Technology and Language

Writing With Atoms. Written literally with atoms, the Japanese Kanji above — each just a few nanometers across — means 'atom.'

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Ulrike Ramming

Joseph Wilson

Walker Trimble

Chandrima Christiansen
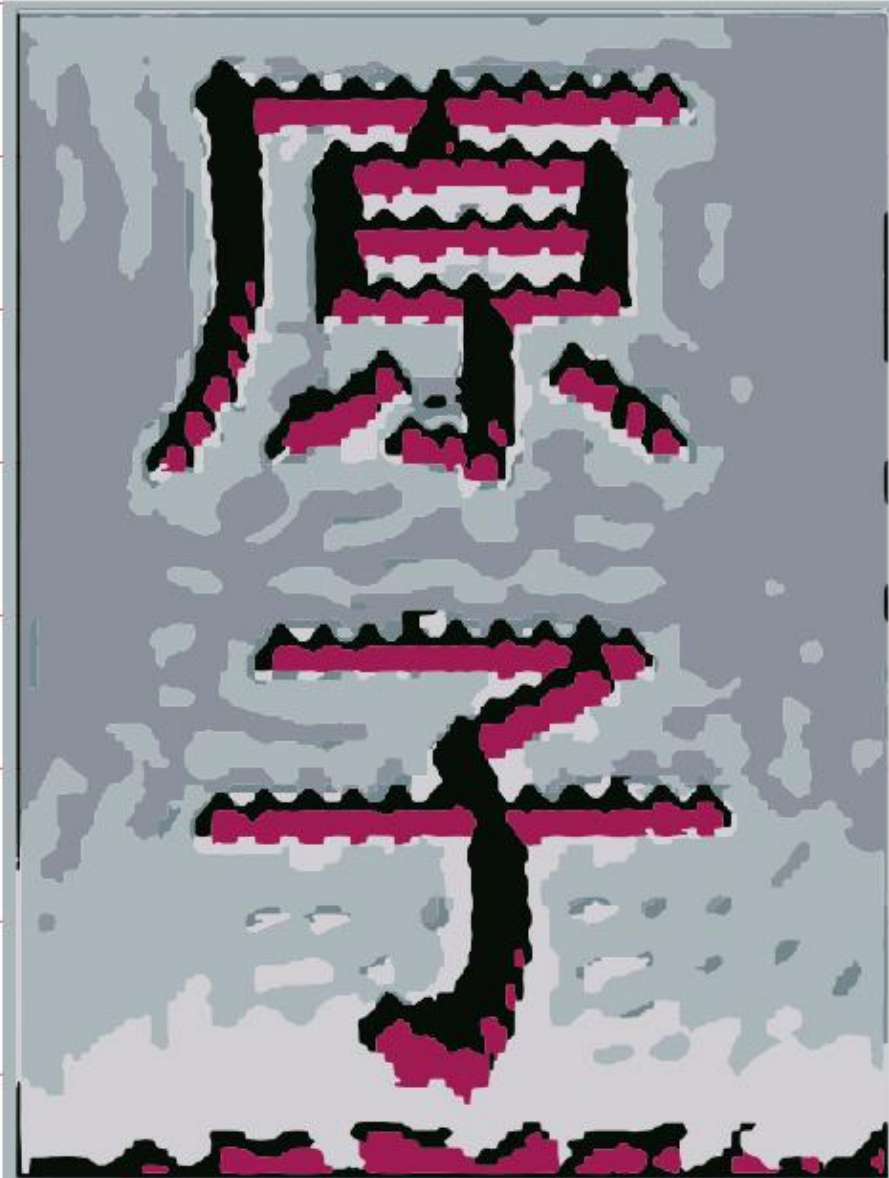
Christopher Coenen and Alexandra Kazakova

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The Word as a Technical Artefact

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In the Beginning was the Word

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Abstract

The problem of modernity haunts the Western tradition of philosophy and moves us from disenchantment and disempowerment of the word to its re-enchantment. If critical reasoning exorcised the magic power of the word, technological achievements of control reinstated it. More straightforwardly, perhaps, Russian thought traditionally viewed the word as a "technical" or "magical" artifact capable of changing the world. In the beginning was God's word but are also the words which open the world of nanotechnology and the digital worlds of software engineering. It is shown how the contributions to this special issue probe various aspects of the word as a technical artefact with technical functions.

Keywords: Modernism; The redeeming word; Disenchantment and re-enchantment; Words and things; Creativity of language

Аннотация

Проблема современности преследует западную философскую традицию и проводит нас от разочарования из-за бессилия слова к повторному очарованию им. Если критическое мышление изгоняет магическую силу слова, технологические достижения контроля восстанавливают ее. Говоря более прямо, русская мысль традиционно рассматривала слово как "технический" или "магический" артефакт, способный изменить мир. Вначале было слово Бога, но это также слова, которые открывают мир нанотехнологий и цифровые миры разработки программного обеспечения. Показано, как в материалах этого специального выпуска исследуются различные аспекты слова как технического артефакта с техническими функциями.

In the Beginning was the Word

By dedicating the first regular issue of Technology and Language to the word as a technical artefact we enter the drama of modernity. „In the Beginning was the Word" refers to the creative and productive power of the word to produce a corresponding world. This is a magical, pre-modern conception which kept haunting, ghostlike, the modern age and which is resurfacing today.

I. THE WORDS AND THE THINGS

The archetypically modern hero of Western literature is Goethe's Faust who finds his mystical bond with nature severed and reinvents himself as a tireless seeker of experience and truth as he is trying to translate the biblical text:

> I feel, this moment, a mighty yearning
> To expound for once the ground text of all,
> The venerable original
> Into my own loved German honestly turning.
> "In the beginning was the Word." I read.
> But here I stick! Who helps me to proceed?
> The Word – so high I cannot – dare not, rate it,
> I must, then, otherwise translate it,
> […] The spirit helps! At once I dare to read
> And write: "In the beginning was the deed."[1]

He cannot rate the word so highly, writes the poet, and elsewhere despairs altogether of the meaning of names. Goethe denies the power of words to redeem a lost soul and forge a unity of mind and world:

THE METAMORPHOSIS OF PLANTS.

> You are confused, my love, by the thousandfold mixture
> Of this jumble of flowers dispersed through the garden;
> You hear their many names, and with a barbarian ring
> One name displaces the other as you listen for them.
> All their shapes are similar, yet none is like the other,
> And thus, the entire chorus hints at a secret law,
> At a sacred riddle! Oh, dearest friend, if only for you
> I could solve it happily and convey the redeeming word!
> […][2]

Goethe here addresses a lover of plants who can identify them by their various names and still knows nothing of them, nothing of the natural order among and between them. The secret word which would (dis)solve the mystery is „*das (er)lösende Wort*" (the redeeming word) but there is no such salvation or redemption through the word. Instead, Goethe famously envisioned another language altogether, namely the language of the

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[1] Translation by Charles T. Brooks, compare http://www.einam.com/faust/index.html
[2] Translation by A.N., compare www.everypoet.com/archive/poetry/Goethe/goethe_the_metamorphosis_of_plants.htm

plants themselves which speak to us morphologically, that is, superficially through their form and by way of their arrangement side by side. Properly arranged they present a formal sequence or series that points to an archetypal plant as a point of origin from which emanates their visual ordering. As questionable or naive as this conception may appear, it testifies to the rejection of a truth that lies deeply behind the surface – and a rejection of the word that penetrates to the essence of things.

To dream of an elusive word that breaks the spell and sets us free, that unleashes natural powers and sympathetically resonates with the order of things (Foucault, 1970) was now a matter for romantic poets with their anti-modern aspirations. Novalis might be cited here or this short poem by Joseph von Eichendorff:

> Divining Rod
>
> Might a song be sleeping in all things
> That are dreaming on and on
> And the world lifts up to hum and sings
> If the magic word you hit upon.[3]

It was said of Orpheus that he could draw song and tears from rocks, and still today it is the prerogative of lovers to find the right word that can transform a situation, that can attain forgiveness and surrender. But as denizens of the modern world we are sure of one thing – that the magic word is lost, irretrievably, that we have forgotten how to be so eloquent. Speaking with Ernst Cassirer (2012), the technologies of wishing – the oracles, prophecies, invocations, rituals and spells – had to yield to the realization that wishing does not make it so. Instead, it requires technology as an exercise of will to gain the cooperation of a recalcitrant world. In the absence of any direct connection, we can only gain evidence by probing and experiment and modern science.

Francis Bacon's (1620/1878) *Novum Organon* showed that science cannot rely on the knowledge of symbols and names but always begins from a position of estrangement and ignorance. A fictitious letter to Bacon by the fictitious Lord Chandos was written by Hugo von Hofmannsthal. It provides a definitive expression of the modernist despair of ever finding the magic word.

> [...] I experienced an inexplicable distaste for so much as uttering the words *spirit*, *soul*, or *body*. I found it impossible to express an opinion on the affairs at Court, the events in Parliament, or whatever you wish. This was not motivated by any form of personal deference (for you know that my candour borders on imprudence), but because the abstract terms of which the tongue must avail itself as a matter of course in order to voice a judgment – these terms crumbled in my mouth like mouldy fungi. [...] Gradually, however, these attacks of anguish spread like a corroding rust. Even in familiar and humdrum conversation all the opinions which are generally expressed with ease and sleep-walking assurance became so doubtful that I had to cease altogether taking part in such talk. It filled me with an in-explicable anger, which I could conceal only with effort, to hear such things as: This affair has turned out well or ill for this or that person; Sheriff N. is a bad, Parson T. a good man; Farmer M. is to be pitied, his sons are wasters; another is

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[3] Translation by A.N., compare https://en.wikipedia.org/wiki/Joseph_Freiherr_von_Eichendorff

to be envied because his daughters are thrifty; one family is rising in the world, another is on the downward path. All this seemed as indemonstrable, as mendacious and hollow as could be. [...] For me everything disintegrated into parts, those parts again into parts; no longer would anything let itself be encompassed by one idea. Single words floated round me; they congealed into eyes which stared at me and into which I was forced to stare back – whirlpools which gave me vertigo and, reeling incessantly, led into the void. [...] the language in which I might be able not only to write but to think is neither Latin nor English, neither Italian nor Spanish, but a language none of whose words is known to me, a language in which inanimate things speak to me and wherein I may one day have to justify myself before an unknown judge.[4]

Hofmannsthal's Lord Chandos experiences as a loss that in the modern world of modern science words cannot be understood as vessels of meaning. Instead, the word is an empty shell which serves as code when conventional signs become coordinated with real things and the relationship of "denotation" or "reference" is established – perhaps flattening the crucial distinction between the life of the spoken word and the notational framework of graphic signs (Ramming, 2021). The „critic of language" Fritz Mauthner (1906) follows suit when he calls for the death of a language that distinguishes and alienates the world of objects from that of the speaker – since words belong to language and mind and merely denote the unspeakable things (pp. 72-73, 120). Instead of evoking things and letting them speak, words signify isolated, disconnected elements of experience. Having lost their power, one should think that words cannot effect things anymore, that they are only now becoming artefacts – artefacts that stand for something but that do not interact with anything, artefacts apparently without technical function. As Ulrike Ramming might point out in her contribution to this issue, these artefacts are perhaps no longer words properly speaking. On her account, they are no longer genuine linguistic entities as the fictional writer Chandos and the real critic Mauthner mistakenly view the spoken word – which weaves people and things together – through the spectacles of the written sign and how it functions conventionally (Ramming, 2021). For them the fluid, dynamic spoken words becomes reified, thinglike, and therefore crumbles meaninglessly in the mouth. In quite another vein, Joseph Wilson reflects in these pages upon the physical materiality and the withering of the written word as it turns into mouldy fungi (Wilson, 2021).

II. THE MAGIC OF MODERNISM

All philosophy is „critique of language" (but not at all in Mauthner's sense). (Wittgenstein, 1922, 4.0031)

If we were to look for a philosopher of language who exemplifies the modernist sentiment, Ludwig Wittgenstein comes to mind. According to his *Tractatus Logico-Philosophicus*, the world is not composed of things with their names, but of facts which correspond to sentences. Along the lines of Hofmannsthal's Lord Chandos, Fritz Mauthner's critique of language had despaired of words and their meanings. In contrast,

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[4] http://depts.washington.edu/vienna/documents/Hofmannsthal/Hofmannsthal_Chandos.htm

Wittgenstein's critique of language shows that language works beautifully when sentences represent facts but that it can do no more (Nordmann, 2013). The word is but an element of the sentence and to know a word is to know its referent and how it can occur in a sentence (Wittgenstein, 1922, 1.11, 4.0031, 3.3).

Though Wittgenstein somewhat modified his point of view later on, he subscribes throughout to a maxim derived from Goethe: "*Denk nicht, sondern schau* – Think not, just look." There is nothing hidden – no reality behind the appearances, no meaning behind the word. It is all right there in our language games and forms of life. Whatever meaning there is, it is in the use of signs and symbols, not prior to them.

And yet, this modern philosopher was looking for the „*erlösendes Wort*" at the same time as he was looking to be saved from the quest for a word that will never be found. The discovery of this magic word would be the discovery that would allow him to stop doing philosophy (Wittgenstein, 1953, 133). For Wittgenstein, the *Erlösung* (salvation) from philosophy comes with the *Auflösung* (dissolution) of philosophical problems – but might this be effected through a word that brings peace of mind and does not raise problems of its own?

