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Semiosis in Cell and Culture: A Study of Semiotic Processes of the Cell in Comparison with the Semiotic Processes of Culture.

Bachelor's thesis

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INTRODUCTION

The topic of this paper is the problem that semiosis is vital; it is genuinely and directly related to living organisms. In order to give cultural semiotics a possibility to succeed in humanities, it is important to note that culture needs a living material. However not all living material as we may think may be considered as semiotic. There are some semioticians who absolutely deny biosemiotics, or any semiotics that does not involve human or group of humans that constitutes the culture. My approach is simple and general, as having the opportunity to study semiotics in Tartu I must accept both approaches – bio and cultural.

The work source of this paper is cell (*cellula*), which can be considered the smallest living organism; it is an autonomous, structurally and functionally whole entity. We know that in 1838 botanist Matthias Jakob Schleiden declared that all plant parts are made of cells or products of cells. Theodor Schwann came to similar conclusion about the animal cells a year later. The cell theory and its development from 19th century have led us to a further scientific understanding of material and physical existence of our own self. However, from an historical perspective humanities arose long before the formation of cell biology. In 20th century the problems of meaning-making and communication became popular, and as a result of combining those two into natural sciences, today the natural scientists are not only fascinated about the chemical processes themselves, but the meaning of the processes (may that be teleological aspect, etc.). Thus the mechanism of the cell as a whole is able to grow and reproduce itself, and by communicating or interacting with the surrounding environment, it is able to bundle the necessary energy for life; in same manner, culture has been depicted as a structural and functional entity, which conceptually has similar abilities.

In order to delimit and define such broad and vague term as „culture“, I plan to dwell from Yuri Lotman’s concept of semiosphere. Following analogy can be drawn between cell and semiosphere: one of the main characteristics of semiosphere is

unevenness or inhomogeneity, and similarly most of the intracellular biochemical processes are quite far from equilibrium. This fact allows us to compare the two, ideally so different entities.

The core idea of this work is to explore how intracellular semiotic processes can be conformed to the cultural semiotic processes. Of course it needs to be taken into account that not all biochemical processes can be considered involving semiosis. There seems to be a foggy line between intracellular process that can be considered as involving semiosis and those based on stereo-chemical processes.

Yuri Lotman's concept of semiosphere is a model to understand culture, however hypothetical and ideal. My goal is to describe specific cell-associated processes compared analogically with culture, based on the assumption that both culture and cell are complete units. The study is based on one hand on the theory of cell and on the model of cell, and on the other hand on one model of communication in semiotics, namely Yuri Lotman's concepts of semiosphere and text.

Research aim and hypotheses, the expected results

The proposed main hypothesis of the work is that the cell as a whole mechanism is similar to culture as a whole mechanism. The reason is that both systems are believed to function because of communication, in both we can find semiosis. Consequently, this is the following question: whether is it possible to adapt the methods of the cultural semiotics for biosemiotics, namely, is it reasonable to consider cell as a semiosphere, text of set of texts? I try to reach to conclusion at the end of the work.

Material and Methods

The planned base materials to be used are fundamentals of cell theory and Lotman's works „Semiosphere" (Lotman 2005) and „Culture and Explosion" (Lotman 1999). Of course it is reasonable to use other cultural semioticians works, such as Umberto Eco's and Roman Jakobson's, a variety of articles of biosemiotics is involved as well. In terms of methodology, it is more reasonable to say that the work is

theoretical grounded, since the attempt is to compare and match the topics with several authors and approaches and to find out if there is anything that connects culture and cell.

The paper consists of three parts. The first part presents the origins and main ideas of cultural semiotics of Tartu Moscow School; this section will give a standing point of semiotics and will be the base of all work. The second part is dedicated to biosemiotics, including a broad introduction to the theory of cell. The third part is analytical, with the aim to bring together the tangent points of the previous chapters. It is clear that this work stands on the borderline of humanities and natural science; so it is expected that in many points additional explanation is needed.

1. ON CULTURAL SEMIOTICS

The purpose of this section is to provide brief overview of cultural semiotics of Tartu Moscow School. I will try to introduce the main points of this approach based on concept of the text and the semiosphere. The section is divided into several thematic parts and in favouring logical order; firstly I see fit to discuss over text and later semiosphere.

Based on Tartu-Moscow School the culture was defined as a domain of organization (information) in human society, in opposition to disorganization (entropy), i.e., integrated hierarchical arrangements of sign systems. The basic unit of culture, in this sense, would be the "text," vehicle of function and meaning. A culture would be the sum of its texts (Sebeok 1986: 163).

Lotman has declared that not a single semiotic mechanism is able to function as a system in isolation; it needs some semiotic space to surround itself (Lotman 1999: 43). And further he explains in his Culture and Explosion (2005) that every dynamic system, especially culture is located in a space where other dynamic systems, other cultures can be found. Thus he believes that no system lives only by its own laws of its own development, because it also bounces with other cultural structures in various ways and this certainly affects the system. He spots out that these collisions can be quite random in its nature and it may be impossible to predict these possible collisions, however, they do happen (Lotman 2005: 80). In certain way culture is characterised by randomness, because lots of contacts do not entirely depend on one culture. Even though culture is structured in certain hierarchic manner, there are so many possibilities to respond to these so called *external irritations* and that may be seen as randomness. The randomness may be explained with an argument that no one has actually managed to draw these possibilities, because there are too many elements to fallow in order to find the logic. Assumingly cultural structures are not as simple as viruses, where you can predict what type of mutations of certain virus

would be dominant in next flu season, because culture seems to have the highest level of semiotic freedom in nature.

1.1. On text

The concept of text can be used almost anywhere where semiotic relations are analysed. Lotman has pointed out that contemporary semiotic study also considers text as one of the basic research concepts, however, he does not consider the text itself as a stable object with the constant properties, but rather functional (Lotman 2005:132). This approach is pretty handy, as it doesn't remove the conventional meaning of text, however, adds a wider range of meaning to the notion of text which depending on context possesses different characteristics. Thus he explains that the text may be a full individual work, but also its parts, the compositional group, a genre, and all in all – literature as a whole (Lotman 2005:132).

Together with Pjatigorski Lotman came to a conclusion, that the function of text can be defined as its social role, the ability to serve the needs of a particular collective or collectives that create the text. Thus the function of text is the relation between the system, its realisation, and between its addresser—addressee. Secondly, when talking about functionality he declares that there should be three aspects taken into consideration: the text itself, the function of text and culture. In first case culture is seen as set of texts, where the function is unique meta-text. In second case the culture is seen as a set of functions in which the text is historically the result of the function. In this case the text and the function can be handled as objects which are explored at some specific aspect (Lotman 2010: 86).

Trying to line out the properties of text it is self-evident that the most efficient way is to use an approach that describes through oppositions. Lotman has declared that one of the main presumptions of semiotics is the existence of a pre-semiotic or extra-semiotic space. He assumes that there must be an extra-semiotic space. The main semiotic concepts are defined through opposition to this space (Lotman 1999: 141).

