesting, but the philosophy and scientific theories that lie behind it. The following section contains a discussion of Greg Egan’s idea of virtual simulation and its status in relation to core reality.

⁸ C. Pavón, ‘*The Way Things Are*,’ interview with Greg Egan, “Gigamesh”, lipiec 1998, s.14.

⁹ M. Dodge, R. Kitchin, *Mapping Cyberspace*, London: Routledge 2001, s. 205.

¹⁰ G. Egan, *Permutation City*, London: Millennium 1994, all subsequent references to the book will be marked parenthetically in the text by the abbreviation PC and page number.

¹¹ A cellular automaton is “any system in which rules are applied to cells and their neighbors in a regular grid.” - P. Callahan, *What is the Game of Life?*, 2000-2005 “Math.com,” <<http://www.math.com/students/wonders/life/life.html>> [odczyt: 5.03.2006].

3. Egan's reinterpretation of cyberspace

When writing about Egan's novel it is important to disambiguate the term "virtual reality." There are two basic kinds of computer simulation in *Permutation City*: one is called the Autoverse; the other one, the environment in which Copies are placed, is referred to as Virtual Reality. As one of the characters, Maria Deluca, explains, the Autoverse is different from Virtual Reality because it is run by "deeper laws" (PC 101) of logic. Copies, together with their virtual environment are just collections of random rules, which do not imitate the way the real world works. "Any copy could outrace a bullet, lift a building, move a planet from its course" (PC 88), as it is not constrained by a set of consistent laws of physics. The Autoverse, in contrast, is regulated down to the level of atoms. This type of simulation might be compared to a refined version of Conway's Game of Life. Conway has designed his cellular automaton as an endless two-dimensional grid of alive or dead "cells." Once the game has been set in motion, the behavior of the cells is determined by four laws – basically the cells can either "die" or "come to life" depending on the number of dead or live neighbors. The initial configuration of cells has a potential to evolve into a completely new pattern, which after some time tends to become stable. The Autoverse is a similar system, but so complex that once its initial stage is properly defined it may have the potential to generate something resembling real life forms. Both the Autoverse and Virtual Reality from the novel can be in fact referred to as a kind of "virtual environment," as long as we assume that the adjective "virtual" stands for the opposite of "real." However, the central idea of the novel – the "dust theory" of the universe undermines the distinction between simulation and reality as well as between mind and matter.

The idea of "dust theory" is a scientific exploration of an old theme of multiple universes or "multiverse" dating back to Michael Moorcock's novel *The Blood Red Game* from 1970.¹² What is new in Egan's reinterpretation of the theme, however, is that he draws on the domain of quantum mechanics and quantum ontology. As Henry P. Stapp writes in his article "Quantum Ontology and Mind-Matter-Synthesis," quantum theory "constitutes a radical break with prior tradition in physics, because it avers, if taken seriously, that nature is built not out of matter but out of knowings."¹³ By "knowings," he understands "particular individual results"¹⁴ of conscious obser-

¹² J. Clute, P. Nicholls, *Grolier Science Fiction: The Multimedia Encyclopedia of Science Fiction version 1.0*. Grolier Electronic Publishing, Inc., 1995.

¹³ H. P. Stapp, *Quantum Ontology and Mind-Matter Synthesis*, 10-th Max Born Symposium. Dec. 31, 1997. "The Online Bulletin of Science Within Consciousness," 2000 nr 5.1., <<http://www.swcp.com/~hswift/swc/Summer00/stapp0001.htm>> [odczyt: 5.03.2006].

¹⁴ H. Swift, *Editors note to 'Quantum Ontology and Mind-Matter Synthesis,'* "The Online Bulletin of Science Within Consciousness," 2000 nr 5.1., <<http://www.swcp.com/~hswift/swc/Summer00/stapp0001.htm>> [odczyt: 5.03.2006].

vation. This Copenhagen interpretation of the quantum theory described by Stapp implies that the world's existence is closely connected with human consciousness. The world is subjective, as without the observer it is just a cloud of quantum possibilities. This is exactly what Egan describes in his novel.