> The philosopher strives to find the redeeming word, that is, the word that finally allows us to grasp what up until now has elusively burdened our mind.
> (It is as if one had a hair on one's tongue; one feels it but cannot grasp/seize/ it, and therefore cannot get rid of it.)
> The philosopher delivers the word to us by means of which I/one can express the thing and render it harmless. (Wittgenstein, 1995, p. 156-157, compare Klagge, 2014)

Does Wittgenstein actually pretend to be this kind of philosopher? The answer to this question doesn't matter much – one way or another, it is interesting that the liberating power of the word is still so recognizable, so closely within his reach. It is evidently not enough to be a critic of metaphysics and of the magic word. What is needed is a sustained exorcism that acknowledges its power and renders it harmless.

Philosophically and scientifically, the progressive intellectualization and disenchantment of the world has overcome the wonders and spirit, the magic word of an enchanted age (Weber, 1946). In the meantime, technology by its amazing feats has re-enchanted the world. As Viktoria Vorotnikova and Serge Karlin show, the magic word lives on, perhaps bastardized, in usernames and passwords, in codes that open doors and unlock mechanisms – codes that might forge new kinds of unity between words and things (Vorotnikova & Karlin, 2021). The fortune, happiness, salvation of bitcoin owners rests upon their knowing the password no less than did that of the miller's daughter rest upon her knowing the name of Rumpelstiltskin, or that of Richard Wagner's Siegmund naming the sword Notung. The world of fairy tales shares with a world of things which work like magic that in both worlds the word retains its power to redeem and liberate, to forge a unity between word and deed, sign and signified, mind and world. These words do not represent some referent, they also do not create or disclose reality, they are powerful instruments that can effect radical transformations.[5]

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[5] As Larissa Aronin points out in conversation, the story continues. Since passwords have to be just right without naming or denoting anything, we are told that we make our passwords unsafe by using names of people and places. The safest pass"words" are no words at all but arbitrary strings of signs – which most people find impossible to do. Here, Vorotnikova & Karlin (2021) offer a perfectly arbitrary choice of perfectly referential signs.

III. TRANSCENDENCE OF CODES

Hitting upon the right word for something and discovering its true name is like finding just the right key that fits the lock and opens the door to a new world with new powers. This is a popular metaphor also for genetics and biotechnology when a specific enzyme engages a substrate and turns it into a new product. What might be the right design of locks and keys, grammars, geometries, and algorithms such that technology and language might create a new human body for a new kind of society? Christopher Coenen and Alexandra Kazakova discuss this utopian program of Alexander Gastev (Coenen & Kazakova, 2021).

The right word, genetic code, or enzyme can unlock something or lock it down. Not just for Rumpelstiltskin, to be sure, it serves to condemn and destroy, see again the modern fairy tales of Richard Wagner – *Lohengrin*, in particular. In Peter Handke's (1992) play *The Hour We Knew Nothing of Each Other* many actors playfully share a welcoming public place with no words spoken. Words introduce distinctions and the laws of hospitality no longer applies: As Thomas Froy (2021) suggests in this issue, nameless strangers are welcome but words will define them as potential enemies.

Silence is a limit of speech, as is the expectation of the final word which will magically put the troubled mind to rest. At these limits, words cease to function as elements of sentences that picture the world – thus they cease to be tools or instruments in systems of representation and communication and take on another character entirely. Again, it was Wittgenstein who asked what happens when we keep speaking beyond the limits of language – where one speaks without saying anything, yet maintaining a ritualistic search for instrumental or technical meaning.

Two papers in this collection pursue a term which, in the modern tradition of Kant and Wittgenstein, would be subject primarily of a critique of pure reason. When the words or symbols we use no longer denote or conceptualize concrete things but reflect only on our representational systems themselves, it might not be legitimate to consider them meaningful – as when "causality" is extended beyond an empirical use to ask about first causes, or when "force" is to encompass material and vital forces, or when the mathematical series of natural numbers is bounded by "zero" and "infinity." Walker Trimble and Chandrima Christiansen do not engage in a critique of pure reason but discuss how "infinity" begins to function beyond the limits of ordinary technical use. Their capacity as mathematical objects to take on theological meaning becomes a technical capacity in its own right (Trimble, 2021; Christiansen, 2021).

Transcendent features of our linguistic codes or numerical systems arise not only in conceptual matters that are taking on a life of their own, signifying nothing or everything, zero and infinity as if these were more than mathematical exigencies but ontological realities. They arise also materially through typography, through strokes, lines and curves, antiquated and industrial fonts, writing by hand or machine. As Tatiana Kazarina (2021) shows, these give rise to aesthetic programs for the convergence of word and thing or for releasing the word from authorial control that amplify or undermine not only the magic but also the visceral power of the word – words that might go "under the skin" as do tattoos.

IV. HELLO WORLD

In the beginning was the word. In recent time, this referred not to the word of God but to that of a company. It concerned not the beginning of the world but the beginning of nanotechnology with its promise to shape and reshape the world "atom by atom" (Amato, 1999). With nanotechnology human powers would expand from the scale of macro- and microelectronics to the even deeper and more pervasive molecular scale. We already knew that atoms are the building blocks of nature, but from now on they would be like Lego bricks the building blocks of engineers.

In April 1990, Don Eigler and Erhard Schweizer for the first time in human history positioned individual atoms at will to spell the name IBM from 35 xenon atoms. They were soon followed by Japanese researchers who learned to write the word "atom" at the atomic scale (fig. 1). At the IBM research facilities Eigler and Schweizer playfully instituted a gallery for nanotechnologically produced artworks. One hall of this virtual gallery was dedicated to the style of "atomilism" and there one could find the "IBM" image. It now had an official title – "The Beginning." And as is customary in art galleries, information was provided about the medium – "Xenon on Nickle (110)."[6]
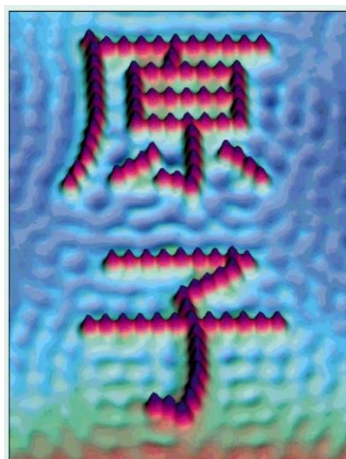
Writing With Atoms. Written literally with atoms, the Japanese Kanji above—each just a few nanometers across—means "atom."

Figure 1. This image was produced by a Scanning Tunneling Microscope and appeared with this legend in the governmental brochure "Shaping the World Atom by Atom" which introduced the US-American public to nanotechnology (Amato, 1999).

Again, a powerful word was set to create or shape a world. And yet, even though some spoke of nanotechnology as "Second Creation" or "New Genesis," this beginning is very different from the biblical one. It is not in the "nature" of atoms to write their own name, and there is no mystical union here between word and thing. On the contrary, there is now a deep awareness that names are completely arbitrary, a strictly human exercise of the will. What does "International Business Machines" have to do with molecular matters? The beginning in question is that atoms were prompted to perform a silly trick, devoid of natural and technical meaning – just to show what they can do and what

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[6] The website no longer exists. What is left of it can be seen at www.ibm.com/ibm/history/exhibits/vintage/vintage_technology.html

humans can do with them. If they can do something completely arbitrary, if they can be arranged to spell the name of the IBM research laboratory or spell the word "atom," then there is no limit to what they can do. A world of new human powers has arisen, in the beginning a token of seemingly unlimited human willfulness (Nordmann, 2006).[7]

The word "IBM" spelled by deep blue xenon atoms was an epigraph of nanotechnology. It set the tone before the actual work would begin. It appeared in the header of its websites and texts. It was a token accomplishment, referring back to the beginning, signaling what is to come. As such it might become part of Irina Belyaeva's history of the technology of epigraphs (Belyaeva, 2021). Even after the words have become disenchanted, even as they serve as technical elements divorced from their original context, they contribute to the technological re-enchantment of the world. They serve as reminders of what is to come, they evoke our powers to shape and reshape the world on the model of writing and rewriting it. As indeed, when software developers write a program that produces written or spoken text, there is a custom that the first test of that program will succeed when the machine awakens to say "Hello World." Here again, in the beginning is the word and what it produces is an enchanted world with its amazing technical feats and the wonders of a technology that works like magic.

V. DIGITAL REALITY

The problem of modernity haunts the Western tradition of philosophy and moves us from disenchantment and disempowerment of the word to its re-enchantment. If critical reasoning exorcised the magic power of the word, technological achievements of control reinstated it. More straightforwardly, perhaps, Russian thought traditionally viewed the word as a "technical" or "magical" artifact capable of changing the world. The anticipation of the word is characteristic of different trends at the beginning of the 20th century: religious philosophers and "Name Worshippers" (Trimble, 2021), futurist poets (Kazarina, 2021), biocosmists and panarchists, and others.

Having devoted several fundamental philosophical works to the study of the word, Alexey Losev (1929/2008) wrote that the word is inherently magical, "after all, magic is nothing more than a changing of being by the power of word, the transformation and self-creation of things by the immaterial energy of the names" (p. 16). Priest Pavel Florensky (1920/1990) saw in the word a concentrated will, which "descending upon some object capable of receiving an impetus from the will, the word makes in it the change that this object is capable of receiving" (p. 255).

Behind the poetic search for words by the futurist Velimir (Viktor) Khlebnikov were dreams of a "star language" – the world language of the future which is used to write an equation that connects time and space (Pertsova, 2000). Biocosmists saw in the ranks of words living cells for created organisms (Svyatogor, 1921/2008), panarchists wrote about the creation through the word of a machine-planet that is freed from the need for death and waste (Gordins, 1919, pp. 43–45). Very far from anarchists and biocosmists,

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[7] To be sure, nanotechnology would not fulfill this sweeping promise. And upon closer inspection, the arrangement of the 35 atoms was difficult to accomplish and produced only a 2-dimensional arrangement of isolated atoms – a far cry from "Shaping the World Atom by Atom."

the head of the Central Institute of Labor, Aleksey Gastev (1922), thinks about the transition from a complex of machines to a machine-state, and then, as a consequence of internationalization, "in the full sense of the mechanized globe", to which he addresses orders in verse which command people, machines and celestial bodies.

Such bold reasoning about the magical or technical possibilities of the word would seem like a funny utopia if humanity hadn't in the meantime created a new world upon its words, a world based on information and communication technologies. With the word of numerous programs created by programmers in different programming languages from different parts of the globe throughout the history of the internet, a new digital reality has been created, which is becoming an increasingly important part of the life of a modern person.

Despite the fact that the highest programming-levels come very close to the spoken and written word, it would seem these are owned by the professional community. However, today there are technologies that allow persons to create with words in the digital world. In early 2021, neural network were shown to create images from text, no matter how strange the phrases were (DALL·E: Creating Images from Text, 2021). It can be assumed that in the near future a person will be able to create virtual reality with words. Already there are precedents of video games that turn the magic words of magicians into reality (for example, in the game The Broken Seal (2018): The player must articulate words in order to fight the forces of evil in magical ways (also Typoman, 2015)). In the end, then, as if by way of compromise, us moderns along with us pre-, post-, and antimoderns meet in the same digital world – a world in which we can cultivate faith in the creative word, a technical artefact with technical functions.

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Calculating with Words:
Perspectives from Philosophy of Media, Philosophy of Science, Linguistics and Cultural History

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Abstract

This essay pursues the title of the special issue *In the Beginning was the Word – The Word as a Technical Artefact* and asks if words can be (technical) artefacts. The following thesis will be defended: as long as words are spoken they are part of parole, of spoken language and cannot be an object. Words as some kind of res are signs, but signs as a class of objects cannot be subsumed under the class of artefacts at large. Words can only be treated as artefacts if they are elements of a formal system; to think of them as being somehow technical means requires to understand them without reference to language. Prima facie, this leads to a paradoxical conclusion: if they are words, uttered words, they are part of language; if words are technically produced material entities, artefacts, they are devoid of meaning and are, therefore, not words.

Keywords: Word; Logical symbols; Formal systems; Notations; Written language; Algorithms; Goodman; Wittgenstein.

Аннотация

Данное эссе, следуя названию специального выпуска "В начале было Слово – Слово как технологический артефакт" спрашивает, могут ли слова быть (технологическими) артефактами. Будет защищен следующий тезис: пока слова произносятся, они являются частью разговорной речи и не могут быть объектами. Слова как своего рода реальность являются знаками, но знаки как класс объектов не могут быть отнесены к классу артефактов в целом. Слова можно рассматривать как артефакты, только если они являются элементами формальной системы; чтобы думать о них как о технических средствах, необходимо понимать их без привязки к языку. На первый взгляд это приводит к парадоксальному выводу: произнесенные слова являются частью языка; но если слова являются технически произведенными материальными объектами, артефактами, они лишены смысла и, следовательно, не являются словами.

Calculating with Words:
Perspectives from Philosophy of Media, Philosophy of Science, Linguistics and Cultural History

Is it possible to regard words as artefacts as the title of this special issue suggests and if, yes, in which way can we understand them as technical means? Usually, we consider linguistic expressions to be signs; they are conventions, but not artificial or technical objects. Further, we think of artefacts as objects which result from technical work, of *poêsis*, we think of them as being fabricated. From this perspective the question arises whether calling artefacts *technical* artefacts is a tautology since all artists, craftswomen as well as engineers are specialists in some kind of *technê. Technê* involves skills, capacities, knowledge and its putting into practice from which all artefacts, technical objects and works of art are ultimately brought into being. Artefacts are always the product of some sort of technique.