So literally if we imagine an object that would be different to a given one, then we may be able to point out the differences and define what we have. The same method has been used to define the concept of text.

1.1.1 Properties of text

Based on Lotman the text has three most important properties: expressivity, boundaries, structurality.

> **Expressivity –** The text is fixed with certain signs or characters and in that sense it is opposed to or confronted with the external structures of the text. The expressivity as opposed to non-expressivity, forces us to see the text as a realization of a certain system, its material embodiment. Sometimes, from the standpoint of certain substructure, something may be considered as extra-systemic and from another subsystems standpoint it may be considered as a part of the system. So in reality the same elements can act as non-systemic in one level and as systemic in another level (Lotman 2006: 94).
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> **Boundaries** – Text contains boundaries. In that sense the text carries an opposition "Belongs to – doesn't belong to" within. (Lotman 2006: 94). The concept of boundaries is manifested differently in different types of texts. It can be the beginning and the end of certain type of text, a frame of the picture, or ramp in theatre. The hierarchy of the text, that its system is divided into multiplex or intricate subsystems, brings us to a state, that many elements that belong to inner system turn out to be a borderline on different types of subsystems. In that way one boundary of a subsystem can sometimes be a boundary of the whole system. Like the end of the chapter can be the end of the book. (Lotman 2006: 95—96)
>
> **Structurality –** The text does not constitute a simple sequence of characters or signs between the two external borders. The text is inherent with the internal organization that makes it a whole in syntagmatic level. Thus the

elements or their combinations need certain secondary characteristics of that organization where they are organized (Lotman 2006: 96).

And finally Lotman states that it should be noted that the structurality and boundaries of text are connected or interrelated (Lotman 2006: 96). In one way we can see that the structure of the system determines its boundary, or another way a boundary can determine or influence the structure.

1.1.2. The hierarchy of notion "text"

Based on Lotman's concept of text, the text is hierarchic in its character. He stresses that in case of speaking of material aspect of expressivity of text; the extremely specific characteristic of sign systems is that "things" don't exist as material substance in the sign systems, but rather relations of things. So the text is built as a form of organizing *i.e.*, as relation system of certain material units. Lotman explains further that between the different levels of text, the new complementary structural relationships may evolve between different types of the system. While text is divided into subtexts (phonological level, grammatical level etc.), each of them can be viewed as autonomously organized entity, but the structure relations between the different levels or in other words the relations between the subtexts become certain characteristics of the whole text, which give the text an invariant nature. However he also claims the opposition to this nature: the functioning of text, in social environment, brings to birth the tendency to allocate the text into variants, with a credible example from textology: explaining that even though it was assumed that the printing technique brought the literary text to disappearance of variants, he explains that it is not true, because it is worth only to record one poem read by various performers to make sure that the printed text gives only some diverse of invariant text type (for example intonation level), but the recordings give its variants (Lotman 2006: 96-97). So in general hoping to see a system or a text as invariant, it is quite impossible, as variants largely depend on how or by whom the text is seen and presented.

1.2. On Semiosphere

Yuri Lotman was cognisant of the complex nature of culture and has declared at the very beginning: *In reality, clear and functionally univocal or mono-semantic systems do not exist in isolation. Neither, taken individually, none of them is function competent. They function only by being immersed in a specific semiotic continuum, which is filled with multi-variant semiotic models situated at a range of hierarchical levels. Such a continuum, by analogy with the concept of "biosphere" introduced by V. I. Vernadsky, will be called the "semiosphere"* (Lotman 1999: 10).

Lotman shows that it is not prudent to handle individual texts and isolated languages separately, even though it may seem evident that the semiosphere is built up from individual texts, because the totality constitutes in relations, as the parts precede the whole. However, in contrary approach the structures would look as if they were constructed from individual bricks that probably won't have any joint. Thus all semiotic space may be regarded as a unified mechanism or an organism. In this case, primacy does not lie in one or another sign, but in the "greater system", namely the semiosphere. The semiosphere is that same semiotic space, outside of which semiosis itself cannot exist (Lotman 2005: 11—12). However in analyzing culture, it is always important keep in mind the whole, but the whole cannot be analyzed deeply or efficiently, if its parts are not at least once viewed separately.

1.2.1. Boundaries of semiosphere

In terms of boundary of semiosphere, Lotman adds a very important characteristic to it. The border is the sum of bilingual translatable "filters", passing through which the text is translated into another suitable language. He explains further that though semiosphere has an apparent isolated nature, because it cannot be contiguous to extra-semiotic texts nor non-texts, the outer texts (messages) can become reality of its internal space. That becomes feasible only because of the boundary. The bilingual characteristics of the boundary give a possibility to translate outer message into one

of the languages of its internal space, or in other words the non-semiotic facts could be semioticized. He explains that in this way: "*The border points of the semiosphere may be compared with the sensory receptors, which transfer external stimuli into the language of our nervous system, or compare with a unit of translation, which adapts the external to a given semiotic sphere*" (Lotman 1999:12—13).

At this point we can compare it with the people that live in geographical periphery of one culture that uses certain language. It is very common that these people who live next to border are at some point bilingual, they are able to understand other cultures' language and traditions and they are able to translate those messages received from other culture and pass it on to, maybe, relatives who live in the geographical centre of their own culture.

Lotman points out that the notion boundary correlates with the concept of individuality. Thus he declares that the semiosphere is a "semiotic personality" and in this respect its individuality is empirically indisputable and intuitively conspicuous, but hardly determinable by formal definition. It is a known that the boundary of personality, as a phenomenon of cultural-historical semiotics, depends on the method of coding (Lotman 1999: 13).

What Lotman most likely tries to say here is that some things are so apparent, in that sense, that its character can be intuitively sensed, but there may not be any definite way to prove that. It is like speaking a language without knowing its grammar rules, but because a person has learned to use certain words or combination of words (sentences) in certain way (because it is common that way), then when asked why this combination of words is used, the person may not be able to point back to grammar rules. Moreover there may not be any formal grammar rules available – this phenomenon can be noticed in non literacy communities or cultures.

But coming back to the bilingual character of the boundary of semiosphere, which has the most important functional and structural position in semiotic space, by translating external communications into the internal language of the semiosphere

and vice versa, he adds the important filtering character of the boundary, explaining that the function of any border or facia — from the membrane of a living cell to the biosphere as a facia, which according to Vernadsky surrounds our planet, to the delimitation of the semiosphere — comes down to a limitation of incursion, filtering and the adaptive transformation of the external to the internal (Lotman 1999: 14—15).

Limitation of incursion, filtering and adaptive transformation are important factors, if those processes can be called so, – the main goal is to protect its own individuality and existence. Organism or culture cannot accept all intruders, as they may endanger its trait of character or individuality or even survival. In this sense primary filtering of so called hazardous, needed or neutral materials is essential in order to accept or reject what is offered by the outer world. Later selection could involve on adaptive transformation in order to make the material or information usable internally.

