Poetics is in the Genes. A Manifesto[1]

ARNE MERILAI

Abstract. The manifesto "Poetics is in the Genes" reveals the commonality between poetics and genetics for the first time. Outside of cellular biology attempts have been made in both (text)linguistics and semiotics to describe the genome and its interactions as similar to language. However, the approach of this interpretation relies particularly on the poetic function of language and its underlying self-referentiality as the starting point. Poetic relevance reveals itself explicitly in its relationship to the cutting-edge concept of CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats), which thematises abundant metric and figurative phenomena and terms on several levels: accumulation, regularity, interval, different repetitions, rhythm, iamb/trochee, stressed/unstressed units, longitude, orchestration; equivalency, substitution, connotation, contrast, analogy; synecdoche, metonymy, metaphor, irony, symbol, paradox, implicature, epithet, simile; palindrome, chiasmus, ellipsis, zeugma, calembour, polysyndeton; poem, verse, stanza, chapter, refrain, (identical) rhyme, collage/bricolage, plot, composition, text, hypertext, architext, palimpsest; graphic imagery, symmetry/asymmetry; homonyms, synonyms, antonyms, archaisms, neologisms; words, phrases, sentences, syntax, definition, quote; cacophony/noise, harmony; spatial and time deixis; self-reflexivity of the utterance and utterer. From this perspective, life stems from primordial poetics as the first level. It is a convincing enough association to apply poetic analysis to the free interpretation process of genomes. A universal law of nature is that symmetry dictates design (including asymmetry): poetics is everywhere.

Keywords: poetics, pragmapoetics, genetics, self-reflexivity, CRISPR, biosemiotics, biolinguistics

[1] The initial version of this article, "Poeetika on geenides: Manifest," was published in Estonian in *Keel ja Kirjandus*, 2021, 1–2, 3–10.

DOI: https://doi.org/10.12697/IL.2022.27.2.15

Introduction

In 2012, Jennifer Anna Doudna, from the University of California, along with her French colleague Emmanuelle Charpentier, proved that the bacterial immune system CRISPR 'scissors', or the Cas9 system, can change DNA in a laboratory much more accurately and universally than ever before. A new scalpel was crafted giving the possibility to cut a DNA sequence more precisely than ever before. This discovery presents amazing opportunities ranging from the fight against viruses and disease prevention to effective cancer treatments and personalised medicine. In 2020, these two brilliant women were awarded the Nobel Prize in Chemistry.

CRISPR is an acronym for Clustered Regularly Interspaced Short Palindromic Repeats. The CRISPR sequence is a kind of genetic library, a memory institution that collects, systematises, stores, and borrows samples from foreign DNA that has attacked cells in order to distinguish it from the organism itself. This helps to protect the organism against invading viruses, whose DNA is cut into pieces after being detected with the help of the samples. Palindromes fit needle-like bristles onto the nucleic acid thread, marking the best places to cut and sew, something that can now be done by humans. Using this primordial defence mechanism, genetic technologists can alter DNA molecules – the genetic dictionary, but not the text – more efficiently than ever before, which is a powerful instrument. And, as the biotechnological revolution unfolds, this is just the beginning of a long journey, although serious dangers of eugenics overshadow it.

CRISPR and poetics

To the philologist it seems obvious that the concept of CRISPR could emerge freely in theoretical verse theory. Indeed, a CRISPR sequence could be formally described as a poem. The parallel with poetics is obvious, even if we leave aside the Heideggerian idea that the 'state-building act' (which could also be a scientific discovery or invention) is also *poiesis* and that, in this sense, genetics has always been poetic existence-giving.

On one hand, the acronym refers to ordered *intervals* or *interspaces*, such as the unstressed syllables between the stressed ones in prosody. On the other hand, it refers to recurrent *tenet-palindromes* and other forms of *repetition* as figurative schemes. Additionally, there are other important poetic terms to which this term refers: *clusters*, *regularity*, *repeats*, and *shortness*, i.e., *longitude*. All components of the CRISPR label refer to the poetic dictionary.