Is it possible to consider words in the same way as artefacts? Who is producing them? In this article I will defend the theses that in a strong philosophical and linguistic sense words cannot be artefacts; from the perspective of Ordinary Language Philosophy it is not even possible to see them as signs, and that means, as entities. A position like this can be considered as old fashioned – didn't Jacques Derrida show that the tradition of occidental philosophy always prioritizes spoken language, *phoné* and *parole*, while neglecting the status of written signs? This is what he calls Logocentrism. Or am I defending a narrow-minded conviction from (good old) philosophy of language, a position that denies any relation to kinds of technique on the basis of principle? Or is my view subject to a very general repugnance against any kind of philosophy of technology?

Against all these suspicions I will present arguments not primarily committed to philosophy of language but based on the history of graphic signs and theories of writing. My thesis is the following: as long as the word is spoken it is part of *parole*, of spoken language and in this sense, it cannot be an object. Words as some kind of *res* are signs and it is important to understand that they can only be considered in this way if there exists some sort of alphabet that allows to reify the elements of a spoken language and to transform them into stable entities. But as I wrote before, signs as a class of objects cannot be subsumed under the class of artefacts at large. Therefore, I will argue in a further step that words can only be treated as artefacts if they are elements of a formal system or binary code; to think of them as being technical means in some sense requires to understand them without reference to language. Prima facie, this seems paradoxical: if they are words, uttered words, they are part of language; if words are technically produced entities, artefacts, do they not stand in any relation to language?

The following considerations introduce a specific type of written signs: logical and mathematical symbols. These are genuinely graphic insofar as they are non-phonetic, i.e. they have not been developed in order to codify spoken language. Literal symbols in general can be understood as language-neutral forms of writing. This argument has been established with respect to a theory of notation as it has been presented by the American

philosopher Nelson Goodman in *Languages of Art.* Systematically developed by the British linguist Roy Harris[8], it shows how we have to understand the relationship between an alphabet, considered as notation, and an expression system, i.e. the writing system for any given natural language. Harris identifies both notation and expression systems as sign systems. From this vantage point, I will treat algorithms and calculus as forms of media, as I introduce in detail in part three of this paper. My understanding of the distinction between the two rests on work by Paul Lorenzen and Bruno Lorenz, founders and representatives of the so-called constructivism of the Erlangen and Konstanz school, a distinct line of thought within philosophy of science. It runs as this: whereas algorithms can be understood as symbolic machines that run automatically, a calculus is a more flexible set of sentences that allows to interpret its components with regard to a discrete field of research. In consequence, we can speak of words as artefacts in the sense of being the results of algorithmical, quasi-automatical operations. In contrast to algorithm, calculi carry meaning.

I

In a short passage of *De la grammatologie* Jacques Derrida (1967) refers to the *characteristica universalis* developed by Leibniz (p. 39). Derrida takes these as an example for a non-phonetic writing system, i.e. an autonomous system of symbols that does not denote spoken words. Leibniz` project was part of the Enlightenment movement insofar as it was aiming to be above and beyond any given specific language. Derrida, however, is not interested in integrating the *characteristica* into the discussions of Western philosophy. Instead, he follows Hegel who claimed that these types of written signs "cheat life". The meaning of a word comes naturally, words are alive. The meaning of a symbol needs to be assigned to it, symbols are dead.

 A more promising and detailed discussion can be initiated with the work of the German philosopher Sybille Krämer. She introduces the notion of typographical or operational graphic systems (Krämer, 1991). The elements of a *typographical* system can be treated as objects, like letterpress characters, for example. The *operational* aspect emphasizes the rule-following character. In this line of thought, *signum* and *signatum* are one and the same. Krämer justifies her stance on the basis of historical and systematical arguments.

Krämers's historical narrative begins with (i) the ancient Greek *psêphoi* used in arithmetics by the early Pythagoreans; this development continues with the introduction of (ii) Arabic graphic figures in Europe, an important step by which the technique of calculating by abacus had been detached from computing with written signs in the long form. A further step marks the introduction of (iii) variables into algebra by François Viète, introducing the representation of indefinite entities, this being a vital requisite for the formulation of the (iv) indefinite calculus by Leibniz. The evolution from *psêphoi* to

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[8] Comp. part II of this paper.

the symbols of indefinite calculus are taken by Krämer as a continuous process of formalization and abstraction.

Krämer`s position confirms what we know about the history of written sign systems: As Denise Schmand-Besserath (1979, 1981) convincingly shows, the origins of graphic systems are not to be found in ideographic depictions but in early practices of calculating and registration, based on the use of so-called calculi (Nissen et al., 1991) . In addition, Peter Koch (1997) emphasizes three different lines of development of what he calls *graphé*: the first is based on the just mentioned calculi or *psēphoi* of ancient practices; the second includes writing systems in the narrow sense, *i.e.* graphic systems used to codify natural languages; and, third, the symbols of mathematical and logical systems. As we have seen, the last can be integrated into the first line, understanding them as written continuations.

Following Krämer's perspective, Pythagorean arithmetics can be understood as (some kind of) proto-theory along the lines of the Erlangen School of Constructive Philosophy of Science. It is a precursor of arithmetics as a scientific established theory of natural numbers. It is important to understand this kind of proto-scientific practice by considering its main features: calculi serve as objects in order to visualize numbers resp. quantities; they are moved schematically and, what is of central importance, there exists no fundamental difference between the calculi themselves and what they are representing. In a different light, Pythagorean arithmetics can be understood as a kind of magical symbolism, as Ernst Cassirer pointed out: The configurations of calculi do not symbolize quantities but are constructed by the process of rule-based operations.

Krämer identifies these characteristics to happen at each evolutionary step: schematic operations rule the handling of the numerals of Arabic notation. By introducing the figure '0' into the scheme of numerals we are confronted with the first abstract entity. In addition, the syntactic moment can be identified at this level, too: the 'meaning' of the numerals >0, 1, 2, 3, 4, 5, 6, 7, 8, 9< is deduced from their position within the sequence of signs. Moving from here to the variables in Viètian algebra enforces the syntactic aspect: the elements cannot be treated with respect to their possible reference but only syntactically. The indefinite calculus represents the culminating point of this development. Indefinites cannot be represented but only constructed by operations (according to Krämer). The calculus is both location and medium in which abstract entities are constituted.

It is important that from this perspective, mathematical and logical symbols denote sign systems which are essentially non-verbal; they do not codify everyday language and they need not be pronounced in order to be worked with.

The thesis of language independence can be extended to writing systems in general, to a language-neutral conception of written signs. The main function of the Greek alphabet, for example, is codifying and notating spoken language. However, this common-sense view can be challenged if the difference between spoken and written language in their specific material realisation is neglected: It is a commonplace in media theory as well as in the early research on *Orality and Literacy* that spoken words have a fluid, transient character whereas graphic symbols are solid (Ong, 1982). Yet, with

Nelson Goodman's theory of notation, the difference between oral and graphic realisations could also be located in their structural aspects. In *Languages of Art*, Goodman points towards a fundamental difference between analogue and digital kinds of art. This difference is based on a nominalistic conviction that signs are not abstract entities, but material realisations called marks or inscriptions. A set of inscriptions is called 'character':

"Characters are certain classes[9] of utterances of inscriptions or marks … Now the essential feature of a character in a notation is that its members may be freely exchanged for one another without any syntactical effect; or more literally, since actual marks are seldom moved about and exchanged, that all inscriptions of a given character be syntactically equivalent. In other words, being instances of one character in a notation must constitute a sufficient condition for marks being 'true copies' or replicas of each other." (Goodman, 1976, p. 131)

Therefore, characters have to be considered as "an abstraction-class of character-indifference among inscriptions." (Goodman, 1976, pp. 132-133) In consequence, an inscription cannot be assigned to more than one character. This formal demand is expressed in the demands of disjointness and finite differentiation. Disjointness means that no two characters have common elements; finite differentiation says that it must be possible, at least in principle, to assign an inscription to one and only one character. In other words, there must be no transition area between two characters. A scheme that fulfills the syntactical demands of disjointness and finite differentiation is called a notational scheme. Such a scheme is digital; schemes that do not fulfil the second demand of finite differentiation are called syntactically dense.

Obviously, the Latin alphabet satisfies Goodman's syntactical demands for notations:[10] its elements, letters, are distinguishable from one another; conversely, it is in principle possible to assign any mark to one and only one character.[11] It is just the second claim, finite differentiation, to which spoken language cannot conform because of the permanent transitions between phonemes.

II

Until now I have shown, first, that graphic systems such as calculi or logical symbols have to be understood as being independent from spoken language. Second, I pointed out that it is possible to regard writing systems to be self-sustaining in relation to language. These results relate to central positions within Analytic Philosophy of Language: Ordinary Language Philosophy focuses on the value of everyday language. Ludwig Wittgenstein (1953), for example, states in his *Philosophical Investigations* that it is impossible to understand everyday communication by means of formal logics. He argues against an objectifying theory of reference and the demand for strictly limiting

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[9] Being a nominalist, Goodman doesn't accept the notion of classes, he is using this term only in a non-formal way.
[10] For these arguments see in detail: Krämer (1996); with respect to notations of informatics: Fischer (1996).
[11] For discussions of non-distinct cases comp. (Goodman, 1976, p. 133).

concepts as formulated by Frege, establishing thereby the notion of a 'language game'. Wittgenstein (1922) here reverses his own previous logicist approach presented in his *Tractatus locigo-philosophicus.*

Similarly, John L. Austin (1962) emphasized the performative dimensions of everyday language, giving credit to the original notion of *logos* as action. And Walter Ong (1982), a cultural historian and researcher in the field of Orality and Literacy, pointed towards the basic phenomenological differences between spoken and written language: uttered words and sentences are realized in the medium of sound, they are fluid and ephemeral; in contrast, graphic marks are robust visual signs.

These positions have in common that they are arguing against some sort of reifying perspective on language, against the linguistic stance that takes language to be a system of signs. In the history of writing and the theory of writing systems, it is a truism that we can only understand language as sign systems if there exists a graphic coding system. But we are also confronted with some myths about the features of alphabetic notations. Eric A. Havelock (1963) expressed with great conviction the supremacy of the Greek alphabet as the only alphabet that transforms the sound of words into graphic signs. In a way, he is right. The letters of the Greek alphabet immediately depict the sound of a spoken word. The Greek alphabet is similarily important for Ferdinand de Saussure, who wants to develop a universal linguistic system on its basis. He overlooks, though, that other realisations of sign systems such as the Arabic scripture which is based on syllables would generate a different perspective on spoken language.[12] This debate exposes a central conflict of two basic principles, the principle or arbitrariness and the phonematic principle. The principle of arbitrariness points towards the conventional character of signs. The phonematic principle asserts that the orthographic order of letters in a written word reproduces the sequence of sounds in utterances. The latter can only be endorsed if the Greek alphabet is taken to be the only and unique example of an alphabet that codifies a complete idiom. One of the central arguments against this view is presented by the English linguist Roy Harris: when endorsing the phonematic principle, how then can we explain that one and only one alphabet is used to codify different idioms? In other words, how is it possible to explain interlingual homography, as the letter sequence *t-a-b-l-e,* having the same meaning in both, English and French, but being pronounced in very different ways? (Harris, 2000, p. 92) To answer these questions, Harris distinguishes between a so-called notational and an expression system. He thereby modifies Goodman's theory of notation which Harris calls a "fixed-code-theory": "Goodman himself seems to regard his distinction between notational and non-notational systems as a more satisfactory replacement for the familiar distinction between digital and analog." (Harris, 1996, p. 1561) That is why Goodman is not able to explain how an analogue

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[12] Unlike the Greek alphabet, Arabic and the Hebrew syllabaries use only consonantal signs. The particular combination of consonants within a written text allows to always identify the correct vowels of the spoken word. Christian Stetter presents an interesting argument why the Greeks had to introduce separate signs for vowels: Ancient Greeks had no problems with the Phoenician syllable as long as they used it for the purpose of trade. But efforts to use it for writing everyday language were confronted with the central problem that in Greek language Tvowels are not clearly identifiable from the combination of consonants. Therefore, it was necessary to introduce step-by-step elements which later were called vowels. Comp.: (Stetter, 1997, p. 56-64).

system like everyday language can be transformed into writing. It is this question which Harris wants to answer. To him, a notation has to be understood as a finite repertoire of signs, based on an internal system. The most familiar examples in Western culture of such internal systems are the Greek alphabet with its typical order of letters and Arabic digits in their numeric sequence from 0 to 9. The elements of a notation are graphic marks – "graphies", in French (Harris, 1993, p. 37) – defined by their visual form and their position within the system.[13] It is decisive that a notation is autonomous from the expression system, i.e. the idiom in question.[14] A writing system is a correlation between two graphic system: (i) an alphabet with discrete elements, letters, and (ii) recombinatorial sequences of these letters which form the words of the language. This fundamental differentiation holds for writing but not for speech.