When an experiment conducted by Paul Durham on his Copy proves that it can retain continuity of consciousness even if it is computed non-sequentially from scrambled packets of data, the Copy comes to this conclusion concerning the nature of the simulation and of the universe:

„This is dust. *All dust.* This room, this moment, is scattered across the planet, scattered across five hundred seconds or more – *but it still holds itself together.* [. . .] ‘Imagine... a universe entirely without structure, without shape, without connections. A cloud of microscopic events, like fragments of space-time... except that there is no space or time. What characterizes one point in space, for one instant? Just the values of the fundamental particle fields, just a handful of numbers. Now, take away all the notions of position, arrangement, order, and what’s left? A cloud of random numbers’ (PC 121).

According to Durham, if a Copy can define itself and retain consciousness in this “cloud of random numbers,” then “the pattern of which we think as ‘the universe’ [could] assemble *itself*, find *itself*, in exactly the same way” (PC 121). Following this line of thought one can see that if the universe is understood in terms of the dust theory, then there is no reason to think that the world of a Copy is in any way worse from the world of the blood-and-flesh Paul Durham. In fact, as the reader learns towards the middle of the book, Durham might be doing exactly the same thing as the Copy is doing, i.e. “finding himself in the dust.” There can be many different arrangements of “the dust” and multiple universes may exist at the same time:

„[W]hy should that arrangement be unique? There’s no reason to believe that the pattern we’ve found is the only coherent way of ordering the dust. There must be billions of other universes coexisting with us, made of the very same stuff – differently arranged” (PC 122).

Before running the Garden-of-Eden-Configuration, Durham confesses to Maria Deluca that he has a history of mental illness which made him “believe [. . .] that [he] was the twenty-third generation Copy of another Paul Durham from another world” (PC163), and at the same time he claims that this was really the case. The reader learns that for the purpose of his experiments in virtual reality, Durham swapped the roles with his electronic clone, and instead of running his scan in a simulation, he put himself in the virtual environment designed for a Copy. Because he believed that he was a Copy when he was inside the simulated environment, his experience of it was the same as it would have been for the Copy. At that point his own life’s history

merged with the history of the Copy's life making the two of them indistinguishable from each other. When Paul came out of the simulation he was still deluded that he was not a real person, but a virtual entity. His delusions enabled him to feel continuity with his life in the virtual world. Dust theory makes it possible for Durham to share the pasts of different people (different versions of Durham from parallel universes) and to remain himself at the same time.

To further illustrate his idea of the dust theory, Greg Egan uses the initial anagram in the book. He manages to arrange fifteen letters in twenty different ways, combining them into words and sentences of a poem. Each rearrangement of letters is a whole in itself and it makes internal sense. Although each line is made of the same letters (the equivalents of the particles of dust), each can be understood separately, as can be seen in the first half of the poem quoted below:

„Into a mute crypt, I
Can't pity our time
Turn amity poetic
Ciao, tiny trumpet!
Manic piety tutor
Tame purity tonic
up, meiotic tyrant!
I taint my top cure
To it, my true panic
Put at my nice riot" (PC, 1).

Our universe works in the way similar to a group of random letters or numbers – as the Copy says – “[w]e are one possible solution to a giant cosmic anagram” (PC 122).

Durham's password to his virtual environment's menu is “Abulafia” (PC 3), which is an interesting allusion to Jewish mysticism. Abulafia was one of the early cabalists, who devised the system of prophetic cabala. He used certain techniques to study the names of God in order to attain prophetic abilities. One of those techniques was *gematria*, the symbolical employment of letters as numerals. In this the letters of a word are to be considered not only as letters, giving the sound, but as numerals, the sum of which may be replaced by the equal sum of other letters, producing, of course, a new word, which must prove to be identical in significance, or at least allied, with the first word whose sum it equals”.¹⁵

Greg Egan makes an allusion to Abulafia because his way of reading God's

¹⁵ *Abulafia, Abraham Ben Samuel*, “JewishEncyclopedia.com,” <<http://www.jewishencyclopedia.com/view.jsp?artid=699&letter=A>> [odczyt: 6.03.2006].

names is similar to Egan's idea of dust theory. When a cabalist ascribes numbers to letters and makes new words out of them by means of rearrangement, he gets different "permutations," but nevertheless they are of the same value. Those permutations are like different patterns of the dust that are all equally real, similarly to Egan's multiple universes.