Lotman also adds the second function of the boundary in the semiosphere: it is the area where semiotic processes are accelerated; those processes always flow more rapidly on the periphery of cultural ecumene, seeking to pass them to the core structures, with an idea to displace them (Lotman 1999: 16). At one point this idea can be seen as information transformation to centre. The information that arrives to centre is already modified to appropriate form, acceptable for the centre. Thus the periphery itself needs to be active and rapidly process everything surrounding itself.

1.2.2 Semiotic irregularity

Lotman ascribes to semiosphere the characteristics of irregularity. However, we shouldn't confuse semiosphere with a total chaos in a space in literal sense. As culture or cultures lie in semiosphere, and cultures can be considered as sets of texts, it is important to remember firstly that culture is defined by organization in opposition to non-culture and disorganization, and secondly one of the main characteristics of text is hierarchical organization.

The irregularity corresponds to point of view and to standpoint of observer. Thus Lotman explains that a "non-semiotic" space may actually turn out to be the space of other semiotics. Because from an internal point of view of a given culture it may look like a non-semiotic external world; however, from the point of view of the external observer, it may establish itself as a semiotic periphery of the same culture. Thus Lotman points out that the crossing point of the boundary of a given culture depends upon the position of the observer (Lotman 1999: 18).

Though there is some high degree of irregularity in semiosphere that can be called a peculiarity of its organisation. Lotman describes it with a matter of fact that a semiotic space is characterised by the presence of clearly prominent organisation of nuclear structures and more amorphous semiotic world gravitating towards periphery, which surrounds the nuclear structures (Lotman 1999:18).

The peripheral areas are not so rigidly organized due to being affected by the internal world same as by the external world. This structural heterogeneity of given semiotic space creates reserves for new dynamic processes (Lotman 1999: 19).

1.2.3. Diachronic depth

The processes in semiosphere, as in any complex system run diachronically as well as synchronically. The diachronic depth of semiosphere is based on memory. Lotman confirms that the semiosphere is equipped by a complex memory system without which it cannot function. The mechanisms of memory are indwelling qualities of individual semiotic sub-structures of semiosphere and also for a semiosphere as a whole (Lotman 1999:25). Thus, in general there is variety of memory options available, which play important part in cultural processes or in any processes of the system.

2. BIOSEMIOTICS

The aim of this chapter is to give an overview of principles of biosemiotics and broad overview of cell.

2.1. The idea of biosemiotics

As declared at the beginning semiosis is vital; it is genuinely and directly related to living organisms. This idea has already been suggested by Sebeok.

Same has been said by Kull in respect to biology: From the perspective of biology, the biosemiotic approach understands that the process of life and the phenomena of life are communicative in its nature (Kull 2008: 669).

Similarly to cultural semiotics the interest of biosemiotics is communication, it seeks for systems that consist of information and are able to exchange the information within given system or between different systems. However, the difference between cultural semiotics and biosemiotics is that biosemiotics does not necessarily deal with human beings, or more correctly biosemiotics does not necessarily involve linguistic communication, as not all communication is verbal-linguistic.

The term communication may become hard to define, as in different fields it is ascribed with different properties. However, for semiotics, as said by Sebeok, is to determine the term communication with *function*: The function of acts of communication depends on the intentional transmission of information, where the intentionality implies the existence of a set of rules according to which the behaviour is to be interpreted, and the behaviour itself depends on the production or exposure by its performer (the information sender) of a certain physical object or phenomenon (the signal) that can be perceived and interpreted by its addressee (the information receiver) (Sebeok 1986: 138). This definition to term communication should cover the characteristics of all information exchange in living nature.

2.1.1. Semiosis in living systems – the concept of code

The more the possibility of semiosis in living systems is investigated, the more it becomes clear that in biosemiotics the concept of code has high importance. The notion code is very ambiguous, as Eco notes: "The *meaning of this term seems to have become exaggeratedly generous, covering many semantic areas*" (Eco 1984: 164). However, in field of biosemiotics the term code is more precisely determined. Thus many authors of biosemiotics take the code as something primary for the sake of communication *e.g.*, Barbieri, who stresses the true codified assemblies and names the three fundamental characteristics of code: *(1) They are rules of correspondence between two independent worlds, (2) They give meanings to informational structures, (3) They are collective rules which do not depend on the individual features of their support structures* (Barbieri 2003: 94). As Barbieri is embryologist, his research is mostly concentrated on cell. But there are other biosemioticians whose semiotic research involves the importance of codes (Hoffmeyer, Emmeche, Kull, Pattee, Bruni, and others.)

Kull has contrasted physics (exact science) with semiotics, and expounds that exact science as assemblage of disciplines, which deals with study of laws that no one created – because natural laws are universal and uncreated –, then semiotics can be defined as sphere, that deals with principles (relations, rules) established by life (including people and cultures). He explains that principles or rules (codes) remain because of inheritance, different from exact science, they are based on memory and in its general structure the memory process is similar to communication process (Kull 2008: 668–669).

2.2. Cell

It is a common knowledge that the cells are fundamentals of life, which can be considered the smallest living organism; it is autonomous or structurally and

functionally whole entity. Thus the mechanism of the cell as a whole is able to grow and reproduce itself, and by communicating or interacting with the surrounding environment, it is able to bundle the necessary energy for life, in same manner, the culture has been depicted as structural and functional entity, which conceptually has similar abilities.

Cells are divided into two main domains: prokaryotic – consist of two kingdoms (Bacteria and Archaea) and eukaryotic – consist of four kingdoms (Protista, Plantae, Fungi, and Animalia).

2.2.1. Cell properties

Every part of cell has its function. But also a cell itself has a function in a bigger picture. Moving out from the cell, to a body (human body for example) we can first see that one of the functions is to group and make a tissue of an organ. There are cells that don't become tissues, certain phagocytes. The most interesting type of cell is stem cells, their DNA is metaphorically blank and they can become a type of cell that is needed. Their capability to produce descendants, which belong to distinct type of cells by function, is called potency (toti-, multi-, pluri-, unipotent). Stem cells first function is to produce specific cells.

Cells consist of many different types of molecules. Even though most of its consistence is water, there are many molecules that pose different structures and functions: carbohydrates preserve the chemical energy in the cell; lipids also preserve the energy, but more importantly the cell structures are mostly built up with lipids; variety of proteins, which have many different functions like catalysing chemical reactions – those are enzymes, or nucleic acids DNA and RNA, which take important role in memory process.

Eukaryotic cells consist of organelles, most of them covered with its own membrane. Most commonly found organelles are, nucleus, nucleolus. ribosome, rough endoplasmic reticulum, smooth endoplasmic reticulum, Golgi apparatus (complex),

mitochondrion, vesicles, vacuole, cytosol, lysosome, centrosome, cytoskeleton, cell membrane. Each of them presents specific even, variety of functions in cell mechanism. To describe them all in detail would be difficult, as the functions may vary from cell to cell, but it is necessary to give a rough overview, since it is not expected that every reader knows these by heart. Hence in general, some of the animal cell functions are shown below.