Figures 2 and 3 below explicitly show the striking similarities between genetics and poetics. These visual quotes are extracted from a caption of the CRISPRCas9 system (Figure 1) which illustrates the genome editing technique (Bhaya, Davison, Barrangou 2011: 277).

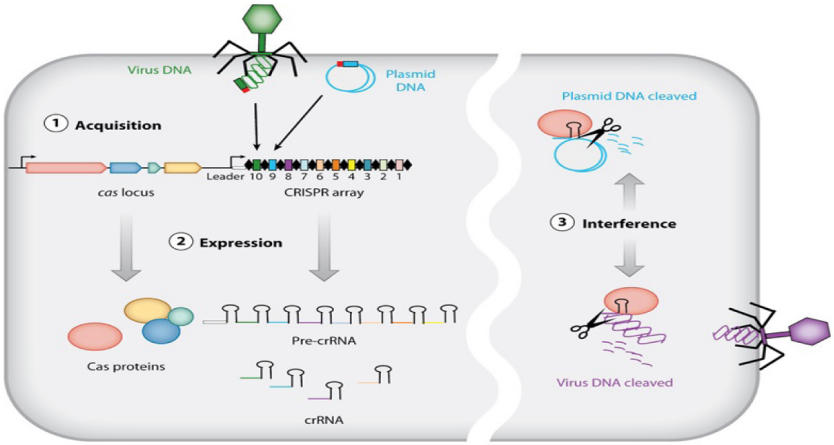

Figure 1. An illustration of the CRISPR/Cas9 system by Bhaya, Davison and Barrangou (2011).

Figures 2 and 3 clearly reveal that these graphs could also be used to describe the formal structure of a narrative poem on all levels: from prosody (phonetics and morphology) or figurativeness (syntax and semantics) to composition and textuality. There are two basic principles of poetics: (1) *parallelism*: similarities, repetitions of equivalencies, analogues and substitutes, the interchangeability and regularity of the units of expressions, which tends towards *rhythm*; (2) *contrast*: opposition, meaningful difference, plus versus minus, which can also shape rhythm. Similar contrasted verses, strophes, refrains, and identical rhymes represent several fields simultaneously, i.e. metrics as well as orchestration and sentence patterns.

Figure 2. CRISPR array: squares as DNA samples, diamonds as palindromic interspaces.

Prosody

On the lowest level, from the *metric* point of view, the CRISPR sequence in Figure 2 is obviously an *iambic* foot, as the first 'syllables' (diamonds) are always unstressed, followed by stressed: *interval–stress*, or interspace–spacer, and so on. Conversely, the alternative would be *trochee*, of course. One can observe a neat 'prosody' of *binary units* with ordered intervals: an explicitly rhythmical, regular, organised, and well-orchestrated structure.

Composition and textuality

Obviously, Figure 2 could represent a formal model of a *poem*, especially a narrative one such as a *ballad*, with its regularly repeated and isolating *refrains* (identical diamonds), or *rhymes*, between the *verses*, *stanzas,* or *chapters* (individual squares), at any strophic level one might choose. The composition is based on repetition, juxtaposition, succession. It looks like an intended *collage* with a purposeful *plot* – rather than a random *bricolage* – with its constituents (stanzas or chapters) as peculiar quotes culled from other, alien parent 'poems' from outer space. Indeed, one can talk about a rhythmic textuality. As well as *hypertext* – cells in holistic interaction – or an *architext* – a genome or stem cell as a Goetheesque *Ur-ei*, a primordial embryo as the seed of everything that precedes it. Or one can also consider *palimpsest*, when the texts – individual genes or larger units in the genomes – are overwritten with new information.