> „The difference […] highlights a fundamental asymmetry between the structure of a spoken language and the structure of the corresponding written language […] a written English sentence, such as *The cat sat on the mat* is based on (and is only possible because of) the application of a notation, i.e. the alphabet, whereas there is no such system underlying the corresponding sentence in spoken English at all. Some linguists would claim that the basic units of a spoken language (at least on the level corresponding to the use of alphabetic characters in writing) are its phonemes. Even if this claim is accepted, Harris would deny that the phonemes of a language constitute an oral notation. Their structural role cannot be parallel to that of alphabetic characters, even though it might be possible in principle to set up a writing system in which each alphabetic symbol corresponded to a single phoneme in the spoken language. Phonemes, if they exist, cannot be divorced from the expression system (i.e. spoken language) in which they occur." (Harris, 1996, p. 1564)

The proposed definition for notations as presented by Harris makes it possible to explain further questions like the following: If one asks after the identity of a handwritten letter/character – is it 'l' or 't'? – one refers to the level of notation. The question can be answered by referring to the position of the graphic sign within the internal position of the system. On the other hand, questions concerning the correct spelling of a word address the expression resp. writing system (Harris, 2000, p. 91). Using an almost identical repertoire of signs – the Greek alphabet – the spelling of the homographic example >table< follows the orthographic rules of the respective language (e.g. the addition of

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[13] In a virtually untranslatable passage Harris (1993) defines notations as follows: „ […] une notation est un inventaire de graphies qui peuvent servir à fournir les signifiants des signes écrits, et dont l'ensemble constitue un cadran emblématique. Une formulation appelle trois remarques. D'abord, elle laisse ouverte la possibilité de choisir les unités d'une notation comme unités d'expression, de telle sorte qu'on établisse un isomorphisme entre les deux structures. Ensuite, la définition proposée n'implique pas du tout que pour écrire il faut toujours une notation. Tout au plus, elle suggère que, dans la taxonomie des écritures, il y aura une place importante réservée pour les écritures à notation. En troisième lieu, elle ne cherche pas à marquer les limites précises des formes que peut emprunter l'ècriture. Néansmoins, elle introduit un concept qu'il faudra admettre tôt ou tard au cours de ce genre de recherches." (p. 44)

[14] Harris' argumentation is focused on developing a detailed understanding of writing systems with respect to their relation to spoken language. His theoretical approach cannot be applied to signs in general, for example, to iconic signs.

accentuation marks in French). The result is one and the same word occurring in two languages, English and French, denoting the same object, yet pronounced quite differently.

Harries understands language and writing – expression system and notation – as two different semiotic systems; he criticizes de Saussure for not differentiating sufficiently between the characteristics of spoken and written signs. In contrast, the German linguist Christian Stetter goes beyond this position when he asks if it makes sense at all to consider language as a system of signs. He, like Harris, calls the phonematic principle an "orthographic myth" (Stetter, 1997, p. 51, translation UR) an "illusion produced by the principles of Greek alphabet" (Stetter, 1997, p. 54, transl. UR). Stetter posits the necessity of readability (*Lesbarkeit*) as the main principle of written language. To be able to read and understand written words is paramount: "The letters of an alphabet are not used and had never been used to denote sounds when the alphabet had been developed, but they had been exclusively introduced in order to make words and texts easily decipherable." (Stetter, 1997, p. 59, transl. UR). In this respect, the central demand of a system of written signs (Harris' expression system) is fulfilled if it shows the necessary internal differentiation for identifying the words of a language. From this perspective, the process of transforming a language towards literacy is reciprocal, it is a permanent process of assimilation and transformation. What does reciprocity mean in this context? On the one side, we see a continuous process of differentiation at the level of what Harris calls notation; on the other side, this development is accompanied by a permanent standardization of spoken language. Only under these circumstances and, in consequence, on the basis of fully developed grammatical standards, is one able to use literary language as means for objectifying language in general.

More radically than Harris, Stetter differentiates more strictly between language and literacy. He follows Austin and Grice in taking language as a form of action. He sees it as a means to create understanding (between communicating parties). Finally, at this point, we are able to state concisely whether words can be artefacts and if so, how. According to Stetter, a reifying conception of words is only available on the basis of a given writing system, for this is what enables us to isolate words and classes of words as syntactic entities. There is no need to reassess this feature of a writing system as a kind of deficiency or aberration from a known or unknown origin. Writing systems function as a tool which provides the requirements for a scientific approach to language. The word as a linguistic sign is a scientific or theoretic entity; it cannot be considered an artefact quite yet.

III

The last step of my argument consists in establishing the difference between the idea of algorithms as machines and the idea of calculus as a medium. At the beginning of this article I pointed towards the necessity to clarify the meaning of the terms 'technical' and 'artefact' with respect to words and formal systems. The meaning of the Greek term *technê* comprises not only (i) the output of technical processes, but also (ii) the use of

tools and machines as means for producing artefacts. Furthermore, (iii) *technê* also denotes the established practices of using these means, *i.e.* traditional, professionalized and self-evident processes of fabricating things. As Wittgenstein put it, rule-following cannot be realized by only one person, once. In the same way, craftsmanship can be understood as following a variety of practical rules in a methodical order. The last aspect of *technê* (iv) refers to the different kinds of handling artefacts – we deal with the objects of everyday life in a different way than with works of art (Hubig, 2006, p. 261-265).

Moreover, technical activities are, and this observation has been stated before, language independent, just as the symbols of formal systems. Technical activities are procedurally encoded. Naturally, we can have a conversation while painting the garden shed to escape the boredom. Similarly, a master will explain to the trainee how to hold a hammer and how to move it efficiently. But for technical activities in general this kind of language involvement is not constitutive; it is a mere epiphenomenon. Peter Janich[15] understands technical actions as non-verbal, manual operations which are subject to the "principle of methodical order" (Janich, 1996). He seeks to reinterpret natural sciences, most notably physics, as first and foremost practical activities, involving skills and techniques – "knowing how"- rather than purely theoretical, abstract, verbal ways of "knowing that".   Poietic activities in this sense – from the Greek word *poiesis* – refer to types of activities which can be executed without being essentially linguistic.

From this perspective, the early arithmetical method of using *psēphoi* is poietical: the process of placing stones in a rule-based manner produces the intended objects, namely, quantities. This interpretation can be extended to formal systems. They can be regarded as *syntactical machines*, logical or mathematical operations are purely mechanical procedures. A distinctive feature of machines is that they are working autonomously: it is impossible to intervene or to take corrective action while they are at work (Hubig, 1995, p. 55). This characterization of machines is applicable to algorithms. They are taken to be a procedure determined by a finite number of steps.

So far, three major models of the computability of functions have been proposed: (i) Church's lambda-calculus, (ii) Turing-computability, and, (iii) Post's canonical system. These models have been proved mutually equivalent (Thiel, 1995, p. 249). Post's model enables us to mutually define the concepts of a formal system and of mechanical operations: operations are called 'mechanical' or 'recursive' if they can be undertaken by a formal system. Turing, in turn, reformulated the concept of countability as the equivalent of being 'computable by a Turing machine' (Heintz, 1993, p. 89). And Church's thesis says that for each algorithm it is possible to specify a Turing machine which realises this individual algorithm. In consequence, the two characteristics of algorithmic operations, namely elementariness and determinacy, lead to the equivalence of being mechanical and being computable.

We can now combine these mathematical observations with our previously established view of technical acts as poietic in order to address the question whether

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[15] Peter Janich is a representative of Methodological Constructivism, an approach to philosophy of science in the tradition of the Erlangen school of constructivism.

words can be artefacts. Both approaches describe non-verbal processes and activities. The results of algorithmic processes can be taken as products of a mechanical process and as such can be called an artefact. But these results are not words because they are not imbued with meaning, they "say nothing".

However, a calculus can serve as much more as just a syntactical machine. A calculus is constituted by an alphabet, by axioms and the rules of deduction. Similar to algorithms, sentences can be derived by syntactical means, namely by transforming chains of symbols. In contrast to algorithms, the sequence of derivative steps is not strictly determined. Once a calculus has been developed, it can be variably applied: it can map out other fields of investigation, like natural numbers, linguistic expressions, or ontological entities, for example. The success of Analytic Ontology is based on its use of formal methods in ontological reflection. Here, the formalisms are used as means to (re)construct scientific theories for their deeper understanding. Erlangen constructivism, specifically in its formulation by Paul Lorenzen, is another example for a formal approach to science. Here, syntactical operations constitute formal rules and these rules are considered to be exemplary for all possible rule, specifically in mathematics and logic.

Therefore, a calculus can be understood as a medium. For a long time, communication theory had been dominated by positions that understand media primarily as material sign systems.[16] Often, the proponents of these positions were committed to the above-mentioned philosophy of Jacques Derrida. They emphasized the material character of signs in contrast to an assumed phonetic purity of voice and word. But this is a very narrow interpretation (Hoffmann, 2002). A broader conception combines reference to the material elements with an account of the rules of their combination and application. Then, and only then, can we distinguish between a concept of a $medium_1$, which comprises the material elements, and the concept of a $medium_2$, which represents the unity between material components and the rules of their combination (Ramming, 2006, p. 49-58). The above presented conception of writing systems as introduced by Harris can be interpreted in this sense: A given notation, such as the Greek alphabet, is a form of a $medium_1$; and its modification for codyfing a specific natural language is a form of the $medium_2$. Along the same line, the example of Greek *psēphoi*, can be analysed in its double sense of mediality: material objects, such as calculi, can be identified as $medium_1$, and they are applied by following specific rules. It is decisive that there are several options to devise rules for the use of *psēphoi*. This explains why we find different kinds of arithmetics in the historical areas of Babylon, Egypt and Greece, for example (Damerow & Lefèvre, 1981).

At this point, a terminological clarification about the difference between a means and a medium is in order. Means are used in order to achieve a goal. In contrast, the term 'medium' includes the multitude of possible uses, affordances, the medium provides. The American philosopher John Dewey differentiates between external and internal means, calling the latter also medium. In his words, external means are

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[16] For a representative discussion of this topic comp. (Gumbrecht & Pfeiffer, 1988).

"… *mere* means …, usually of such a sort that others can be substituted for them; the particular ones employed are determined by some extraneous considerations … But the moment we say 'media', we refer to means that are incorporated in the outcome. Even bricks and mortar become part of the house they are employed to build; they are not mere means to its erection. Colors *are* the painting; tones are the music. A picture painted with water colors has a quality different from that painted with oil. Esthetic effects belong intrinsically to their medium; when another medium is substituted, we have a stunt rather than an object of art." (Dewey, 1934/2005, p. 205)

These considerations are not only interesting for analysing art, they are also helpful for our understanding of how we deal with technical artefacts[17] or symbols. I would like to apply the distinction between means and medium one more time, this time to the example of ancient calculi: They are used to achieve a certain goal, such as registering goods, or, more abstractly, for constructing figured quantities (*figurierte Anzahlen*) as in the Pythagorean proto-theoretic arithmetic. Within these practical contexts, they are used as pure means. However, they are more than this. As material objects, they are indispensable for enabling these kinds of practices (as has been discovered by research to the history of calculating systems). Specific actions are based on the availability of specific means, and thereby, the means turn into a medium. But means as a medium are not exclusively intrinsic means, as Dewey proposed. Their characteristics as a medium also comprise an immanent possibility to initiate further developments (Hubig, 2006; Ramming, 2008). For example, the introduction of the Arabic system of numerals combined with a system of decimal numeration marks the beginning of mathematical operations with written symbols. This is not trivial; it was the beginning of a process by which the practice of formulating mathematical problems by written texts had been superseded by formal representations. A further step in the abstraction process of mathematics was the introduction of alphabetic letters into algebra. This step represents the necessary precondition for formulating indefinite numbers within a calculus. In both cases, the newly introduced systems of symbols must be considered as more than pure means of computing and calculating: they are inner means that have to be considered as the preconditions for the formulation of new forms of arithmetic and algebraic practice.[18]

It is not surprising that the presented considerations on means and medium can be applied to the calculus. A calculus consists in graphic signs like mathematical and logical symbols ($medium_1$) in combination with axioms and rules of deduction ($medium_2$). As we have seen before, the mere existence of these graphic symbols offers not only means for calculating but is also medium insofar as more advanced kinds of mathematical operations like indefinites can be developed. As we have seen before, a calculus does not comprise a finite sequence of calculating steps.

What results from this for the word as object? Is it an artefact or not? We can, first, note that there is a reciprocal relation between formal systems and natural language. One of the central advantages of formal systems is that they avoid the ambiguity of everyday language. But the subtleties of natural languages are interesting, too, since they contain fine-grained logical differentiations as Gottlob Frege showed in his considerations on

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[17] For a detailed theory of medium with respect to philosophy of techniques see Hubig (2006).

[18] A similar argument has been presented by Edmund Husserl in his *Krisisschrift* with respect to the development of modern physics.

logical semantics. We have to state, secondly, that within the context of formal systems it is unusual to talk of a 'word', but to use the term 'expression'. An expression consists of a combination of elementary signs, conforming to syntactic rules. For example, first-order logic accepts the combination 'fx' as symbol for single-digit predicates, but not 'xf'. Ludwig Wittgenstein (1922) in his *Tractatus logico-philosophicus*[19] refers to the visual character of logical symbols when he asserts in 4.022 that a sentence shows what it means. This holds because the logical signs of a sentence indicate the combination of those categories the sentence includes (3.31: the sign of a sentence characterizes its form). Wittgenstein's differentiation between the sign of a sentence (*Satzzeichen*) and a sentence/symbol (*Satz*) shows the two dimensions of a logical symbolism: from the sentence as a sign we can read its categorial structure; the sentence as a symbol refers to possible meanings. The categorial structure of a sentence implicitly points to possible interpretations. In other words: the logical syntax of expressions indicates possible fields of interpretations and excludes others. In consequence, unlike algorithms as syntactical machines, a calculus can be considered as a medium of expression because it expresses possible meanings, possible interpretations. It may seem to be problematic from the perspective of media theory and media philosophy to call a calculus a formal 'language' because of its genuine graphic character. However, in a broader, more general perspective, it makes sense to speak of a calculus as a language because of its representative character. From this follows that we can call the elementary signs of a calculus 'words'.