Nucleus - Nucleus is double membrane enclosed and most of the genetic material (chromosomes) is gathered there. The function of the nucleus is to maintain the integrity of these genes and to control the activities of the cell by regulating gene expression — the nucleus is, therefore, the control centre or brain of the cell.

Nucleolus – main function is to transcribe ribosomal RNA (rRNA) and combine it with proteins to form incomplete ribosomes.

Ribosome – lots of ribosomes take part of the primary protein synthesis. Ribosomes link amino acids together in the order specified by messenger RNA (mRNA) molecules. Ribosomes consist of two major components — the small ribosomal subunit which reads the RNA, and the large subunit which joins amino acids to form a polypeptide chain. Each subunit is composed of one or more ribosomal RNA (rRNA) molecules and a variety of proteins. The ribosomes and associated molecules are also known as the translational apparatus.

Rough endoplasmic reticulum (RER) – most of the secretory and membrane related proteins synthesis, and primary folding to correct confirmation, post-translational modification, glycosylation takes place in RER. RER is attached to ribosome.

Smoot endoplasmic reticulum (SER) – main function is synthesis of lipids, phospholipids and steroids. But also the regulation of Ca-ion concentration and drugs or toxins detoxification takes place in SER. The metabolism of carbohydrates is carried out there. SER is not attached to ribosomes.

Golgi apparatus – Main function is to package proteins (further glycosylation, also adding phosphate and sulphate groups) before sending off to correct position. In Golgi apparatus, it is decided where the protein should move. The apparatus consists of three compartments.

Mitochondrion – is necessary for processing nutrient to energy (generates most of the ATP) and converting energy. But also is involved in other tasks like cell differentiation, signalling or controlling the cell cycle as well cell growth. Mitochondrion has its own DNA (different from the cell).

Vesicles – main function is the transport of materials on cytoplasm for example transporting processed proteins to Golgi apparatus.

Vacuole – depending on a cell type the functions may vary, but major role of the vacuole is autophagy, by keeping the balance between biogenesis and degradation. It helps to recycle the mis-folded proteins.

Cytosol – has many functions, but among others one of the functions is to transport metabolites, but also metabolic process in general.

Lysosome – main function is to clear away the waste materials and cellular waste. It consists of acid hydrolase enzymes, which help to digest literally all waste in the cell.

Centrosome – main function is to regulate the progression of cell-cycle.

Peroxisome – main function is to break down fatty acids through β- oxidation, also biosynthesis of lipids.

Cytoskeleton – most obvious function is to help to give a necessary shape to a cell. Its role is to support the transport within cell, but also movement of the cell itself. It consists of filaments: microfilaments, microtubules and intermediate filaments.

Cell membrane – is a selective barrier between intra-cellular components and extra-cellular world. Its main role is anchoring cytoskeleton to provide shape to the cell,

but also helps to group cells together when needed. The inner and outer membranes can pass through some substances because of the channels in it.

Defects in organelles or in cellular function can cause serious dis-function of the whole organism.

2.2.2. Inherited archive

Genetic information is extremely important for living organisms, it needs to be preserved and passed to next generation. The genetic material is organized into chromosomes (chromosomes consist mainly of proteins and nucleic acids). More specifically genetic information is stored in DNA. As genes are the carriers of inherited information, thus scientifically they can be taken as structural and functional entities. Gene is a unit of genetic information, which determines the genesis of proteins or more correctly said, it is a segment of DNA that codes certain RNA and through mRNA it codes a certain polypeptide (Heinaru 2012: 992). Genes determine the genesis of certain elementary characteristic of the cell; which in primary level are RNA- or protein molecules (Heinaru 2012: 199).

Genome (DNA) holds large amount of information, it is like an encyclopaedia or dictionary, which holds the knowledge of the world, and discloses the information when needed. Pattee gives a reasonable parallel here: "*Memory structures must have a large number of energy degenerate or equiprobable states. Indefinitely extendable one dimensional discrete sequences optimally satisfy this requirement. Such degenerate sequences are undeterminable by physical laws and therefore have high information capacity. Reliability requires a small number of types of subunits. That explains why both genetic and human languages consist of linear sequences with small alphabets.*" (Pattee 2013: 23).

Thus what Pattee reveals here is the primary syntagmatic similarity between human language and genetic material: both contain and possess readiness to disclose large amount of information, which is combined from only numbered units.

Eco doubts if genetic processes are semiotic, he explains that even at the elementary level of these biological phenomena, there is no sensible difference between correlation and instruction – that there is no sensible difference between those two (Eco 1984: 184), however, Eco's note does not really make a difference as Giorgi, Bruni and Goldberg base on Hoffmeyer's explanation and say that because genes have no agency per se and no capacity to construct any structure, hence genes are just memory options to be accessed by the cell whenever their expression is required by specific contextual clues. They explain that the term instruction is meaningless because it is not addressed to anything in the system that may prove capable of interpreting and eventually using it to effectuate an appropriate action in response. The cell itself selects which option may affect the outside world more appropriately, while the genome remains essentially inert and meaningless in the absence of cellular activity controlling its expression (Giorgi 2013: 491).

2.3. Semiosis in cell

It may be really hard to prove that there is semiosis in cell, even Barbieri has acknowledged it: *biosemiotics has not yet proved that the cell is a semiotic system*. The cell is the unity of life and there is no chance that biosemiotics can become a science if it does not prove that signs exist in the cell, at the molecular level. He asks an important question which relates to the problem of biosemiotics: *can we prove that the cell is a semiotic system?* (Barbieri 2008a: 180)

Barbieri has proven very effectively that the semiotic processes take place in cell. For example driven by the idea of codified processes, he claims that at least 3 following semiotic processes take place in cell.

Signal transduction – one of the known organic code (i.e. semiotic process) is signal transduction. As we know the cell is always connected to outer environment. It receives information and necessary substances from extra-cellular environment, so in that manner it needs to react to that environment. The cell has its own mechanisms how to in large *communicate* with the outer world, and those mechanisms are important in decision making, which information to take in and which to ignore. Usually the reaction of the cell is followed by gene expression. The outer signals never react with genes directly; therefore they are always transformed into inner signal world in – *secondary messengers*. Only the secondary messengers or their derivatives can react with genes. In most cases, first messengers won't even enter into the cell; they are caught by special receptors, which are located on cell membrane. The transfer of information from the outer environment to the gene takes place in two steps: firstly from *first messenger* to *second messenger* (called signal transduction) and in second step from second messenger to gene (signal integration) (Barbieri 2003: 105).