Schemes of speech

Sentence patterns are quick to emerge alongside recurrent palindromes and other forms of *repetition*. Looking beyond the illustration in a broader sense, one might say: if something is omitted, cut out from the genome, then *ellipsis* is at work. Especially relevant for genetics might be *chiasmus* (e.g., Pelkey 2017), reflections in mirror (Rubens: prince of painters and painter of princes), just as in both chains of nucleotides. These famous four letters – A, C, G, and T – seem to be organised in a clear chiastic manner. Regular palindromes as interspaces also function as *conjunctions* between the spacers, the definitions of foreign genomes, i.e., between *quotations*. It is close to *polysyndeton*, which is the accumulation of conjunctive words. One can also speak of *zeugma* (Mr Pickwick took his hat and his leave), or *pun* or *calembour*. In that case, a single particle acquires a double meaning and function: the individual excerpts could become the basis of multiple outputs, which also brings us to *tropes* or *figures of speech*.

Figures of speech

Alongside *metric*, *syntactic* and *compositional rhythm*, *metonymy* as a figure of speech seems equally salient. The *metonymicality* of the CRISPR sequence leaves no room for doubt, as its storage units, the spacers, are causally in a *synecdochic* pars pro toto relationship with the sample parent genomes. But *metaphoricality* may also be observed in genomes. For example, when a completely new meaning or meanings are assigned to an earlier concept. The pleiotropic polyfunctionality, i.e., double meaning, of a genetic unit is like metaphor in language. Additionally, the spacers may also be considered as representing *symbols* of something else, something much bigger, and more important. All of these represent the relationship between the set and the subset.

One may even detect analogues of *verbal irony* (conversational implicature in Paul Grice's terms) or *situational irony* or *paradox* when cells – obviously cancer cells in particular – attempt to convey one thing, but the results is the opposite: destructive proliferation instead of growth, death instead of eternal life. It is also recognisably ironic and paradoxical when mutations useful in near-future evolution turn out to be boomerangs, developmental setbacks, or dead ends for the species in the long run. Metaphor, metonymy, symbol, irony, paradox – these are figures of speech where A is said but B is thought, implied.

One can also consider *epithets*, i.e., accompanying descriptive terms, as well as *similes*, i.e., explicit comparisons with something else. Epithet and simile differ from other tropes in the sense that they are literal and straightforward, rather than non-literal, expressions. However, metaphors are sometimes called implicit similes.

Graphic patterns

If a cell had eyes like ours, these associations could also call forth *graphic image patterns* as is the case with the 'mushrooms', the palindromic interspaces, in Figure 3. Puzzling though it may be, the cell is somehow able to see these fungi, otherwise these regular and highlighted patterns would not exist.

Figure 3. Palindromic interspaces of a CRISPR array.

Deixis

In the future, I would be intrigued to find out whether one can speak about *deixis*, pragmatic (linguistic) orientation acts (q.v. Merilai 2005; 2020) inside a cell. Is there an *origo*, an orientation centre in a cell? Is it its nucleus? Are there any observable deictic space and time dimensions: here, there, in, out, up, down, above, below, in front, behind, left, right, towards, forwards, now, earlier, later, and so on? That would be astonishing – cellular self-reflexive, context-dependent deixis.

Poetic lexicon and syntax

When it comes to a stylistic vocabulary, one might say that a cell can interpret the clusters of *homonyms*, *synonyms*, and *antonyms* as well as *archaisms* and recurring *neologisms* – numerous 'words' or phrases that have either lost or not yet acquired meaning – from the genome. In fact, *synonymous mutation* is a regular term in genetics, another self-evident borrowing from the poetic lexicon. Semantic *cacophonic noise* in a genome which adjoins meaningful *harmony* is also an important lexical phenomenon. *Words*, *phrases*, *quotes*, and *definitions* are all to be considered on this level. Comparative research on syntactic and genomic patterns forms a worthy collection, which could be reactivated from the vantage point of the poetic function.

Library

The "bibliographic" indications of *accumulation – collections*, *catalogues*, *definitions*, *quotes*, *labels*, *exhibits*, *repository*, etc. – can also be interpreted from the poetic point of view.