The idea of a dust theory is also explained in a sequel to Egan's short story "Oceanic," where „the protagonist realises that he is merely one of an infinite number of conceivable characters written by an infinite number of conceivable Egan's. He then realises that not only is it not meaningful to ask which is the "real" character, but that his own identity might be shared by an infinite subset of characters, who share identical plots except for the placement of a comma, or an arbitrary misspelling".¹⁶

As the above excerpt suggests, Paul Durham's Copy might be as real as his flesh-and-blood creator in a different universe. This shows how arbitrary, according to the dust theory, the real versus virtual dichotomy is, which, seemingly, ends the discussion of the relation between virtual reality and core reality. However, one should bear in mind that understanding the universe as "dust" in its various arrangements is only theoretically possible. One would need to view the universe from the outside, from a point of view of a god-like figure in order to be capable of perceiving it in the way which Egan has described. Being a part of a particular universe, one is constructed according to the rules that govern that universe and their perception of things is grounded in that core reality. It is not possible for an ordinary sentient creature to perceive all things as equally real or equally virtual if we understand that "real" refers to some material reality. Possibility is not reality for the mind and for the senses – one can only *think* that other universes possibly exist, but they must be defined against the reality one inhabits. If one wanted to completely deny the concept of the real, then nothing could exist at all, because, objectively, the virtual can only exist if there is something material.

Being constrained by the traditional concepts of space, time and matter, one is unable to perceive things without the real and virtual distinction. That is why the inhabitants of different universes in Greg Egan's novel perceive the reality they are a part of as more convincing than any other "permutation of the dust." This tendency can be illustrated with the part of the text in which Paul Durham's Copy starts referring to his original as the "*djinn*" (PC 45), as if the Copy were the "right" Paul Durham, and his original just a remote fantastic creature. When the Copy starts watching

¹⁶ J. Slater, *Dust – why I don't believe it*, "rec.arts.sf.written," <http://www-users.cs.york.ac.uk/~susan/sf/books/_misc/pcity.htm> [odczyt: 7.03.2006].

television broadcasts from the real world he starts thinking to himself whether he shouldn't "be relieved that he hadn't wasted his time on so much ephemeral detail" (PC 47). This again, shows how the shift in perspective changes the perception of what is real and what is virtual.

Similarly, what might be seen as a toy universe by Maria Deluca, i.e. the Autoverse, is considered the only possible reality by the only indigenous intelligent Autoverse denizens, the Lambertians. What seems real for the later generation Elysians, the Copies from Permutation City, is just a fantasy, or, at best, a computer simulation when compared to flesh-and-blood Maria's reality. Paradoxically, some of the eighteen founders of Elysium, i.e. the Copies of real-world people which were included by Durham in the Garden-of-Eden configuration, feel that their former world on Earth was somehow more real than Permutation City, because the planet was built of matter. However, in the light of the dust theory, Permutation City is as real as Sydney, or any other city existing on Earth.

The reader might also be deluded in their perception of the book and think that Permutation City and the Autoverse Planet are just virtual environments conjured up by Paul Durham with his initial configuration of the system. It is not the case, in fact. Durham does not create any new universes and does not "send" the copies to any other universe. Permutation City and the rest of Elysium is, functionally, a TVC cellular automaton - in this case a 6-dimensional regular array of self-replicating processors infinitely growing into space in the form of crystals. This could be called a deeper reality of Elysium, because it is, in fact, hidden from its inhabitants view. The processors run the elaborate simulation of the City and the software which constitutes the Copies. The result is a Virtual Reality environment, which allows the Elysians almost unlimited powers – they can create their own private worlds, change their appearance and personality traits or create their own custom scenery. The only fixed points are the TVC automaton rules and Permutation City's architecture, which has been agreed upon by all the Copies to become a shared "hallucination." From the point of view of flesh-and-blood humans, Elysium is just a simulation, because it is not built out of matter, not confined by consistent laws of physics and it is being computed on processors. In addition, the processors themselves are immaterial. However, in the light of the dust theory, it is a consistent pattern that matters, be it a pattern of material particles or just pure data. There is virtually no difference between a possible pattern and an actual one, because any mathematically possible logical sequence of events appears capable of "finding itself in the dust." As Cosma Shalizi writes in the review of Greg Egan's novel, "[t]his is true even of the worlds where everyone has

an unshakable conviction that they are not real,”¹⁷ just like the eighteen founders of Permutation City.