Barbieri explains that first and second messengers belong therefore to two independent worlds, which suggests immediately that signal transduction is likely to require the intervention of organic codes, as there are found hundreds of first messengers in signal transduction, but only four second messengers (cyclic AMP, calcium ions, inositol triphosphate and diacylglycerol) (Barbieri 2003: 106–107). So Barbieri suggests that in signal transduction, the three characteristics of the codes can be found:

(1) A correspondence between two independent worlds.
(2) A system of adaptors which give meanings to molecular structures.
(3) A collective set of rules which guarantee biological specificity. The effects that external signals have on cells, in conclusion, do not depend on the energy and the information that they carry, but only on the meanings that cells give

them with rules that can be called *signal transduction codes*. (Barbieri 2003: 109)

Splicing – is a process, where the intron sequences are cut out from nuclear RNA and the ends of the remainder exons are joined together for mRNA (messenger RNA). Barbieri calls it a true assembly, because exons are assembled into messengers, and we need therefore to find out if it is a *catalyzed* assembly (like transcription) or a *codified* assembly (like translation) (Barbieri 2003: 101). The catalysts of splicing are spliceosomes, but different from tRNA, the snRNP (*small nuclear ribonucleoprotein*) it works slightly differently. At the end of this process, Barbieri has explained that two different recognition processes take place in splicing; one at the beginning of intron, and another at the end of intron (Barbieri 2003: 102). This process is semiotic, because of the following reasons:

(1) Splicing establishes a correspondence between two independent worlds.
(2) Splicing is implemented by molecular adaptors which give meanings to RNA sequences.
(3) Splicing consists of a community of processes that guarantee biological specificity. (Barbieri 2003: 105).

Genetic code: transcription and translation – two important parts of genetic processes are called DNA transcription and RNA translation. Transcription is replication process, during which a complementary RNA molecule is synthesized from DNA. The chain is complementary because it is not identical to DNA chain, from which it was replicated – the nucleotides of DNA are A, G, C, T, but the nucleotides of mRNA are A, G, C, U, thus thymine gets replaced with uracil in RNA (A→U, T→A, G→C and C→G. However RNA translation is a process, during which, based on nucleotide sequence of RNA the chain of polypeptide consisting of amino acid residues is synthesized. The genetic code is correspondence between nucleic acids and primary structures of proteins. Through the genetic code the genetic information that is contained in sequence of nucleic acid is translated into amino acid sequence of protein. It is a process where elements of one system are put

into correspondence with the elements of another system with an assistance of so called middlemen. Three nucleotide sequence is called codon corresponds to one amino acid. In protein synthesis the information carries is RNA (mRNA *i.e.*, *messenger* RNA), and the codons are triplets combined from four nucleotides A, C, G and U (adenine, guanine, cytosine and uracil). As nucleotides work in combination of three, then we know that in genetic code there are sixty-four codons, to which only twenty different amino acids correspond. Thus some codons carry the synonymous function in this respect; they code the same amino acids.

For conclusion of the two named processes: for RNA transcription a normal biological catalyst (RNA polymerase) is sufficient, because this is basically process of copying where only one recognition process takes place. However in translation, instead, two independent recognition processes must be performed at each step, and the catalyst of the reaction (the ribosome) needs special molecules – first called *adaptors* and then *transfer* RNAs – in order to link the two processes. Briefly, an amino acid is attached to a tRNA by an enzyme (an aminoacyltransferase) which specifically recognizes a region of the tRNA, while a different region (the anticodon) interacts with a messenger RNA (Barbieri 2003: 97—98).

Eco calls both of them metaphors: "translation" and "transcription" are metaphors with an argument that the elements in play are coupled together because of a *stereo-chemical complementarity*, for the same reasons for which a given key fits a given keyhole (Eco 1984: 183), probably Eco relies on a fact that generally only one DNA strand of duplex of particular DNA segment gives rise to usable information when transcribed into mRNA, but theoretically the DNA could yield two mRNA's with different sequences and hence different protein-coding potentials. Nevertheless, also Barbieri confirms that transcription is not codified process. However translation tends to show the characteristics of true codified assembly: as he explained the two independent recognition processes must be performed at each step, and the catalyst of the reaction (the ribosome) needs special molecules (first called *adaptors* and then *transfer* RNAs) in order to link the two processes.

Additionally, we now know that RNA polymerase can initiate strand growth, however DNA polymerase cannot, instead it also need pre-existing RNA. Also transcription and translation cannot occur concurrently in eukaryotic cell, because the nucleus, where the protein synthesis occurs is separated from the cytoplasm and the primary RNA transcript of protein-coding gene must undergo several modifications (RNA processing), that yield a functional mRNA and after that the suitable mRNA must be transported to the cytoplasm before it can be translated into protein.

It is important to note that genetic code can be considered semiotic, because the relation between codon and amino acid is arbitrary in a sense that there is no physic-chemical instruction between the amino acid and the codon, but what links them is the code. Genetic code is historical and as Barbieri explains – a true convention, an extraordinary exception of nature (Barbieri 2003: 96).

Though the universal genetic code is considered unique and precise, there can occur some exceptions. One of the known aberrancy is when Trp (tryptophan) is linked above the UGA "stop codon" instead of neighbour UGG codon (see Tabel 1.) (Lodish *et al*. 2000: 118).
The above phenomenon is actually a rule in mitochondrion DNA. The language of triplet codons varies between nuclear and mitochondrial DNA- within the mitochondrion, so TGA encodes tryptophan rather than "stop" (as in the nucleus).
However there is another credible example – certain human cells can encode the modified amino acid Sec (selenocysteine) using TGA "stop codon" Epstein 2003: 79). Thus in reality we could actually have 21 amino acids corresponding to 64 triplets, but based on the frequency of TGA (UGA) encoding selenocysteine in all human cells makes it rather an exception of the code than a rule.

But further to these three adequately described codes Barbieri refers to variety of codes offered for semiotic processes of cell, mainly based on Tifanov's suggestion: (1) *the transcription codes*, (2) *the gene spicing codes*, (3) *the translation codes*, (4) *the DNA structure codes*, (5) *the chromatin code*, (6) *the translation framing code*, (7) *the modulation code, and*, (8) *the genome code*. He seems to accept those with

extreme compromises, but clearly he’s not convinced how surely the features of code are manifested according to his approach to concept of code (Barbieri 2010: 778). However, he does confirm that there are still many nondeciphered codes in nature (Barbieri 2008: 11—12)

3. ANALYSIS

The aim of this section is to bring together the tangent points of the previous chapters and to find out if there is anything that connects culture and cell. In order to come to a conclusion whether it is possible to adapt the methods of the cultural semiotics for biosemiotics – is it reasonable to consider cell as a semiosphere, text of set of texts – I plan to place cell into context of cultural semiotics, in order to see if the Lotman's properties of modelling culture can be considered general or universal for biosemiotics.

It is important to note that I handle cell as a theoretical model of a system. The whole system consists of subsystems (components) and subsubsystems (subcomponenets). Hence organelles are understood as subsystems and molecules are understood as subsubsystems. This division seems to be the most appropriate one. The division is based on Miller's system theory "Living Systems" (1978). Also Juri Lotman's concept of the text or semiosphere allows such approach, as Lotman himself handles a culture as a system – a dynamical system.