Thus, it is tempting – and by no means rhetorical – to say that genetics seems to be fully poetic. Although the formal similarity is diverse and obvious, it is not worth equating the two disciplines with different methods and goals in a stricter sense. This parallel, however, could be acknowledged more broadly, creating a new perspective and common ground in both the natural sciences and the humanities.

My hypothesis is that genomes can be shaped by a *primordial poetics* just as a poem is. Life – the language of polymers and nucleic acids, the communication of proteins – seems to be primordially poetic. Therefore, it may be argued that genetics and poetics grow from the same root, from the same primal function. Genes as language and text have been written about both metaphorically and

literally (see López-García 2005; Raible 2001). Not long ago, Suren Zolyan and Renad Zhdanov (2018) called the genome a *hypertext*, or a process, which may be approached from the viewpoint of *text linguistics*. Within this, however, the activity of the cell could still come under more precise focus and observation from the perspective of the *poetic function of language use*. I have been tempted for a long time to bring the idea to cellular biologists, but now, facing the genetic concept of the *palindrome*, which was borrowed from the poetic dictionary and made famous, it is again the time to seize the drawstring of genetics.

Poetic self-referentiality

In language and literary studies, the self-referencing ability of the text is called the poetic function of language. Already in 1958, Roman Jakobson (see 1981) described the poetic work of language in a ground-breaking and transparent way according to the Slavic schools of form. For him, the literariness of language was one of the six functions of communication, which, if left unstudied, would leave linguistics incomplete. The basic functions of language, slightly modified (q.v. Merilai 2003: 382–383), would be: (1) *referential* (contextual, epical), (2) *emotive* (expressive, lyrical), (3) *conative* (addressing, dramatic) functions as referential activity, (4) *metalingual* (language- or semantic-driven), (5) *phatic* (contact- or channel-driven), and (6) *poetic* (expression- or form-driven) functions as linguistic self-referential activity. This, apparently, could also be projected to the vegetative iconic communication of cells.

The poetic function reveals itself when the paradigmatic similarities of language are recognised, combined, and directed into an ordered syntax, the expression and speech. This creates linguistic equivalents at the level of the perceptible form of self-communication: language becomes visible, highlighting not only the content but also itself, its composition and structure, which in ordinary cases remain hidden. However, it can be argued that linguistic self-manifestation is not absent from ordinary language either, something that has been proven in work related to deixis (Merilai 2005).

Although the Nobel Prize is not awarded in philology, Jakobson undoubtedly formulated a breakthrough vision that underpins modern poetics as well as cultural semiotics based on a secondary model system. It is presumable that Jakobson, like many other linguists, semioticians, or other researchers, comprehended the direct linguistic potential of genetics, since the processes of encoding and exchanging molecular information are structurally similar to linguistic communication in both their stability and variability (Jakobson 1970: 437–440). However, he did not pay attention to the possibility of poetics in

genetics, probably since molecular biology was still too young. But now the time seems to be ripe for what is ripe.

I consider the self-referencing capability of the expression, i.e., the textual auto-reference, to be the core of poetics. In introducing and developing pragmapoetics, I have visualised poetic self-referentiality as depicted in Figure 4 (Merilai et al. 2003: 23; Merilai 2007: 382; 2013: 12). In genetics, this pictorial generalisation could be applied to self-recognition and self-copying processes in cells.

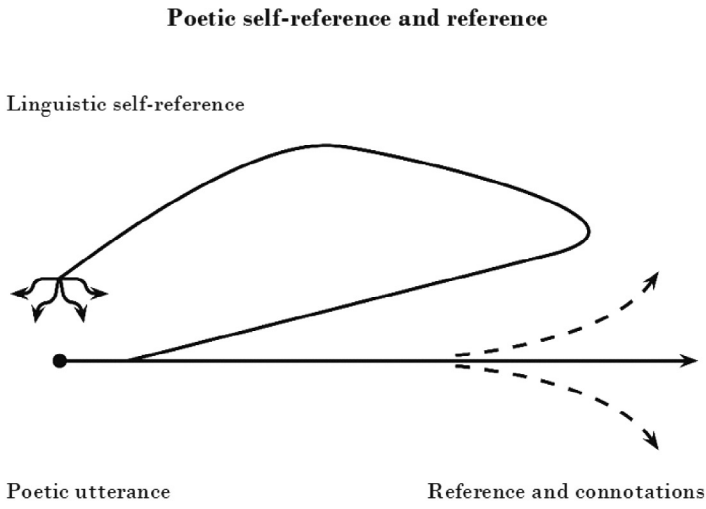

Figure 4. Poetic function.