We can now give a definite answer to the question if words can be artefacts: They cannot. Artefacts are the results of technical and mechanical processes which run autonomously and have to be considered as completely independent of language. The results of totally non-verbal processes cannot produce a linguistic entity. In contrast, words are genuinely verbal. As utterances they are no objects but parts of linguistic-performative actions. They achieve the character of an object when they become elements of a literal language. The elements of formal systems must be considered as genuinly graphic insofar as they do not only underlie syntactical operations but insofar as they provide the medium for the development of such kinds of operations. But insofar as the formal system implicitly indicates possible interpretations, the expressions of a calculus can be called 'words' and this is what constitutes the difference between words and artefacts.

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[19] For detailed analysis of Wittgenstein's argumentation from a perspective dedicated to a theory of logical symbols as graphic signs see Ramming (2006), chapter III.

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Decaying Words: The Metaphor of Evolution in Language Becomes Literal in a Canadian Forest

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Abstract

In 2009, two Canadian poets Stephen Collis and Jordan Scott travelled to five different ecosystems within the borders of British Columbia (BC). At each location, they left a copy of the canonical text of physical anthropology, Darwin's *Origin of Species* (1859), open to the elements, for one calendar year. The project, documented in the photographic book *Decomp* turned the poets' usual mode of expression on its head: instead of manipulating words to create a final work of linguistic expression, the poets let nature dissolve the integrity of the book, leaving words and morphemes dangling in poetic fragments. The *Decomp* project allows us to reflect on the environmental influences on language, and the organic structure of language. The dominant metaphors that describe language come from the biological world, and from Darwin's theory of evolution in particular. Languages can be said to evolve, mutate, grow, stagnate and even die. Like the words in Darwin's text left to the elements, languages can be isolated by geographic factors and left to fossilize without continued exchange with other cultures. In the forests B.C. the metaphorical mapping between biology and language becomes literal. We bear witness to the effects of entropy on the book and as the line between animate and inanimate agents blurs. As the poets piece together the fragments of Darwin's prose in *Decomp*, we are confronted with such questions, confronted with the ephemeral nature of language and the acts of assembly we all perform every day in the face of linguistic change, and often, decay.

Keywords: Evolution; Metaphor; Poetics; Materiality; Anthropology; Darwin

Аннотация

В 2009 году два канадских поэта Стивен Коллис и Джордан Скотт побывали в пяти различных экосистемах Британской Колумбии, где оставили книгу Ч. Дарвина "Происхождение видов" на один год. Этот проект, задокументированный в фотокниге "Decomp", перевернул привычный способ выражения поэтов: вместо того, чтобы манипулировать словами для создания финального лингвистического произведения, поэты позволили природе разрушить целостность книги. Проект "Decomp" позволяет задуматься о влиянии окружающей среды на язык и органической структуре языка. Доминирующие метафоры, описывающие язык, происходят из биологического мира и, в частности, из теории эволюции Дарвина. Можно сказать, что языки развиваются, видоизменяются, растут, стагнируют и даже умирают. Подобно словам в тексте Дарвина, языки могут быть изолированы и окаменеть без постоянного обмена с другими культурами. Метафорическое взаимодействие между биологией и языком становится буквальным, грань между живыми и неодушевленными агентами стирается. Как собираются фрагменты текста Дарвина в "Decomp", мы постоянно собираем язык перед лицом языковых изменений, а часто и упадка.

Decaying Words: The Metaphor of Evolution in Language Becomes Literal in a Canadian Forest

DECOMPOSITION

In late 2009 and early 2010, observant hikers in the wilds of British Columbia might have noticed, tucked under a tuft of moss or hidden underneath a boulder, a copy of Charles Darwin's (1859) *Origin of Species*, left open to the elements. The canonical text of evolutionary anthropology was left there, on purpose, by two Canadian poets, Stephen Collis and Jordan Scott. Exactly one year later they went back to see what had had become of the books.

The project, documented in the photographic book *Decomp* (Collis and Scott, 2013) turned the poets' usual mode of expression on its head: instead of manipulating words to create a final work of linguistic expression, the poets let nature dissolve the integrity of the book, leaving words and morphemes dangling in poetic fragments. "I'm not going to put the natural into the text," writes Jordan Scott, one of the poets, "I'm going to put the text out into the natural world and see what happens to it" (Collins & Scott, 2013, p. 3). The project recasts printed words as organic elements in an organic system.

The degree to which a physical environment can influence a language can be explored here in an absurdly material way. According to Sapir (1912), a specific environment can affect a language in three ways: at the level of vocabulary; at the level of the phonetic system; and at the level of syntax and morphology (p. 228). He is, of course, talking about the effect of environment on a *spoken* language, not on written artifacts like books. For a spoken language, it is obvious that a speaker's surroundings influence the words they use, both in the collection of words that has been assembled over time to refer to the objects in the vicinity, but also in the way that words are chosen as conversation unfolds in real-time and speakers react to changes in their environment. At a phonemic and morphological level, though, Sapir (1912) argues that language is largely independent of environmental effects (p. 234).
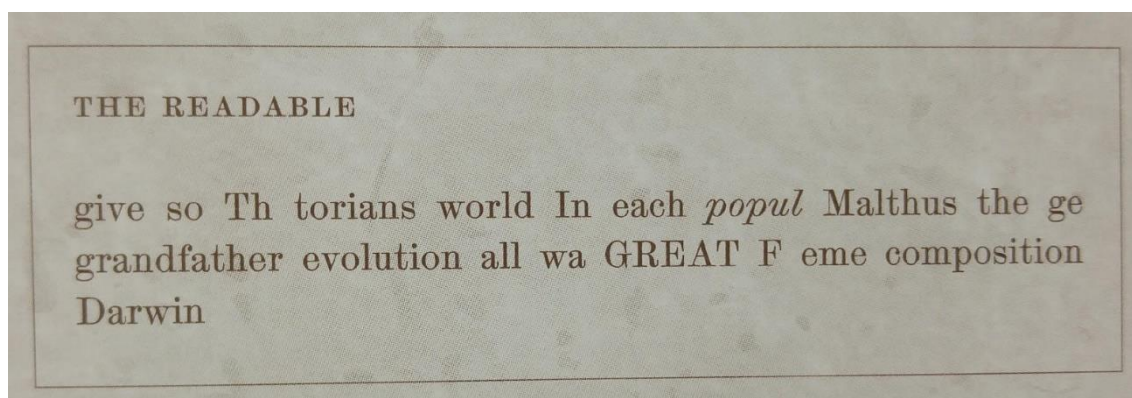

Figure 1. Collis and Scott typeset found scraps of Darwin's (1859) *Origin of Species* into forms of found poetry in *Decomp* (2013).
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In the weathered pages of Darwin's *Origin of Species*, a material manifestation of the English language, we see the exact opposite effect. Because words have been written into a material form, they are subject to the material ravages of the environments. Darwin's vocabulary remains intact, frozen in time at the moment of writing, but his carefully chosen syntactical and morphological structure is compromised. The poets delight in finding fragments of sentences that emerge from the detritus, a remix project collaboration between non-human agents. "give so Th torians world In each *popul* Malthus the ge grandfather evolution all wa GREAT F eme composition Darwin," 'reads' one fragment displaying an eclectic mix of punctuation and word fragments (Collins & Scott, 2013, p. 45). "the hope th little ho natur ing ed if we among accumulated over ensoul-ment thoughts," reads another, a fragment that includes intact morphemes that have been severed from their root words, floating, waiting to be reattached to roots they can imbue with meaning (Collins & Scott, 2013, p. 22). Plato's distinction in *Phaedrus*, meant as a criticism of the practice of writing, between the "living and dead word" (Jowett, 2008) collapses here: the dead words are living again, themselves imbued with vitality through the agency of the forest.

ISOLATION

The two poets are engaged in a literal manifestation of what Sapir (1912) calls "linguistic archaeology" (p. 232). They re-discover these books as artifacts signifying human activity, permanently altered by their state of isolation away from other books and other people. "Where one book was left, amidst some rocks, under ponderosa pine, just up the dry slope from the sagebrush and grasslands," write Collins and Scott (2013), "we found at first only the word *species*, isolated and torn from the book" (p. 30). The signifier here becomes iconic of the signified: a self-contained unit subject to the forces of change.

Figure 2. The word "species" becomes an iconic, self-contained signifier of its signified concept in the natural environment of British Columbia.
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This theme of isolation features strongly in the study of languages. Linguist Edwin Doran (1954) draws our attention to the language of the Cayman Islands, "a curious mixture of an archaic form of English with fragments of Negro dialect, Spanish forms, and expressions common to the Southern United States, as well as a remarkable number of nautical words," (p. 82). The early inhabitants of this cluster of islands, located between Jamaica and Cuba, were an eclectic mix of pirates, ship-wrecked sailors from England, and slaves brought through the Middle Passage. The islands are remote and did not feature as stops on any well-populated trade circuits, and as such, their language largely froze in time. Doran (1954) identifies phonemic peculiarities, such as the islanders' tendency to substitute /w/ for /v/ at the beginning of syllables, such as wessel for vessel, or wulgar for vulgar, a trait common to Elizabethan cockney (p. 83). Cayman vocabulary is also heavily laden with 17th and 18th-century nautical terminology including *windward* to refer to the East end of the island, and *fathoms* to measure the lengths of roads (Doran, 1954, p. 84).

But of course, the isolated environment of the Cayman Islands provides a different kind of environmental influence from what Sapir had in mind. The Cayman dialect has the features it does because of historical contingencies, such as the glaring ethical breech of transporting humans over the Atlantic Ocean to work as slaves, not because wind and rock have sculpted form into the islanders' words over time. The wind and rock from British Columbia can, however, and do sculpt words out of book pages, in only one years' time, much to the delight of our itinerant poets.

ENTROPY

The poets reveal a sense of glee in watching the sacred texts of an entire discipline succumb to the elements, especially when there are so many references to such elements within the pages. The signified takes revenge on the signifier, any gap between the two collapsed under the force of "heaving frost," (Collins & Scott, 2013, p. 101) "insect armies," (Collins & Scott, 2013, p. 120) and "red nature" (Collins & Scott, 2013, p. 94).

But with too much reflection, glee can turn to melancholy, as the initial rush of destruction wears off. "It is certainly true that words are transformed. They no longer signify shadow, earth," writes Maurice Blanchot, as quoted in Collins and Scott (2013), "an accumulation of syllables that have lost all meaning." (p. 123) There is an inevitability to the decomposition of the books, just as there is an inevitable decomposition, over time, of our languages, our cultures, and of course, our physical bodies. Claude Lévis-Strauss (1955) half-jokingly suggested in the pages of *Tristes Tropiques* that we should change the name of the field of Anthropology to 'Entropology,' as "the study of the highest manifestations of this process of disintegration" (p. 414). Lévis-Strauss (1955) acutely felt the transient nature of the cultural phenomena he was meant to observe as an Anthropologist. "The institutions, morals and customs that I shall have spent my life noting down and trying to understand are the transient efflorescence of a creation in relation to which they have no meaning, except perhaps that of allowing mankind to play its part in creation," he writes (p. 414). The poets Collins and Scott take Lévis-Strauss' *pensée* seriously and 'play a part in its creation' by committing acts of "creative destruction". They write: "That there are no messages, no poetry after decomposition, but a minute ecological process in which we have no part but intrusion, or at best no part but the donation of raw material for becoming dirt. Small anti-entropic pockets called

'evolution' amid the general irresistible lean of entropy" (Collins & Scott, 2013, p. 92). In response, Collins and Scott (2013) "compose in the long wake of decomposition" (p. 67).

Figure 3. The "general irresistible lean of entropy" at work in a forest
in British Columbia.
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METAPHOR

The *Decomp* project also allows us to reflect on the organic structure of language. The dominant metaphors that describe language come from the biological world, and from Darwin's theory of evolution in particular (Lewontin, 1970). Languages can be said to evolve, mutate, grow, stagnate and even die. Languages like the Cayman Island dialect can be described as 'fossilized,' and will eventually go 'extinct' or 'die'. This metaphorical mapping emerged after the publication of Darwin's *Origin of Species* in 1859 and eventually gave rise to the field of evolutionary linguistics. Science historian Richard Boyd (1979) calls this a "theory constitutive metaphor" (p. 361), one upon which the entire field relies to make sense of observed phenomena. The structure and the entailments of the metaphor have largely determined the direction of the research. "The hypothetical, or exploratory, role of metaphor is central to theory development and supports the view that it can provide a way to introduce terminology for features of the world whose existence seems probable but many of whose fundamental properties have yet to be discovered," he writes (Boyd, 1979, p. 357).

Darwin (1871/2004) himself mused about the similarities between natural selection in the biological world and the change of languages over time in *Descent of Man* writing

that "The formation of different languages and of distinct species, and the proofs that both have been developed through a gradual process, are curiously parallel" (p. 59).