3.1. Cell as a text

As noted earlier the concept of text could be used anywhere, because as Sebeok refers to Lotman – a text is substratum of a significant whole (Sebeok 1986: 163). Generally cells, except free living cells, constitute a whole – a bigger organism. Thus trying to apply Lotman's concept of text to cell, the following points could be drawn out if molecules are considered as elements, organelles are considered as subtexts and cell as a whole is the text. In order to use same terminology, I find appropriate to understand signs or elements as subsubsystems, subtext as subsystem and text as a whole a system as a whole.

Text	↔	System	↔	Cell
Subtext	↔	Subsystem	↔	Organelle
Element	↔	Subsubsystem	↔	Molecule

3.1.1. The properties of a cell as a text

Expressivity – The cell as a text is also fixed with certain signs or characters in primary level, which can be called molecules. Those molecules that function in particular cell are opposed to what are outside, even though the molecules outside of cell may have exactly the same chemical composition, they are irrelevant at the moment. They as particulars did not get elected to be part of the interior of the cell. And in that sense they are opposed, as they are not needed inside and they don't carry the given function of interior. For example there is plenty of K^+ or Na+ or H_2O molecules outside of the cell, but only the ones that are in are the ones that express the system. Thus what is inside is the material embodiment of the system. There are molecules in the cell that are not recognized by one organelle (subsystem), but are essential for another organelle (subsystem). One molecule (element) can act systemic for several organelles (subsystems) and again non-systemic for others, but at the end this depends on systems structure.

An analogy from a cultural aspect can be drawn here. Imagine we are reading a book in a park and one of the characters in that book is described with certain qualities. The qualities described match exactly with a person sitting next to us, but this person is sitting next to us and not in the book, therefore even carrying all the necessary qualities, the person is not part of the book and therefore does not express the book. This example may be too casual, but the idea is easy to follow.

Boundaries – In Lotman's sense the boundaries carry an opposition "Belongs, doesn't belong" within. The most apparent boundaries of the cell are membranes. Not only the outer membrane of the cell, but also inner membranes (the membranes of the organelles) can be considered as boundaries. As text can consist of intricate subsystems, the cell consists of intricate subsystems, thus similarly to cultural text – a boundary of one subtext may function as a boundary of the whole. Unique example

of this is cell membrane, a membrane is an organelle, but at the same time it is a borderline of the cell.

The cell membrane doesn't only carry a function do draw a line between given system and the "other", it also the expresses the whole meaning of the given. Of course this may seem too generous as no conclusion of an article, or fence of the house reveals the whole content of the text or artifact, however, its boundary carries the information about the whole. So through the boundary a certain system can be recognized as what it is. And same happens with certain type of cell; it is recognized by bacteria, or virus or another cell only based on surface e.g., its physical border.

Structurality – As Lotman said text does not constitute simple sequence of characters or signs between the external borders. In analogue, a large number of molecules are interacting in complex manner in cell. In certain way we can say that combinatorial interactions are unified by homologous modular subunits. They are the building bricks of structure, but also function. Emmeche has explained if certain element or component has function in the system then at the same time this element or component has a meaning for that system (Emmeche 2002: 23). Cell is inherent with the internal organization that makes it whole in syntagmatic level. We may consider the cell as functioning in horizontal and vertical level. One molecule itself, taken out from the context is basically meaningless element; it needs its position in combinatory sequence, in order to reveal its secondary characteristics of the organization.

3.1.2. The hierarchy of a cell as a text

As text is hierarchic in its character, in same manner cell is hierarchic in its nature. If text constitutes a whole from subtexts and elements, then similarly the cell constitutes the whole from its organelles and molecules. Due to this cell function is relational. Many compartments share same molecules or, more correctly said, during one process many compartments *i.e.*, organelles are driven through. So also cell is

built as form of organizing *i.e.*, as relation systems of certain material unit. Between the different levels of text or organelles, the new complementary structural relationships may evolve the relations between the different types of the system. If the subtexts of the text can be viewed as autonomously organized entities, then the organelles can be viewed the same, however, in deeper investigation they are relational and unable to function out of the system.

The cells as a whole, is invariant in its nature, but certain conditions we can establish the variety. The term variety should be seen as abstract, as the system itself is invariant, same as its subsystems are invariants, their structure and functions are the same in general, so the question here is who is the observer and where is the observer positioned at. Thus the term variant is actually targeted to observer.

There can be also another view to the variant–invariant problem: within the cell biomolecules are constantly phosphorylated and dephosphorylated, sequestered and mobilized, cleaved and ligated, refolded, and synthesized etc and for every positive response to these processes there can be a negative response in different levels. Or maybe more adequate example is a pluripotent stem cell, which means one cell has a possibility to birth variants other than itself, but in this case the new cells are all new systems.

3.2. Cell as a semiosphere

Yuri Lotman was cognisant of the complex and relative nature of culture and has declared at the very beginning that, in reality, clear and functionally mono-semantic systems do not exist in isolation. They function only by being immersed in a specific semiotic continuum, which is filled with multi-variant semiotic models situated at a range of hierarchical levels (Lotman 1999: 10).

Cell cannot survive in isolation. Especially animal cell, it is not able to produce the needed energy from scratch. Plant cells are more potent, however even their capability is limited; they need certain extra force, like sun to enable the energy

production process. Nevertheless certain exterior molecules or physical forces are essential to start the energy production or transformation machinery. Thus the cell needs its sphere, but can it be that sphere?

3.2.1. Boundaries of a cell as a semiosphere

At large the boundaries of semiosphere carry the same function as boundaries of text. They are borderlines, but in addition they are also bilingual translatable filters. In case taking the cell as semiosphere, then the following problem situation rises, if cell membrane is the borderline of so called semiosphere, what are other cells and molecules then? Of course we can say that other cells are other semiospheres not the given one and molecules are texts of the other semiotics. But in this case what are the cell organelles? Other doubtful point here is: if we take other cells as other semiospheres then, yes, certain cells can be considered as non-semiotic to given cell at the beginning, but how to handle same type of cells that are to be gathered to form a tissue of a greater organism?

The characteristics of the boundary of semiosphere are indeed applicable to cell, as it is the border of particular semiotic space with important functional and structural position. The border translates the external communications into the internal language of the semiosphere and vice versa. This is applicable in cell to cell communication, because *e.g.*, human cells communicate with each other via two specific molecular mechanisms: first, by motility (*i.e.*, by using a membrane-bounded molecule to activate a neighbouring cell's protein sensor by direct contact); and second, by secretion (*i.e.*, using a soluble molecule to activate a distant cell's sensor without the necessity of cell contact). In addition, however cells may sense their environment by mechanisms other than the interaction of performed biomolecules with specific receptors. Extinct stimuli such as heat, electricity, hypoxia, and mechanical force can also initiate adaptive cell responses that include the activation of nonspecific stress response pathways (Epstein 2003: 194).

By defining the characteristics of boundaries of semiosphere Lotman has also used the cell as model of example e.g. *The function of any border or facia — from the membrane of a living cell to the biosphere as a facia, which according to Vernadsky surrounds our planet, to the delimitation of the semiosphere — comes down to a limitation of incursion, filtering and the adaptive transformation of the external to the internal* (Lotman 1999: 15). So the question here shouldn't be whether the cell membrane has characteristics of boundaries of semiosphere, rather than how to constitute the whole world in logic hierarchy with given notions provided by Lotman: elements, text, and culture; semiotic – extra-semiotic.