If one follows the implications of the dust theory, it appears that a real world is the one which is capable of sustaining itself due to its internal logic. The Autoverse planet Lambertia is such a consistent pattern. At first, when the data on Lambertia is included in the Garden-of-Eden Configuration it is just a logical possibility. Only when the TVC universe expands enough for it to be computed does the planet “unfold.” Lambertia is initially designed as a simulation which is run on computers located inside the Elysium. As one of the later generation Copies points out: “Elysium was envisioned as a fixed frame of reference, a touchstone of reality – against which the Autoverse could be declared a mere simulation” (PC 281). The truth turns out to be different, when Permutation City implodes in the final chapters of the novel.

As a logical and structured pattern, the Autoverse could never be a “mere simulation.” It is an independent universe in its own right and it does not need anyone to create it. Even Maria, who designed the primordial bacterium, from which the Lambertians have developed, cannot “believe that [they] themselves would have failed to have lived the very same lives without her. Somehow, they still would have found a way to *assemble themselves from the dust*” (PC 267). The only thing that Durham and Maria create with their initial configuration of the system is the link between the two environments, i.e. Elysium and Lambertia. With the emergence of intelligent creatures on Lambertia, the relationship between the two worlds dramatically changes.

According to the theory of quantum mechanics and its Heisenberg Uncertainty Principle, “[o]n the atomic scale, matter and energy are inherently fuzzy. We cannot simultaneously specify the momentum and position of a particle to better than a certain precision.”¹⁸ One of the famous paradoxes connected with the Principle is the “Schrödinger’s cat,” which involves a cat closed in a non-transparent box together with a vial of poisonous gas. The vial is connected to a Geiger counter, and once the counter detects that a radioactive atom has decayed, the vial is broken and kills the cat. It is impossible to determine the definite outcome of the experiment until the box is open, as the chances of the atom decaying are fifty to fifty percent. Only when a conscious observer opens the box, is the state of the cat determined.¹⁹ The

¹⁷ C. R. Shalizi, *Permutation City* by Greg Egan: *Simulated Leibniz*, “*The Bactra Review*”, <<http://cscs.umich.edu/~crshalizi/reviews/permutation-city/>> [odczyt: 7.03.2006].

¹⁸ S. Dutch, *Schroedinger’s Cat is Alive or Dead, but not Both, and Definitely not Neither*. <<http://www.uwgb.edu/dutchs/PSEUDOSC/SCHRCAT.HTM>> [odczyt: 15 Mar. 2006].

¹⁹ E. Schrödinger, *Quantum Theory and Measurement*, red. J.A. Wheeler and W.H. Zurek, Princeton University Press 1983.

Schrödinger's cat paradox should not be treated as the ultimate proof for the hypothesis that conscious observation can determine the actual state of any system, because there are certain flaws to the idea. However, it shows what importance quantum physics and quantum ontology ascribe to mind and consciousness.

This leads the discussion back to Greg Egan's dust theory and the intelligent Autoverse life. As conscious beings, the Lambertians introduce a new element important for to ontological status of their universe, i.e. perception. When trying to make sense of their world and their planet's history, the creatures form various hypotheses and test them for logical coherence. As Maria has programmed the planet's prehistory into the Garden-of-Eden configuration complete with its "proper astrological context, and a geological history that stretched back to the birth of its sun" (PC 126), at first they have no problems arriving at plausible theories and explanations of their origins. They encounter difficulties only when they start hypothesizing about the content of the primordial cloud from which their universe has emerged. The elements that form it have been programmed into the initial configuration by hand and, seemingly, cannot be traced back to any particular earlier cosmic event. To the Elysians' surprise, Lambertian researchers manage to find a logical and feasible answer to the question of their world's beginnings without considering the idea of any supernatural intervention. As one of the characters puts it, they manage to "out-explain" (PC 307) the Elysians, thus, making the idea of creators seem completely ridiculous. The Lambertians' perception of the Autoverse severely affects the TVC universe rules, undermining its status. Planet Lambertia can no longer be controlled from the inside of Elysium. When Copies create a link with the processors on which Autoverse is supposedly computed, it appears that the planet cannot be frozen or slowed down in relation to the standard TVC time. The situation seems to be the reverse of what it was at the beginning – the Elysium behaves like a simulation run from the inside of the Autoverse. The TVC automation rules no longer hold true, which suggests that the ultimate truth cannot exist in a universe explained by quantum mechanics.