I sketched the predecessor of this diagram as a university student while pondering philosophy and discussing phenomenology; many times before, I was inspired by the explanatory power of that scheme in poetics as well. In addition to intentionality, i.e., the subject's self-awareness and self-reflection, this image helps to show the reflexivity of the utterance. First, a poetic utterance refers to its propositional and modal contents. Second, its textual qualities create the communication between language elements on the formal surface. The first is the *mimesis* or truth level – *de re*; the second is the *poiesis* or expression level – *de dicto*. This 'two-faced' Wittgensteinian or Lotmanian, back and forth, roundabout, flashing scheme is supplemented with additional arrows, as it corresponds better to the associatively referential – connotational – and pluralistically auto-referential, formal quality of the poetic expression.

Thus, the same model would also be applicable when characterising the primordial poetics of genetic writing, reading, multiplying, propagation, learning, memory, and communication processes in cells. Naturally multiplying, identical, *parallel* sequences – identity reestablishment – simultaneously shape the opposition, the *contrast* to foreign sequences, which is poetic by definition. It seems, that DNA replication in matrix synthesis, which ensures the accurate transmission of information, must have the self-referentiality mechanism at work somehow similarly to that of the poetic expression. However, how it functions on a biochemical level remains a mystery to my layman's eyes at this point. How molecular self-reflection occurs in the copying process is my next question for microbiologists, but the similarity to the poetics of language does not seem coincidental. Especially thought-provoking is the characteristic fact that poetic self-referentiality – as *the core* of the secondary modelling system – always transforms the initial linguistic disposition (on the primary modelling level), as the latter may sometimes be barely restorable from the final result or even beyond recognition. This peculiar phenomenon must have its counterpart in genetics, too, if my hypothesis has any truth to it.

If Ángel López-García (2005: 155, 173) could reach the reasoned hypothesis, in his detailed monograph, that genetic codes may have been a pre-program from which linguistic codes originated, then the same conclusion can be logically extrapolated to poetics as an inevitable part of language. Consequently, literary codes may also have their pre-programs on the genetic level.

Therefore, based on the pioneer of generative grammar Noam Chomsky (see Chomsky 1980), the biolinguistic discussion of a genetically inborn universal grammar, the so-called language instinct, may be revived in the context of cellular poetics, as the poetic self-referential function is an integral part of the definition of language.[2] As biolinguist Lyle Jenkins (2000: 232) says, a better understanding of human language – and poetry, to be added accordingly – helps better understand the language of cells.

Everything that lives interprets. From this point of view, poetics is the basic principle of life, apparent in the self-referential genetic reading and translation process of organisms as self-interpreting biotexts, a notion introduced by biosemiotics (Kull 2002; Maturana, Varela 1980). The genome itself is a passive sequence of defined signs that only comes to life when the cell reads it. However, the cell is free to choose which section it is currently activating. This is not

[2] If language (and mathematics) has an inherited structural basis, it must be polygenetic. At the end of the last century and beginning of the current one, it was even argued that some genes specifically capable of affecting language ability – thought to number in the thousands since the time of Salvador Edward Luria (Jenkins 2000: 124) – are already localisable (see, for example, Lai et al. 2001).

an individually determined, (neo-)Darwinian process, but an open plurality. The cell is the first level of life, and, according to biosemioticians (see also Weber 2016; Noble 2006), this life is a freely choosing and creative ambassador from the beginning.[3] Creation: poetry, music, whichever primordial activity is already occurring in the cell. The complex weave of protein texts from the genetic threads is in constant search of new patterns. Thus, old metaphors are successfully changing in recent epigenetic research of gene expressions. It is no longer common belief that evolution is based solely on changes in DNA, but more on novelties in cellular interpretation and holistic interaction.