I'd rather tend to think, that when Lotman introduced the term semiosphere drawing an analogy to biosphere then semiosphere would contain all cultures. Biosphere contains all the living and nonliving nature on earth. Thus the most logical subsystems of semiosphere would be cultures where culture consists of texts which are subsubsystems and so on.

Wouldn't it be more productive to add the characteristics of semiosphere boundary to text boundary? In this case we could solve two problems at the same time: we could treat the cell as text, and the boundary of text would also function as a filter that allows signal transduction, described by Barbieri as a semiotic process, but also intracellular communication as a semiotic process.

3.2.2. Irregularity

Based on Lotman the internal irregularity is one of the characteristics of semiosphere. In this matter, similarly most biochemical processes are far from equilibrium in cell. Normally every chemical reaction moves towards the balance, but in biochemistry the processes are slightly different, because in state of equilibrium all energy would be released and that would be parlous to a cell. Even the intracellular pressure is kept different from the environment, as otherwise

different substances from the environment could act as spontaneous intruders, and due to physical laws the cell wouldn't be hard target to conquer.

3.2.3. Diachronic depth of a cell

As expounded at first section the characteristics called diachronic depth is possible because of the memory of the system. Similarly to semiosphere, the cell has a complex memory system, without which a cell couldn't function or exist as living system. The whole function of a cell is based on genetic information which metaphorically called is the memory of a cell. Activated genes organize the synthesis and release of protein effectors. Hence, just proteins cannot transmit information to future generations without genes and genes cannot influence their environment without the proteins (Epstein 2003: 20).

Proteins need genes as genes need proteins. Thus cell is internally regulated and all parts are through one or another way connected and dependant on one another.

3.3. Semiosphere or text

In case we stick to option that cell is a text, we can draw a model where molecules (elements or signs) build up organelles (subtexts) and organelles build up the cell (text) as a whole, cells (texts) build a grater organism, which exists in semiosphere.

In case we take a book for an example "The truth and justice" by A.H. Tammsaare – the book consists of many texts of culture, the understanding of everyday life, the understanding of pride or shame or justice in certain cultural sphere are just few examples, what the reader should understand – this artistic text is addressed to another human being, to be read and understood. On the other hand cell can't read other cell literally, it can't even read its own subtexts, but can the culture read itself entirely? The only one who can read the cell in nearly similar manner to a book is human, because of human necessity to explain the processes to himself. Another cell

or compartments of the cell cannot read the text or subtext horizontally and vertically at the same time. Its parts read only what is relevant to them, but in parallel with the book, can a child understand the book same as the author or an older person? I tend to think no. This is the fruitfulness of semiotics; the meaning doesn't depend only on sign, on the sender, or on the receiver. It depends on all of them and at certain point the functioning of meaning is unpredictable. Every addressee receives the variant of the text, sometimes only part of the text specific to its previous knowledge. And same idea is followed in semiotic processes of cell, some organelles are not able to recognize the mis-folded or wrongly linked proteins, others are. Cell doesn't think or ask questions about its existence, it only functions by the mechanisms of recognition and memory.

Regarding to concept of semiosphere – trying to analyse the possibility of cell being equalized with semiosphere, more clearly it shows that this concept is rather inadequate. Believe that the concept of semiosphere would need more specific determination. Cell has its determination in space and time, which can be measured, it is like a tale, a cultural text which functions in certain space and in certain time and is determined by boundaries. We must understand that subtexts, but texts in general are interconnected in one or another way, may the link between them be called *memory*.

Another confusing point is that, though the model of semiosphere possesses some unique and important characteristics that Lotman did not ascribe to text *i.e.*, the boundary being a bilingual translatable "filters", which the cell membrane truly is, but then at the other hand if semiosphere is analogy of biosphere, it means it should contain different semiotics, different cultures and thus different cells. I tend to think that Hoffmeyer sees the semiosphere the same – a semiotic continuum, a shared universe of sign activity through which cells, organisms and species all over the planet interact in ways that we still hardly understand. And yet every single species (including humans) has only limited access to this (Hoffmeyer 2008: 153).

In total isolation we could use the concept of semiosphere on cell, however, that would mean we would tear the cell out from any context, even metabolic. Therefore cell seems to be part of semiosphere rather than itself. Hence it is more prudent to handle cell as text, however the properties of text are not entirely sufficient.

Merleau-Ponty notes that the science manipulates with the things in a sense that models of things are created, and science performs transformations on the variables or their indices, that the definition of the model facilitates (Merleau-Ponty 2013: 15).

In relation to above humans create models that are ideal and the function of these models is to simplify the process of understanding certain phenomena. Some of the created models are used in multiple objects or phenomena, and can be done so because the definition of a model allows it. Even though Lotman offered his models of text and semiosphere to cultural semiotics, they could be used in biosemiotics. Same has been understood by Kull, confirming that Lotman formulated several important questions and proposed concepts, which can be considered good basis for future analysis of biosemiotic problems (Kull 1999: 127). Thus believe the concept of semiosphere and the concept of text both can be broaden to cell in certain extent. As both concepts have given something for biosemiotics that needs to be taken account when analyzing living nature.

CONCLUSION

In this paper I showed modestly that the cell can be analyzed with the methods of cultural semiotics. I came to a conclusion that it is more reasonable to handle cell as a text though some characteristics of the semiosphere *e.g.*, characteristics of the boundaries of semiosphere hold good for cell.

As the core idea of this work was to explore how intracellular semiotic processes can be conformed to the cultural semiotic processes, for this reason I brought out main aspects of Juri Lotman's concepts of text and semiosphere. The concept of text is one of the basic research concepts of contemporary semiotics and can be used in biosemiotic approach as well as semiosphere. The main properties of text are: expressivity, boundaries and structurality. The text is hierarchic in its nature.

Notion semiosphere was introduced by Lotman in analogy to V.I. Vernadsky's notion of "Biosphere". Lotman gives very important characteristics to boundary of semiosphere. Boundaries of semiosphere are bilingual translatable filters.

In the second part I brought out some important point of biosemiotics, including the importance of the notion code. The code is set of rules of correspondence between two independent worlds, they give meaning to informational structures, and they are collective rules which do not depend on the individual features of their support structures. As cells are structural and functional entities, the semiosis is essential within a cell. Semiosis in cell is presented through codified processes.

In the third part I intended to bring together the tangent points of previous chapters and to find out if there is anything that connects culture and cell. In order to come to a conclusion whether it is possible to adapt the methods of the cultural semiotics for biosemiotics – is it reasonable to consider cell as a semiosphere, text of set of texts – I placed a cell into context of cultural semiotics, in order to see if the Lotman's properties of modelling culture can be considered general or universal for biosemiotics. Proceeding with this, I handled both terms: semiosphere and text as

systems, as well I handled a cell as a system and reached to the conclusion, which was not exactly what I expected. I expected that one Lotman's concept of cultural semiotics – either semiosphere or text – turns out to be appropriate in analyzing cell. However, neither I found crucial characteristics in both. Thus, in conclusion both concepts – the concept of semiosphere and the concept of text – offer an important aid in understanding cell.