Some philosophers of science have suggested that scientific theories are, by necessity, analogical in form, in order to create a simplified and understandable model of nature (Hesse, 1966). In the 19th century, linguists engaged in philology, the comparative analysis of languages, in order to try and find similarities. Darwin's theory gave linguists more tools with which to think about language change over time, as having shared ancestors, for example, or as evolving faster or slower due to differential environmental pressures. Good metaphors that allow scientists to make progress in their fields will tend to endure, whereas metaphors that are not 'good to think with' will fade away. Successful metaphors also succumb to entropy, but instead of fading away from use they lose their 'metaphoricity'. Over time, novel metaphors lose their novelty and become 'conventional metaphors', those expressions that pepper our speech without reflection. 'Dead metaphors' (to use a metaphor to describe a metaphor) are metaphors that are considered by standard speakers to be synonyms of the literal meaning, although with some prompting, they can see the metaphor underlying the term (i.e. "it was a very deep blue" or "they used a crane to move the bricks" (Deignan, 2008, p. 39). Sometimes dead metaphors are only traceable through etymology and, as such, can be called 'historical metaphors'. The word 'evolution' is such a metaphor. It traces its roots to the Latin *evolvere* which meant "to unroll" or "to roll out," especially of scrolls of parchment (Harper, n.d.). When it was first used in the 17th century, it was a novel way to describe the progression of something from a simpler form to a more complex form, usually applied to embryos as they grew. By the time Darwin used the term (which appeared only once in the first edition of *Origin of Species,* poetically, as the last word in the text) it has lost the metaphorical connotation. Today, most linguistic theorists would agree that the meaning has 'shifted' and the metaphorical meaning has become the dominant, literal meaning, as has the vocabulary that, once applied to biological evolution, now applies to language. For most linguists, languages *literally* evolve and the process can be considered a parallel example to that of biological evolution of a fundamental phenomenon.

Figure 4. The metaphorical mapping between biological and linguistic systems made literal.

The mapping that occurs between biology and language can be summarized as follows, using Aristotle's original notation when describing analogy:

$$\frac{gene}{species} :: \frac{word}{language}$$

When linguists first explored this metaphor, genes had not yet been discovered, yet they were predicted by Darwin as a basic unit of hereditability between generations. As scientists discovered the mechanism by which inherited traits were passed from one generation to the next (genes) and their internal structure (nucleotide base pairs), the analogy became tighter and suggested directions for experimentation.

$$\frac{nucleotide}{gene} :: \frac{phoneme}{word}$$

Yet even the solidity of the words *gene* and *species,* taken from what is known in metaphor studies as the "source domain" (as opposed to the "target domain" of language, the domain in need of the metaphor), crumbles under scrutiny. In explaining how analogy works, Aristotle uses these very words with a very different mapping: "Metaphor consists in giving the thing a name that belongs to something else; the transference being either from genus to species, or from species to genus, or from species to species, on the grounds of analogy," he writes in *Poetics* (as quoted in Garett, 2007).

In 1956, a multi-disciplinary team of biologists, linguists and psychologists explained that they "turned to linguistics where… fundamental units organized into a system have been firmly established and examined phonological and phonetic theory and empirical data on phonetic evolution, searching for similarities with the process demonstrated in Mendelian genetics" (Gerard et al., 1956, p. 6). The authors propose an experimental design where phonemes are examined for random change as nucleotides are subject to random mutation. "An evolutionary perspective seems prerequisite to mutual involvement of linguistics and biology; the renewed interest in the origin of language, and the comparative study of animal communication, are part of the general renewal of evolutionary perspective in anthropology" (Hymes, 1963, p. 97).

A paper on statistical methods from 2015 makes this comparison explicit: "phonemes are the units of sound that make up words and distinguish one word from another, just as the four nucleotide bases (A, C, T, G) make up DNA gene sequences or the 20 amino acids make up protein sequences" (Hruschka et al. , 2015, p. 1). The authors continue to write that "in a linguistic context, sporadic changes refer to the replacement, over some arbitrary interval of time, of one phoneme in one place by another and are analogous to single nucleotide or amino acid substitutions in gene sequences." (Hruschka et al. , 2015, p. 2)

But there are obvious limitations to such a metaphorical mapping. Under Darwin's formulation, evolution is driven by natural selection which is based on random mutations at a genetic level which then confer an advantage or disadvantage on the individual, and eventually, the species. But languages, as we saw with the Cayman Island dialect,

'evolve' in ways that depends more on socio-economic factors and contingencies of history than they do on random changes in phonemes pronunciation. The fundamental question remains, "What factors shape languages over time? And at what level?" (Greenhill, 2016, p. 31). Scientists are thus tasked with probing the limits of the metaphor to see where the model falls apart. As a descriptive tool, linguists can map the "phylogenetic relationship" between languages and determine families, descendants, ancestors and relatives (Campbell, 2017, p. 1), but the mechanisms that cause language to change cannot be ascribed to random mutations.

Determining the "selective pressures" on languages is a different undertaking for linguists than it is for biologists examining species. The first issue of the *Journal of Language Evolution* from 2016 summarizes the different hypotheses on how, or even whether, linguistic traits are selected for. "If languages do indeed evolve then they must show the three crucial aspects of an evolving system: variation of traits, inheritance of those traits, and the differential survival—that is selection—of those traits," the editors write. Selection, they argue, might operate at the level of the speech act, not the phoneme, or operate to favor shorter words and sentences so speakers can conserve energy. The editors point to effects of group size, notions of prestige and class, the prevalence of loan words, isolation from contact with other speakers as variables that need to be considered under a model of language evolution (Greenhill, 2015).

Figure 5. The effects of "non-quite-human" actants. © Stephen Collis and Jordan Scott, Courtesy of Coach House Books.

ONTOLOGY

As we come back to the forests of BC, we note that the poets have figured out a way to subject Darwin's words to the random vicissitudes of coastal climate. They are probing the limits of Sapir's metaphor that environment can affect language. They blur

the boundary between living things like wasps and humans, and non-living things like books and words. If the metaphor of evolution that is used to examine language has died and become a literal description of how language changes, does it make sense to classify language as a non-living thing? If the pages of the books left in the forest are used to create nests, or are decomposed by worms and mushrooms, are they similarly inanimate?

Political theorist Jane Bennett (2010) calls for an ontological shift away from a neat binary between living and non-living things towards a recognition that so-called inanimate 'things' are complex 'vibrant' materials that contain their own "vital materiality". "I want to highlight what is typically cast in the shadow," she writes: "the material agency or effectivity of nonhuman or not-quite human things" (Bennett, 2010, p. ix). Pine needles, rain, wind, beetles, or the tread on a hiker's boot are all objects that *do* things to the books in *Decomp*; they act upon them, hence Bennett's frequent use of Latour's term, *actants*. The words on the pages reveal themselves to be actants in their own right, more than just metaphorically alive. They are "non-quite-human" in their agency. "In composing and recomposing the sentences of this book--especially in trying to choose the appropriate verbs, I have come to see how radical a project it is to think vital materiality," writes Bennett (2010), "It seems necessary and impossible to rewrite the default grammar of agency, a grammar that assigns activity to people and passivity to things," she concludes (p. 119).

As an extension of this ontological shift, Bennett uses an argument, to come full circle, from the work of the original ontological trickster, Charles Darwin. Based on his observations of earthworms, Darwin described how they made topsoil and vegetable mould, and as a by-product, made the earth habitable for humans. According to Bennett (2010), this frames earthworms as agents who made history, as political beings (p. 95). Worms feature strongly in the pages of *Decomp*, nesting in the cool gaps under the book covers, or chewing through pages and returning the pulp to the forest ecosystem from whence it came. Collins and Scott (2013) remind us that, "soil is a verb" (p. 120), and not only when it works to make something dirty, but when it acts on objects to imbue them with organic matter. This includes the poets themselves. A new "soil ontology" is required "requiring that humans be included more decisively in the concept of soil, that is, as members of the soil community rather than as mere consumers or service beneficiaries" (Puig de la Bellacasa, 2015, p. 13).

DEATH

Lévis-Strauss' existential melancholy in the face of unstoppable entropy can be framed here, dealing as we are with decomposition and humus, as a reaction to death. Just as species can go extinct if they are not deemed to be the "fittest" for an ecosystem, so can languages experience "language death." Language death is the endpoint of a process which sees a minority language getting squeezed out by a dominant language (Dressler, 1996, p. 95). Linguist Nancy C. Dorian (1981) gives an example of a dialect of Gaelic spoken on the Northern tip of Scotland that is almost gone entirely. Swamped as they are by the English spoken in Great Britain, these previously isolated communities, each of which spoke separate a distinct dialect on different sides of a mountain range, are at danger of having their differences flattened, crushed by the inevitable roll of entropy towards uniformity.

English, the language in which Darwin wrote, is not in danger of becoming extinct. Latin, the other language that appears often in the pages of Origin of Species, is dead, but did not experience "language death" in the same way that East Sunderland Gaelic was lost to its speakers. Instead, Latin was able to reproduce, spawning daughter languages that took over much of Europe (Dressler, 1996, p. 195). It might not be around anymore, but Latin's genetic material has survived, heard in the phonemes of Italian and Spanish.

Figure 6. "Words are things we do together."
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RECOMPOSITION

For Collins and Scott (2013), "words are things we do together" (p. 123). Their experiment in the woods with five sacerdotal texts from the high priest of evolution was a cheeky move to remind us of the social communion we share when we use words together. Their experiment would have little meaning if it was not documented in written (and photographic) form. In keeping with the theme of irreverence, Scott writes that "the pine is mightier than the word" (Collins & Scott, 2013, p. 132). Sapir would be pleased to know that each of these nouns differ from their idiomatic archetypes in a patterned manner. From 'pen' to 'pine' we have a change of two letters but only one phoneme (/e/ > /aɪ/); but for sword to word we only have one letter removed but experience an auditory shift of two phonemes (/s/ > ∅ in word-initial position, and /ɔ/ > /ɜː/). There is only one nucleotide in difference between these two pairs of genes.

The poets piece together the fragments of Darwin's prose in one final act of resistance against the entropy that threatens to unwind us all. Assembling phonemes into words and words into sentences are acts of assembly we all perform every day, together, battered by wind and rain.

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Claiming Infinity: Tokens and Spells in the Foundations of the Moscow Mathematical School

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Abstract

The Moscow Mathematical School, led by Dmitri Egorov, made tremendous strides in the development of set theory in the period around the Russian Revolutions. The concepts of transfinite sets and absolute infinity have long had a controversial association with religion, namely in the explicit theological statements of the founder of set theory, Georg Cantor. However, several recent studies have argued that the Moscow School was instrumentally shaped by a sect called the "Name Worshippers". Here we examine more precisely what the Name Worshippers meant by naming, and how their semantics might have, and might have not, shaped the views of the Moscow School. This paper is a review and severe corrective of the book *Naming Infinity* by Loren Graham and Jean-Michel Kantor, yet we also have our own analysis. Examining the Name Worshippers' semantics as defined by themselves and their opponents argues for the greater theological influence being Cantor's. However some aspects of their beliefs indicate that they tended to treat names as tokens, objects of incantation and instantiation. Finally, we show how this fascinating chapter in the history of theology and mathematics contributes to realistic versions of what contemporary neurologically-based semantics calls "meaning externalism" and a science of essences.

Keywords: History of mathematics; Theology; Transfinite sets; Absolute infinity; Name Worshippers; Georg Cantor; Dmitri Egorov; Pavel Florensky; Nikolai Luzin

Аннотация

Московская философско-математическая школа, возглавляемая Д.Ф. Егоровым, в первой четверти XX века добилась огромных успехов в развитии теории множеств. Споры относительно взаимосвязи религии и концепции трансфинитных множеств и абсолютной бесконечности не угасают до сих пор, несмотря на явно богословские утверждения основателя теории множеств Георга Кантора. Более того, в нескольких недавних исследованиях утверждается, что взгляды Московской школы были существенным образом сформированы сектой имяславцев. В данной статье мы уточняем, что имяславцы имели в виду, говоря об именах, и могли ли их семантические теории повлиять на позиции Московской математической школы. Статья содержит обзор и серьезную критику книги "Именование бесконечности" (Л. Грэхэм, Ж.-М. Кантор), а также наш собственный анализ проблемы. Изучение семантических концепций имяславцев, определенных ими самими и их оппонентами, убеждает в том, что Кантор оказал на Московскую школу большее теологическое влияние, нежели имяславие. Помимо этого, некоторые аспекты их воззрений указывают на то, что они были склонны рассматривать имена как токены, заклинания и инстанцирование. Наконец, мы покажем, как эта значительная глава в истории теологии и математики поддерживает создание версий реализма, которые современная неврологическая семантика называет семантическим экстернализмом, и научного подхода к сущностям.

Claiming Infinity: Tokens and Spells in the Foundations of the Moscow Mathematical School

1.1 Introduction: Faithful Mathematics

The relationship between religion and mathematics is one of the most fantastic in the history of science – from the calculation of the movements of heavenly bodies – which were also gods – to the geometry of temples, the timing of sacrifices, the deification of 'one'. Since Laplace's famous (and apocryphal) answer to Napoleon's question about God ("I have no need to subscribe to such a hypothesis."), encounters between the present queen of the sciences and the former one have been far more furtive. Rather, what is surprising is that they happen at all.

Of all the sciences, mathematics carries with it some of the temple (see Wertheim, 1997). Gödel believed in a personal God and attempted to prove His existence, and many mathematicians continue to believe that numbers have a real, individual existence … somewhere, often to the chagrin of the philosophers.