The question arises here of how it is possible for the Lambertians' perception to change the status of Elysium so much, when according to the dust theory both universes are completely viable and should be capable of sustaining themselves. The problem with the two universes lies in the fact that they follow from two conflicting versions of reality. According to the Lambertians, their planet is a real environment, which has naturally came into being and is going to end once its sun dies, as no system can be eternal. For Copies, Lambertia is a simulated world, created for entertainment of their immortal selves. Once the Lambertians start perceiving their

planet in a different way from the Elysians, the two views on reality clash, and it is no longer possible for the two environments to exist “side by side.” As Durham’s Copy explains in the novel, “[o]n Planet Lambert, everything that happens is intimately tied to one set of physical laws, applied uniformly, everywhere. And they’ve had three billions years of that. We may not know what the deepest laws are, any more, but every event the Lambertians experience is part of a coherent whole. If there’s any conflict between the two versions of reality, we can’t rely on our own version taking precedence” (PC 271).

In contrast to the internally consistent Autoverse, Elysium is built on approximations of the laws of chemistry and physics, and, although, on the surface, it seems consistent with the cellular automaton rules, all of its private environments “contradict each other – and themselves – a billion times a day” (PC 271). When tested against the unbending Autoverse logic, the Elysium fails to present as a structured consistent whole, and it is torn apart and stripped of its immortality. It does not cease to exist, but it becomes a finite structure, bounded by space and time.

The case of Permutation City’s implosion shows that it is impossible to determine the truth about reality once and for all. In the light of the dust theory all the possible universes are equally probable and equally real, as long as they are internally coherent. In the case of all logically possible universes, virtuality is just a function of perception and it results only from a subjective view of a universe’s intelligent inhabitants. However, not all the environments described in *Permutation City* are logically consistent. The recorded environments in which Copies are placed after being scanned are incomplete and self-contradictory. These environments are true manifestations of what is commonly understood as virtual reality.

The main characteristic of virtual environments in the novel is their imperfection, which is a result of high prices of computing power needed for complex rendering. The visualization of those environments is usually tailored to the temporary point of view of a Copy. Things that are out of range of the Copy’s view are not being computed at all. Although the sensations that a Copy experiences seem to be perfectly imitated by the simulation, in fact they are just being “faked from a patchwork of empirical rules, not generated from first principles” (PC 8). The degree of imperfection also varies with different sections of such a simulation, as can be seen from the example of Paul Durham’s Copy’s apartment and its surroundings. When the Copy is taking a shower in the initial part of the book, he is looking for visible flaws in the simulation, and he fails to find any:

”[h]e scrutinized the droplets and rivulets of water on his skin, searching for some small but visible anomaly at the boundary between his body – computed down to subcellular

resolution – and the rest of the simulation, which was modelled much more crudely. If there were any discrepancies, though, they were too subtle to detect” (PC 8).

The view of Sydney as seen from his flat is also convincing, but the Copy knows that it is just a recording of the real place, skillfully interwoven into the visualization. It is not possible to physically interact with the Copy’s surroundings if it has not been predicted by the software. Outside of the simulated apartment, things are no longer computed with maximum verisimilitude to reality:

”the architecture of the building was reproduced faithfully enough, down to the ugly plastic pot-plants, but every corridor was deserted, and every door to every other apartment was sealed shut – concealing, literally, nothing. He kicked one door, as hard as he could; the wood seemed to give slightly, but when he examined the surface, the paint wasn’t even marked. The model would admit no damage here, and the laws of physics could screw themselves” (PC 10).

The street outside of the building the Copy inhabits is just “three-dimensional wallpaper” (PC 10), designed for decorative purposes. It includes images of crowds of people walking around – as if involved in everyday duties. The immediately noticeable thing about them is that they do not react to the Copy’s presence and they feel completely neutral to his touch. Even, when the Copy climbs on an old woman’s back, she does not register it in any way.

In spite of all those approximations and imperfections, it is still possible for the observer to fall for the illusion. This is partly because in Greg Egan’s novel the simulation achieves the highest degree of immersion possible. It is no longer the interaction between a living person and the images projected on haptic devices, but a Copy, a virtual entity, is put *inside* the simulation, and it can experience it directly. In this way, the problems such as the incompatibility of hardware or the limitations of receptor stimulation can be avoided. It is not mentioned in the novel whether Paul Durham, who is put inside of the simulation instead of a Copy, actually uses any advanced hardware in order to experience the virtual environment or not. Nevertheless, as one can judge from Paul’s total conviction that he is a Copy, he cannot feel any physical discomfort from the hardware that could possibly spoil the illusion.