TABLE OF REFERENCES

Barbieri, Marcello 2003. *THE ORGANIC CODES An Introduction to Semantic Biology,* Cambridge University Press

Barbieri, Marcello 2008a. *INTRODUCTION TO BIOSEMIOTICS The New Biological Synthesis.* Dordrecht: Springer: 179—207

Barbieri, Marcello 2008. THE CODES OF LIFE The Rules of Macroevolution Dordrecht: Springer:

Barbieri, Marcello 2010. *Biosemiotics: A New Understanding of Life* In D. Favareau (Ed.) Essential Readings in Biosemiotics (pp 751—796)Dordrecht: Spinger.

Eco, Umberto 1984. *Semiotics and the philosophy of language*, Macimillan

Epstein, Richard J. 2003. *Human Molecular Biology*. Cambridge: Cambridge University Press

Emmeche, Claus 2002. *The chicken and the Orphan egg: On the function of meaning and the meaning of function* In Sign System Studies 30.1 (pp15—31)

Giorgi, F., Bruni, L.E., Goldberg, L.J. 2013. *The Egg as a Semiotic Gateway to Reproduction* In Biosemiotics 6 (pp 489-496). Dordrecht: Springer

Hoffmeyer, J. (2008). *Semiotic scaffolding of living systems*. In M. Barbieri (Ed.), Introduction to biosemiotics (pp. 149–166). Dordrecht: Springer.

Lotman, Juri 1999. *Semiosfäärist*. Tallinn: Vagabund

Lotman, Juri 2005. *Kultuur ja plahvatus*. Tallinn: Varrak

Lotman, Juri 2006c. *Kunstilise teksti struktuur*. Tallinn: Tänapäev

Lotman, Juri 2010. *Kultuuri tüpoloogiast*. Tartu: Tartu Ülikooli Kirjastus

Kull, Kalevi 1999. *Towards biosemiotics with Yuri Lotman* In Semiotica 127-1/4 (pp 115-131)

Kull, Kalevi 2008. *Biosemiootika* in Keel ja Kirjandus 51- 8/9. (pp 665—674)

H. Lodish, A. Berk, S. L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell. 2000. *Molecular Cell Biology*. W. H. Freeman and Company. New York.

Merleau-Ponty, Maurice 2013. *Silm ja Vaim*. Tartu: Ilmamaa

Miller, James G. 1978. *Living Systems*. New York: NcGraw-Hill Book

Pattee, H.H. 2013. *Epistemic, Evolutionary, and Physical Conditions* In Biosemiotics 6 (pp 9–31) Dordrecht: Springer

Sebeok, Thomas A.1986, Encyclopedic Dictionary of Semiotics. Berlin: Mouton de Gruyter

APPENDIX

Table 1. The Genetic Code (RNA to Amino Acid)*

First Position (5' end)	Second Position				Third Position (3' end)
	U	**C**	**A**	**G**	
U	Phe	Ser	Tyr	Cys	**U**
	Phe	Ser	Tyr	Cys	**C**
	Leu	Ser	Stop (och)	Stop	**A**
	Leu	Ser	Stop (amb)	Trp	**G**
C	Leu	Pro	His	Arg	**U**
	Leu	Pro	His	Arg	**C**
	Leu	Pro	Gln	Arg	**A**
	Leu (Met)	Pro	Gln	Arg	**G**
A	Ile	Thr	Asn	Ser	**U**
	Ile	Thr	Asn	Ser	**C**
	Ile	Thr	Lys	Arg	**A**
	Met (Start)	Thr	Lys	Arg	**G**
G	Val	Ala	Asp	Gly	**U**
	Val	Ala	Asp	Gly	**C**
	Val	Ala	Glu	Gly	**A**
	Val (Met)	Ala	Glu	Gly	**G**

** " Stop (och) stands for the ochre termination triplet, anad "Stop (amb)" for the amber, named after the bacterial strains in which they were identified. AUG is the most common initiator codon; GUG usually codes for valine, and CUG for leucine, but rarely, these codons can also code for methionine to initiate an mRNA chain.*

Source: Lodish et al. 2000: 118

RESÜMEE

“Semioos rakus ja kultuuris: Raku semiootiliste protsesside uurimine võrrelduna kultuuri semiootiliste protsessidega”

19. sajandil alguse saanud rakuteooria ja sellest edasi arenenud raku uurimine on meid viinud täpsema teadusliku mõistmiseni iseenda materjaalsest või füüsilisest eksistentsist. Ent veel enne rakuteooria tekkimiset oli inmkond üsna pikalt jõudnud nautida vaimuteadusi. 20. sajandil sai populaarseks tähenduseloome ja kommunikatsiooni probleem ja tänaseks ei paelu loodusteadlasi mitte ainult keemilised protsessid iseenesest, vaid protsesside tähendus. Nõnda rakk, kui tervik mehhanism, on võimeline kasvama ja end taastootma ning ümbritseva keskkonnaga suheldes iseseisvalt eluks vajalikku energiat komplekteerima. Samas on ka kultuuri kujutletud kui osadest koosnevat ehituslikku ja talituslikku organismi, millel on elusorganismiga ideeliselt samad võimed.

Probleemipüstituse aluseks võib pidada rakku (*cellula*), mis on elusorganismi väikseim ehituslik ja talitusliks üksus. Antud töö keskseks ideeks on uurida rakusiseseid semiootilisi protsesse, analoogiliselt kutuuriliste semiootiliste protsessidega. Selleks, et nii laia ja ebamäärast mõistet nagu kultuur kuidagi piiritleda pean mõistlikuks lähtuda Juri Lotmani semiosfääri mõistest.

Töös antakse põgus ülevaade rakumehhanismidest ja lähtutakse konkreetsetest rakuprotsessidest, mis oma loomult on kommunikatsioonilised. Hiljem võrreldakse rakuga seonduvaid kommulikatsioonilisi protsesse kultuuri analoogiaga, tuginedes Juri Lotmani teksti ja semiosfääri kontseptsioonidest. Uurimus lähtub ühelt poolt rakuteooriast ja rakumudelist, teiselt poolt semiootikas käsitlevatest kommunikatsiooni käsitlusest, täpsemalt Juri Lotmani teksti ja semiosfääri käsitlusest.

Kuigi eeldatavaks tulemusek peeti üht võimalikku kultuuri uurimise kontseptiooni olevat sobilik rakuprotsesside semiootilisel käsitlemisesl, siis töö lõpuks jõuti järeldusele, et mõlemad – nii semiosfääri kui ka teksti kontseptsioon sisaldavad endas olulisi omadusi, mis aitavad rakku paremini mõista.

I, Reili Mere

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