One of the more significant trysts in this recent history came with the theological grounds for the birth of set theory. The classical, Aristotelian, definition of infinity as potential (if it is infinite, it must always encompass something more or other to itself) was contrasted in scholastic philosophy with actual infinity, which was identified as an attribute of God, simple and complete. Potential infinity was resolved by Georg Cantor (1845–1918) in the formulation of transfinite sets. As a realist, Cantor, held that all his transfinities were dependent upon an actual infinity. He appealed to the Catholic Church to confirm the orthodoxy of his doctrine and to be assured that the statement of 'multiple infinities' would not compromise the fundamental simplicity of divine nature. There seems to be no cynicism in this appeal, rather Cantor regarded the actual infinite to be *theoretically* essential and regarded engagement with Thomistic thinkers as important (Thomas-Bolduc, 2016; Tapp, 2012). Recent efforts to suggest that Cantor later rejected these approaches have not been supported by his letters and diaries. For many historians, there is something distasteful about such brilliant figures as Cantor, or Gödel, whose work has had such a great influence on science, relying on dusty proofs of God's existence – let alone that those proofs might have been essential to their progress.

The intellectual and religious confluence at the birth of the Moscow School of mathematics received a great deal of attention with the publication of *Naming Infinity* by the Harvard historian of science and Russian expert Loren Graham and the mathematician Jean-Michel Kantor at the Institut de Mathématique de Jussieu in Paris (Graham & Kantor, 2009). There modest questions and claims first posed by Russian scholars (Demidov, 1999; Ilarion, 2007a) received geometric expansion. Unfortunately, Western reviewers have submitted these claims to neither Voltarian nor Torquemadan criticism. Just as Cantor's realism, *Naming Infinity's* claims are significant in the sense to which they relate to fundamental developments and have a bearing on the philosophy of language and on language as an algorithmic generator of signs. For the claims of *Naming Infinity* are not that, like ancient astronomy/astrology, maths can tell us something about the divine, or, like calculating calendars, they can help us fulfil religious duties. The

claims are that a religious sect, called the Name Worshippers,[20] dominated the founders of the Moscow School and that adherents of the sect believed they were creating God by naming him in prayerful incantations, some of which were carried out in a corner of the mathematics faculty chapel. Progress was made because Name Worshipping mathematicians believed that to name a set was not just to define it but to create it. Since the names had to do with the divine, naming absolute infinity was creating God.

I do not just intend to put the English reader right by the error of these claims and the false reading of Eastern theology which lies at their foundation, but to better define what the Moscow school hierophants were doing when they named sets – was it magic, setting semantic extensions, creating tokens, or some or all of these. Furthermore, what did the authorities of the Russian Orthodox Church think the Name Worshippers were doing? Can they tell us something about what the mathematicians' philosophy of denotation actually was in their condemnation of Name Worshipping? To this we will turn to a heuristic semiotic definition of a bare token to help us along. Finally, we will see how recent research in 'externalist' – which point to realist – notions of meaning can help explain a version of creativity that is both mathematical and theological. Despite the muddled and bloody history, heresy, and all too oft-encountered madness – there is still something divine about this debate – tokens jingling in the pockets of God.

1.2 Truth-content and Rationality

Cantor's realism was avidly Platonic, or Plotinian: "Every extension of our insight into what is possible in creation leads necessarily to an extended cognition of God." (Thomas-Bolduc, 2016, p. 141) Naming sets is not a creation of them, but a definition of them. This bears comparison with the ancient notion of *apeiron* as that which was at once infinite and undefined. Realism allows one to find new things. Henri Lebesgue's (1927) statement that certain functions which cannot be analysed can be named does not conflict with this view unless you hold that what cannot be analysed cannot exist.

The most fruitful claim of *Naming Infinity* is that the members of what the authors call the "French Trio" – Émile Borel (1871–1956), Henri Lebesgue (1875–1941), and René Baire (1874–1932) – came to a certain impasse in their development of set theory precisely because they were beholden to a Cartesian, rationalist view of the world that sat ill at ease with multiple infinities (Graham & Kantor, 2009, pp. 60–63). Deifying Lebesgue's names allowed the Russian trio of Dmitri Egorov (1869–1931), Nikolai Luzin (1883–1950) and Fr. Pavel Florensky (1882–1937) to find errors in the French trio's work and move theory forward for the whole field.

The figures of both the French and Russian trios were emblematic of their extraordinary times. Borel was a local mayor, radical politician, and sometime Minister of the Navy. Florensky's fervid mysticism was matched by equally radical scientific breadth and intensity. The confluence of the two in his case led to a life of imprisonment and execution under the Stalinist régime. Cantor's prevarications with religion resemble those of Schoenberg, or Mahler. From Theosophy to Neo-Byzantine architecture, this was a time of inner and outer spiritual turmoil.

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[20] Though the Russian term *'Imiaslavtsy'* more correctly means 'Name Glorifiers', I will stick to previous convention and translate it as above. This preserves the contrast between 'worship' (Gk. *latreia*) and 'veneration' (*proskunēsis*) that was crucial in the anti-pantheism arguments of the iconoclast debate. 'Glorification' is the standard translation of *doxalogia* and when applied to the name of God is controversial to no one.

Naming Infinity begins with an especially dramatic eruption of this tension on the monastic republic of Athos in August 1913. Russian soldiers with rifles and water cannon stormed the St. Panteleimon Skete and demanded monks repudiate the confession of the "Name Worshippers". Some of those beaten, soaked and arrested continued to cry "*Imia Bozhie Sam Bog*" – "The Name of God is God Himself" – the central doctrine of the group condemned by the Patriarch in Constantinople and the Russian Synod earlier that year (Ilarion, 2007a, p. 545).

The Name Worshipping movement had three stages of development from roughly 1907 to the 1920s. In the first stage, the reception of the book of schemamonk Ilarion (Domrachev, 1845–1916) *On the Mountains of the Caucasus* introduced the identity of the name of God with God. This was taken up by defenders of hesychasm of different stripes as well as intellectuals of a mystical bent, even the poet Osip Mandelstam later wrote a verse mentioning the Name Worshippers. The second stage begins with the categorical rejection of the sect by a judgement of the Holy Synod and their repression on Mt. Athos in 1913. Around this period the theological and philosophical apologetics of the movement were defined with an emphasis on naming being an act and referring to divine energies ([3] below). The final stage saw the conflict continue within and without the church as figures such as Florensky, Sergei Bulgakov (1871–1944), and Alexei Losev (1893–1988) expanded arguments to general ones regarding semantics, aesthetics and ontology in general. When the Church was to make a final decision on the issue between 1917 and 1918, the Revolution itself had transformed the Church from judge to co-defendant.

This episode was one of the last gasps in Russian philosophy before communism imposed Comtian naturalism and its unflinching service to progress and the party. From at least before Vladimir Soloviev's *Crisis in Western Philosophy* (1874), many Russian philosophers had regarded what he called "rationalism" and Florensky called 'positivism' as cardinal barriers to spiritual, moral, and even scientific, progress. While Soloviev (1989) put the blame on early Western mediaeval philosophy, (p. 3) Florensky faulted nominalism (Florensky, 1994a, p. 126).[21] In the first case, human reason is pitted in a Faustian bargain against traditional authority, in the second Platonic realism is pitted against an arbitrary (in the Saussurian sense) association of names and appearances. For Florensky nominalism and positivism were rejections of any coherence to reality. For him, in turn, the opposition to Name Worshipping was "a symptom of grave mental illness, close to that of neurasthenia or hysteria. It is a particular functional disorder of the nervous system" (Florensky, 1994b, p. 318). [22]

The Name Worshippers believed themselves to be an integral of the Church's tradition of constant prayer. The Jesus Prayer, which in its standard version reads: 'Lord Jesus Christ, son of God, have mercy on me,' is part of the Eastern Orthodox ascetic tradition devoted to the suppression of the bodily and spiritual passions and the cultivation of stillness, or quietness ('*hesychia*'). Under proper direction, faithful repetition of the Jesus Prayer, also called the Prayer of the Heart, promotes that stillness. With the help of the Holy Spirit, following the natural paths of divinely created reason that lead one to conquer the passions and cultivate the virtues, one is able to see what practitioners call

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[21] In this his views resemble those of John Milbank and the Radical Orthodoxy movement.

[22] Unless otherwise indicated, all translations from non-English sources by W. T.

the uncreated light, a great step along the way to salvation. Hesychasm, as articulated by Sts. Gregory of Palamas and Symeon the New Theologian, was accepted as Church doctrine in the 14th century by an ecumenical council.

In their account, Graham and Kantor conflate the hesychastic tradition as a whole with the Name Worshippers. This is possibly because *Naming Infinity* discusses theology only from the perspective of the movement itself and betrays no general knowledge of Orthodox theology. The Jesus Prayer and the practice of its repetition under appropriate spiritual direction is utterly uncontroversial (see Gillet, 1987; Ilarion, 2007a), though actual engagement of laypeople and monastics, even on Mt. Athos, with the Jesus Prayer has been rather inconsistent. The Name Worshipper movement came at a low point in a revival of hesychasm that had already begun toward the end of the 18th century. The Name Worshippers claimed to represent the *true* hesychastic tradition, but they were continually forced to shift and alter their original positions respective to it. In fact, it may well be that their final position ([3b]) would have been acceptable in some form had it been articulated as such from the start, so long as the name itself were regarded as part of creation.

The difference between the debates over the hesychastic tradition and those around Name Worshippers is that the former concentrate on the action of the prayer in the practitioner and the nature of revelation that results from it and the latter in the nature of the name itself.

Graham and Kantor maintain that

[1] $\llbracket God \rrbracket \rightarrow God \wedge \llbracket God \rrbracket = God.$[23]

is the position of both the Name Worshippers and the Cantor school. Uttering names was not an act of definition of already undefined entities, it was an act of creation *ex nihilo*. That the left-hand part of the formula generates the right-hand part. This is a dramatic claim put in prevaricating language:

> Georg Cantor suggested these new infinities and made them seem real by assigning them different names. For some people the very act of naming these infinities seemed to create them. And here the Russian Name Worshippers had their opening: they believed they made God real by worshipping his name, and the mathematicians among them thought they made infinities real by similarly centering on their names (Graham & Kantor, 2009, p. 96).

As V. N. Katasonov (2009) says in one of the few critical reviews of *Naming Infinity*, "this sounds a rather vulgar assertion" (p. 137). The book's subtitle is: "a true story of religion, mysticism, and mathematical creativity". For them, mysticism names things and creates them. This analogy gets repeated very often in the book, along with a great deal of emphasis put on mundane acts of naming.[24] Katasonov justly asserts that the

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[23] Here I use the semantic notation in Rabern (2017), where double brackets refer to that which is to be denoted; in most cases this means "the word itself". So [1] means: "God" denotes the semantic extension of "God", and "God" and that extension are an identity. As Nizhnikov (2011) argues, Florensky (1994b) would not accept this type of notation for identities, though he does use proper subsets for his ontological arguments. As we shall see, the movement from identity to presence to inherence with shared properties is part of the development of the Name Worshippers' semiotics.

[24] For example, when Arnaud Denjoy proposed that Luzin be the godfather of his son, Luzin suggested a name (Graham & Kantor, 2009, p. 99). This is noted portentously, despite the fact that nearly all Christians are given a new name at baptism. Furthermore, name-giving is part of monastic practise. When figures such as Losev were secretly tonsured during repression of the Church, receiving a new name was one few, then secret, emblems of monasticism they could preserve.

Name Worshippers never associated acts of naming with creation. The analogy is false. Furthermore, it is clear Cantor and members of the Moscow School were realists – they believed the mathematical objects they described were real entities. If they believed their infinities were real entities rather than a nominal ones, it is unlikely they thought they did not exist before mathematicians created them.

The literary source of the Name Worshippers, *On the Mountains of the Caucasus* can also be seen as a source of divergence from hesychastic doctrine. Its statement "*V imeni Bozhiem prisutstvuet Sam Bog – vsem Svoim Suschestvom i (vsemi) Svoimi beskonechnymi svoistvami*" (Ilarion (Domrachev), 1907/2018, p. 210) "God Himself is present in the name of God – all of His essence and all of His eternal attributes."– thus

[3] $\llbracket \text{God} \rrbracket \rightarrow \text{God} \wedge \llbracket \text{God} \rrbracket \supset \text{God}$

To give an idea of the naiveté of this argument, we are required to use the proper superset symbol to express the relationship of the name to God because $\llbracket \text{God} \rrbracket$ has the letters $\llbracket G \rrbracket$, $\llbracket o \rrbracket$, $\llbracket d \rrbracket$, and anything else proper to the name (script, font size, sonogram, intonation) which means that there are more tokens comprising the name of God than God Himself. Though *On the Mountains of the Caucasus* is regarded by all parties as representing the Name Worshippers, its more sophisticated followers did not claim that the essence was identical to the name, i.e., God = $\llbracket \text{God} \rrbracket$. They also, as we shall see, did their best to refine what "is present" means in the above statement to avoid outright heresy and absurdity.