One of such situations when the border between reality and virtual reality is blurred in the mind of the observer is when Paul wakes up as a Copy in his apartment. For a few moments he cannot recall what has happened before. Looking at the dust in the air and the way it reflects the sunlight, he is reminded of the moments from his flesh-and-blood childhood. The simulation is convincing enough for him to put the experience side by side with a similar experience from real life. Being so perfect, the illusion can only be crushed by the appearance of the menu

window which Copies use to adjust their environment. Even though the window is something obviously simulated and out of place, it seems realistic to Durham, when he hits it in anger and despair:

"[h]e gave the interface window an angry thump; it resisted him as if it was solid, and firmly anchored. As if he was solid, too. He didn't really need any more convincing, but he gripped the top edge and lifted himself off the floor. He instantly regretted this; the realistic cluster of effects of exertion – down to the plausible twinge in his right elbow – pinned him to this 'body,' anchored him to this 'place'" (PC 4).

As it can be seen above, virtual reality in the book can be convincing enough so as to fool the senses. The degree of convincingness varies depending on the amount of processing power available, which can be bought and sold as QIPS, i.e. "quadrillions of instructions per second" (PC 27) on the QIPS Exchange. Theoretically, if one could afford vast amounts of computing power, one would be able to create simulations precise to the minutest detail, as long as he simulated closed environments. The limited capacity of processors in Greg Egan's novel makes it still impossible to compute whole universes. Nevertheless, in those utterly convincing, flawless, albeit limited simulations, the only things that could betray the illusion would be the ones running against real, internally consistent world logic. The world of Copies is full of such disturbingly unrealistic details, e.g. when they hurt themselves their cuts stop bleeding after a few moments, or their bodies' wastes can be "magicked out of existence long before reaching bladder or bowel" (PC 9). Certain bodily functions are optional and can be edited out by the Copy by using special software.

The copies can go even further and also modify their personality in any way they want. The ability to control one's emotions, feelings and features of character completely makes it possible for them to accept their new incorporeal condition and survive the initial feelings of depression and isolation following their transition from the physical world. Some Copies, who are members of the so-called Solipsist Nation movement, choose the freedom of Virtual Reality above the desire to cling to their ideas and preconceptions from their life in the flesh. They deny the old laws and refuse to obey the rules constricting the human society. Those Copies no longer treat their virtual existence "as less than real" (PC 116), and try to exploit its advantages, e.g. by assuming completely new forms of presenting themselves, such as for instance the musicians who look like "living saxophones" (PC 116); or leaving the rules of Newtonian physics behind them. Their rejection of the outside world can be seen in the fact that they do not mind being run at such a large slowdown in relation to real time, that they are not able to follow the worldly affairs any more.

4. Conclusion: subjective realities

When asked why he was so much interested in philosophy of consciousness and reality, Greg Egan said: “[t]ake away consciousness and reality and there’s not much left.”²⁰ *Permutation City* is a complex exploration of Egan’s favorite themes and presents the reader with a unique view on the ontological nature of all things. Drawing on the ideas of quantum mechanics, mathematics of virtual reality and medieval cabalist works, he formulates the dust theory of the universe, invalidating the assumptions of Newtonian physics and the common belief in the objective juxtaposition of the real and the virtual. As an alternative, the author proposes a “subjective cosmology,”²¹ and the idea “that what we experience as ‘the universe’ depends significantly on the structure of our own bodies and minds ... [where] subjective experience pieces all of reality together as the pattern in an intrinsically random cloud of events.”²² According to the dust theory hypothesis all the possible permutations of the dust co-exist at the same time, but they are perceived by different observers.

However, not all the “virtual” environments from *Permutation City* can be treated as examples of Egan’s “dust universes.” Some of them are just internally inconsistent approximations of real worlds – recorded and transformed into computer software. These environments are the only true instances of virtual reality in the book, if it is understood as the opposite of the real. Even as imperfect imitations of reality, these environments bear the threat of fooling their inhabitants into the belief that they experience actual reality, which enforces one of the most important ideas in the book, i.e. the subjectivity of all truth: not only can the perception of reality be influenced by the existence of virtual worlds, but also a world, real or virtual, can be influenced by conscious perceptions.

²⁰ “Eidolon”s. 42-45.

²¹ Tamže, s. 42-45.

²² R. Farnell, *Attempting Immortality: AI, A-Life, and the Posthuman in Greg Egan’s Permutation City*, “Science Fiction Studies,” 2000 nr. 27.