If life is based on primordial poetics, then where there is life, there is interpretive primary poetics. However, Zolyan and Zhdanov, who approach from a textual linguistic perspective, also casually mention the possibility of *poetics* and briefly compare the DNA helix to music, while Tartu professor Kull (1998), to whom they refer, has clearly relied in his own work on the idea of *autopoiesis*, which one could consider the root of poetics. So, it would be right to follow this Ariadne thread – as a method – to find a way through the maze as Theseus did. Just as our brains have been noted to have the same honeycomb-like structure as the universe, one may juxtapose genetic interactions with poetry, because both, in the macro and micro, have a form-bound, self-referential text and entangled speech structure. The analysis of poetic form that we have learned to master in literature can be projected back to the genetic level, which

[3] Berlin science writer Andreas Weber (2016) calls his fascinating, essayistic and figurative approach biopoetics. However, he does not approach poetics in a textual-analytical, formal-structural manner but rather from a cognitive standpoint, from the inner experience of the receiver and the first-person expression. In this case, the term poetic, meaning lyrical – emotional, soulful, aesthetic, erotic – is central to the subject's self-perception, as opposed to formal poetics. Biopoetics in this sense is rather biopoetry in a non-fiction form. If a biopoetic approach gives life to and introduces (micro) biology, then analytical biopoetics, which has not yet even been created, should look at the technique of (micro)biological 'texts', its formal devices and the autoreferential principles behind their composition. The formalist biopoetic approach has a different object, goal, and methodology. If the former is more Platonic, humanistic, then the latter is Aristotelian, structural: the logical discipline itself, not the popularisation of it.

Again, Denis Noble's biopoetic book, Music of Life, does not adhere to Weber's elevated style but is just as sublime in mood. Both approaches are connected by the perception that their subject is clearly poetic. Noble's program is Systems Biology, an integrated viewpoint, a larger holistic picture that is otherwise often lost in narrow disciplines. His metaphor approaches music – the idea of rhythm, a part, a score, orchestration, polyphony, symphony, harmony – with a poetic potential. "The organism is an orchestra without a conductor," says Kalevi Kull in the afterword (in Estonian) of his translation book, which refers to "the poetic, aesthetic, creative aspect of life" (Kull 2016).

is less well known in this respect, to point out typological similarities. Thus, philology can be of help in more areas than just the humanities and didactics.

As Ludwig Wittgenstein said (1958: 19): "To imagine language means to imagine a lifeform." And vice-versa. A text is an organism, and an organism is a text; a text is a complete holistic process in the context of other wholes. In literary studies, it is called intertextuality, rhizome, and intermediality.

Expanding the program

We know that the general idea of the poetic function, where symmetry dictates design (and thus also asymmetry), was also harboured in Albert Einstein's theoretical thinking, as is the case with many other natural scientists. It is evident that the question of poetics may as well be reduced to the observation level of inanimate nature, but let this perspective remain the crystallising punchline of this manifesto.

Arne Merilai
arne.merilai@ut.ee
University of Tartu
ESTONIA

References

Bhaya, D., Davison, M., Barrangou, R. 2011. CRISPR-Cas Systems in Bacteria and Archaea: Versatile Small RNAs for Adaptive Defense and Regulation. – *Annual Review of Genetics.* 45, December, 273–797. https://doi.org/10.1146/annurev-genet-110410-132430

Chomsky, N. 1980. On the Biological Basis of Language Capacities. – Chomsky, Noam. *Rules and Representations.* New York: Columbia University Press, 185–216.

Jakobson, R. 1970. Linguistics. – *Main Trends of Research in the Social and Human Sciences, Part one: Social Sciences.* Paris – The Hague: Mouton / Unesco, 419–463.

Jakobson, R. 1981 (1960). Closing Statement: Linguistics and Poetics. – R. Jakobson. *Selected Writings. III: Poetry of Grammar and Grammar of Poetry.* Ed. by Stephen Rudy. The Hague–Paris–New York: Mouton Publishers, 18–51.

Jenkins, L. 2000. *Biolinguistics: Exploring the Biology of Language.* Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511605765

Kull, K. 1998. Organism as a Self-reading Text: Anticipation and Semiosis. – *International Journal of Computing Anticipatory Systems, 1*, 93–104.

Kull, K. 2002. A Sign is Not Alive –A Text Is. – *Sign Systems Studies*, 30 (1), 327–336. https://doi.org/10.12697/SSS.2002.30.1.21

Kull, K. 2006. Organism kui dirigendita orkester – ja eluteaduse süda. – D. Noble, *Elu muusika: bioloogia teispool geene*. Transl. Lauri Laanisto. Tallinn: Varrak, 205–214.

Lai, C. S. L., Fisher, S. E., Hurst, J. A., Vargha-Khadem, F., Monaco, A. P. 2001. A Forkhead-domain Gene is Mutated in a Severe Speech and Language Disorder. – *Nature*, 413, 519–523. https://doi.org/10.1038/35097076

López-García, Á. 2005. *The Grammar of Genes: How the Genetic Code Resembles the Linguistic Code*. Bern: Peter Lang.

Maturana, H., Varela, F. 1980. *Autopoiesis and Cognition: The Realization of the Living.* Boston: D. Reidel. https://doi.org/10.1007/978-94-009-8947-4

Merilai, A. 2005. Regarding Pragmapoetics: Deixis. – *Regards multidisciplinaires sur la deixis: de l'énoncé à l'énonciation et vice-versa. Multidisciplinary views on deixis: from utterance to uttering and vice versa. Multidistsiplinaarsed vaated deiksisele: lausungist lausumiseni ja vastupidi.* Université de Tartu, Centre d'Etudes Francophones Robert Schuman. Studia Romanica Tartuensia 4b. Eds. Daniele Monticelli, Renate Pajusalu, Anu Treikelder. Tartu: University of Tartu Press, 271–285.

Merilai, A. 2007. Pragmapoetics as Literary Philosophy. – *Interlitteraria*, 12, 379–392.

Merilai, A. 2013. Kirjandusteoreetilise ühendvälja poole. – *Methis: Studia Humaniora Estonica*, 12, 7–17. https://doi.org/10.7592/methis.v9i12.1089

Merilai, A. 2020. Deictic Close Reading. – *Interlitteraria*, 25 (1), 26–40. https://doi.org/10.12697/IL.2020.25.1.4

Merilai, A., Saro, A., Annus, E. 2003. *Poeetika: Gümnaasiumiõpik*. Tartu: Tartu Ülikooli Kirjastus.

Noble, D. 2006. *The Music of Life: Biology Beyond the Genome.* Oxford: Oxford University Press.

Pelkey, J. 2017. *The Semiotics of X: Chiasmus, Cognition and Extreme Body Memory*. Bloomsbury Advances in Semiotics. London etc.: Bloomsbury Academic.

Raible, W. 2001. Linguistics and Genetics: Systematic Parallels. – M. Haspelmath, E. König, W. Oesterreicher, W. Raible, eds., *Language Typology and Language Universals: An International Handbook*. Berlin – New York: Walter de Gruyter, 103–123.

Weber, A. 2016. *Biopoetics: Towards a Biological Theory of Life-as-Meaning.* Biosemiotics 14. Berlin: Springer. https://doi.org/10.1007/978-94-024-0832-4

Wittgenstein, L. 1958. *Philosophical Investigations*. London: Basil Blackwell.

Zolyan, S. T., Zhdanov, R. I. 2018. Genome as (Hyper)Text: From Metaphor to Theory. – *Semiotica*, 225, 1–18. https://doi.org/10.1515/sem-2016-0214