Our concept of semantics has gone through so many centuries of nominalism that the realism of figures such as Florensky adheres to seems to us intensely radical. He rejects any distinction between signs and appearances. Peter's shadow is not Peter, he writes, but it is no figment of the mind. It is a manifestation (*yavlenie*) of Peter, it bears some the power of the original, as St. Peter was able to heal those on whom his shadow fell (Florensky, 1994b, pp. 314–315). Florensky's realism means signs partake in the ontology of their referents. The act of naming can, then, be a creative act of invocation. Magical, and thus heretical, aspects of naming were not absent from Pavel Florensky's thought.[25] In magic, invoking a name, as a spell, can manifest its referent. [1] itself can make utterances and repetitions of the name theurgic. What Graham and Kantor claim is that it is not only theurgic, but *theopoetic*, that the Name Worshippers believed they were *creating* God. This calls to mind the hermetic tradition where magic spells and rituals create and bind the god to the hierophant or to a sacred image. Indeed it would follow that if the tokens of a name (letters, sonograms, scraps of paper on which it is written) are greater than the referent itself (as in Ilarion's [2b]), those who know the name have power over its referent.

Naming Infinity's own description of the rather conventional religious lives of Egorov and Luzin, with bible readings and icons, belies such Faustian insufflation. As Katasonov (2009) writes, Graham and Kantor declare their rationalistic views "with great pageantry" (p. 140). It is bible reading and icons that are vulgar to the contemporary intellectual. Surely Cantor could not *really* believe his sets of absolute infinity had a content. Such clearly brilliant men and women could not actually believe they were

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[25] This is especially the case in his early works, his interest in semiotics, and his magnum opus *The Pillar and Ground of Truth* (1914). Later, perhaps under the influence of priestly life and the tutelage of Elder Isidore, Fr. Florensky moved toward more orthodox positions.

describing external reality. Like much in the history of science, let the fairytale be the nursemaid to the truth. Troublingly for the authors, the ground set by theology did indeed yield creative results. The discoveries of set theory loudly attest to the strange nature of creativity itself, which in this case clearly means venturing into the deep and unknown, much like the extended uses of set theory in tropology, game theory, and artificial intelligence.

Just like most mathematicians, these figures believed the what they professed were reflections of reality. We might need to make room for a little less Comtian pageantry.

2. THE NAME WORSHIPPERS' SEMANTICS

The formal semantics of the Name Worshippers has not received due attention.[26] Let us state their identities in simple semantic notation:

[1] $[\![God]\!] \rightarrow God \wedge [\![God]\!] = God$.

  [2(a)] $[\![God]\!] \rightarrow God \wedge [\![God]\!] \Leftrightarrow God$.[27]

  [2(b)] $[\![God]\!] \rightarrow God \wedge [\![God]\!] \supset God$

  [3(a)] $[\![God]\!] \rightarrow God \wedge [\![God]\!] = God$'s divine energies.

  [3(b)] $[\![God]\!] \rightarrow God \wedge [\![God]\!] \subset God$'s divine energies

[4] $[\![God]\!] \rightarrow God \wedge [\![God]\!] = $ a human-created convention.

  [5] $[\![God]\!] \rightarrow God \wedge [\![God]\!] = $ a human convention made with a God-created and   inspired mind.

  [6] $[\![God]\!] \rightarrow God \wedge [\![God]\!] \cup$ [divine energies] by means of [5].

The slogan's status required that all hold [1], but the intellectual Name Worshippers rejected [2] and asserted that [1] actually meant only [3]. Florensky and Losev went on to argue that the semantics of [1] meant [3a] which meant [3b]. Florensky considered this to be the part of an ontological process which was the way all semantics worked in a movement of essence through energy. However, it is clear that Florensky's ontology considers [3b] to mean that the name as a sign bears the presence of its referent. In the system of late Name Worshippers, [3b] would not accommodate [6] as the signs are a full part of creation. The opponents to the Name Worshippers held [4], while [5] is the traditional view of the Church Fathers regarding names in general, and [6] is an adaptation of [5] which applies more properly to their view of the names of God. [6] means that God can imbue divine names, like any aspect of creation, with divine energy, but the name is not energy (no version of [3a] is correct), nor is energy the name. The semiotics behind $[\![God]\!]$ are not different from that of any other name. [4] allows for the operation of prayer to work, just as a message should work when sent to the addressee, and no differently. [3], [5], and [6] all allow for the operation of prayer based on a special property of names, and/or divine names in particular. Put differently, all but [4] have something about the second part of the formula that affects the way the first, the denotation $[\![God]\!] \rightarrow God$, operates. To be clear within the context of these arguments: [1–3] need not be in contradiction, [4–6] are not in contradiction. However, many would consider [4] not to represent the reverence given to the names of God by the faithful of any tradition. [4] was

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[26] A Russian survey of Name Worshippers and philosophy is worth mention: Nizhnikov (2011).

[27] I.e., $[\![God]\!] = God \wedge God = [\![God]\!]$. Both domains are co-extensional.

the statement of the synod in 1913 and was taken by many to be an extreme and politically-motivated position. [4] served more to vitrify differences than to resolve them.

Graham and Kantor's view can be accommodated by both [1] and [3], though they only mention [1]. Perhaps as a model for their understanding of it, they describe the priestly magic of Pythagoras and ancient Egypt (Graham & Kantor, 2009, pp. 21–22), but they do not understand the significance of denotation for Orthodox theology. They presume that the condemnation of Name Worshipping as 'pantheism' was mistaking that term for 'polytheism' (Graham & Kantor, 2009, p. 15). Rather it was part of the argument that that [1] means each synonym and instance of God's name must have a different extension. Thus ⟦God⟧, ⟦Jesus⟧, ⟦All-Mighty⟧, ⟦Yahweh⟧ would all be different gods. This is polytheism, but that is not the point.[28] We see different instances of signifiers, tokens, as we shall call them, but creating an identity means that the extension shares the nature of the referent. Since words are objects in the world, part of creation, [1] implies that God is a created thing. When God is taken to be part of creation the Church calls this pantheism, the charge levelled against Spinoza's monism. Since a name is an obviously identifiable element of creation, followers of [1–2] are pantheists.

The defenders of Name Worshipping did everything in their power to refute the charge of pantheism and emanationism, and [3] is their most concerted response with [3b] coming closest to traditional orthodoxy. Divine energies helped them account for the operation of repeating the Jesus Prayer. Furthermore, the activity of divine energies and their relationship to essence is an important part of the theology of St. Gregory Palamas, and so provides links to the hesychastic tradition. Yet, the debates of the 14th century surrounded the nature of the experience of the divine and not the essence of names. In fact, if names are created things, [3a] can also mean that the divine energies are created. That, the Name Worshippers' critics noted, is exactly the position of Barlaam of Calabria, St. Gregory's opponent. Barlaamism was a heresy both sides hurled at one another (Ilarion, 2007a, pp. 424, 521–22).

The most important discussion of names in Orthodox theology came in the late 4th century Eunomian debate. Two lengthy treatises by the Cappadocian theologians St. Basil the Great and St. Gregory of Nyssa involved refuting the claim that a name accounts for the full extension of its referent. These complicated arguments have received two excellent studies (Radde-Gallwitz, 2009; DelCogliano, 2010) worthy of examination by historians of linguistics. If we put the jist of these arguments in Classical terms, the Church takes Hermogenes' position in Plato's dialogue *Cratylus*: names are conventions made by men. But, of course, Socrates' solution to the issue was that God, the nomothete, gave good names that suited the referents. In the arguments against Eunomius, this gets a significant twist. Man created signifiers (as Adam named the animals in the Garden of Eden), but he did a good job of it because his rational capacity was created by God, made in the image of God. The Stoic and Aristotelian-influenced arguments, synthesized with biblical anthropology and the incarnational understanding of human nature, all make for a reading of the name quite a bit meatier than that of Plato. For it examines naming not just as something to do with words, but as a human faculty enabled by the divine. Gregory discusses at length the purposes of the human faculty of invention (*epinoia*), making

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[28] Furthermore, Fr. Antony (Bulatovich), speaking for the Name Worshippers, flatly rejects this claim and regards all names for God as the same (see Ilarion, 2007a, p. 607). The practice of the Name Worshippers only included references to ⟦Jesus⟧ and ⟦God⟧.

name-giving something akin to what many would call a 'technology', like medicine, boat-building, or statecraft.[29] [4] represents the statements of Arbp. Antony (Kharpovitsky), and the more Hermogenean position (Ilarion, 2007a, p. 486). ⟦Jesus⟧ → Son of Sirach, ⟦Jesus⟧ → the Greek name for Joshua the son of Nun, ⟦Jesus⟧ → the Son of God are all the same denotative operation. It is the referents of each iteration which are different. Bulgakov in his defence of Name Worshipping declared this the height of "rationalism" (Ilarion, 2007a, p. 542). [4] is clearly rejected by the Name Worshippers, and I have yet to see any particular versions of [5] or [6]. For them the name of God was prior to all human naming.

Indeed, the lack of concern over the intention behind the utterance, its context or medium, suggests the central place of the name matters much more than the worshipful habitus that enfolds it. Florensky and Losev's later work on names suggests as much. And this is indeed part of what troubled theologians. A repetition is that many more instances, that many more names, their invocation has a power of itself. All this smacked of magic, Kabbalism, and the theurgy of Iambilichus or Giordano Bruno.

Another concern for theologians are the rather unique and selective readings given to the great deal of patristic theology devoted to the symbol. The Greek notion of the symbol (*syn-bole*) as a sign with content allows for a doctrine where the bread and wine of the liturgy are both symbols of the Body and Blood of Christ, and also are identical with it; where the Creed is called the 'Symbol of Faith', though it is at once a *statement* of faith. Similarly, icons are equivalent to the Gospel as the Word of God, and the Word of God is an icon.[30] The theology of the symbol is richly intertwined with the all-important theology of the incarnation as the symbol is, in part, a product of *epinoia*. It is, indeed, the incarnational aspect of the Name Worshippers' thought that is sorely lacking. In the eyes of contemporary Orthodox theology, at least as this author views it, the incarnation is a resolution of the fundamental question as to how God interacts with the world, as well as how essences and appearances are related. For Florensky, Bulgakov, and Losev, the formulation of their opposition to Western positivism – be it in semiotics or Sophiology – has resulted in giving inordinate power to signs over the person of the Incarnate God. While a full semiotics of Name Worshipping must await its own study, we shall see what the above results might tell us about the founders of the Moscow School.

Among the list of heresies liberally applied to Name Worshippers was 'Platonism'. The implication of [3] is that creation issues forth from God as part of His essence. This is more precisely defined as emanationism which is a subtype of pantheism. The Orthodox hesychastic theologians are not pantheists because the God's energies, or activities, are, firstly, not created things and, secondly, distinct from God's essence. This was part of middle and later Name Worshippers' arguments supporting [3]. However, Florensky, Losev, and the rest of the Moscow School had a great enthusiasm for Plotinus, (see Graham & Kantor, 2009, pp. 93–94). An emanentist understanding of [3] would mean that naming and uttering the names of God was fundamentally different from that of [5] and [6]. Platonism and Florensky's ontology of signs tend to lead toward emanentism.

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[29] See Gregory of Nyssa, *Contra Eunomium* 2.1.182-184 (*PG*).
[30] See St. John of Damascus (2003), first treatise.

As a strange and interesting 1907 article by Florensky on infinity suggests, Cantor's power to grant descriptions of the indescribable was sufficient ground for theological speculation on its own (Florensky, 1994a, p. 79–145), though Florensky's direct contributions to set theory itself were minimal. Florensky gave Cantorian infinities philosophical and theological weight and introduced them to a more general readership (Troitsky, 1997, p. 538), the cause was then taken up by Losev. In a comment on pseudo-Dionysus the Areopagite's text *On the Divine Names*, (c. 6th century), Losev wrote that apophatic theology of names alone was

> ...completely impossible. This is not only agnosticism, but *atheism*. It is the rejection of revelation, of theophany, not to speak of the Church, sacraments and prayer. Thus it is necessary that this supra-essential abyss, in some sense *existed*. That *it is* means that it has a boundary, a position [*stanovlenie*]. The mathematicians have a good understanding of this – the differential, integral – this position takes place in the depths of essences [*v nedrakh suschnosti*], without passing into some other form of being. (Losev, 1997, p. 75, emphasis in original)

Human freedom and the divine were only accessible when they had a name. The ability of advanced calculus to supply names to functions that could not be completely described provided an answer to determinism, apophaticism, and agnosticism. Not only was Name Worshipping cataphatic, it was *mathematical* – the most rigorous type of thinking there is. Losev planned to give a full account of the science of Name Worshipping in an elaboration of his project. His repression and imprisonment in the GULAG redirected his interests for the rest of his very long and productive life.

The semantics of the mathematical Name Worshippers seem then to regard the right side of the equation in [1] to comprise the unbound and unlimited properties of functions, especially those of mathematical theory – plots of imaginary and rational numbers on a graph, for instance. The left-hand side, the name, is not an arbitrary signifier, but an manifestation of the right-hand side, a shadow that carries some of the power and operation of its referent. Mathematics, and science in general, define names and their referents in a dialectical fashion with one adjusting the other. At the source of the dialectic, the *causus primus*, is a predicate by nature impossible to define and a subject fixed as the name of God. Where as German and French mathematicians were willing at different levels to engage with this equation, the ontological lustre across the boundary between signifier and signified seems to be a Russian innovation expressed by, or prompted by, Florensky's ontology. A useful avenue for further research would be to see whether this non-arbitrary understanding of names influenced the development of description set theory and its further contribution to topology. There names greatly proliferated and expanded into network and communication theory. These were uniquely Russian/Soviet contributions.

Thus though most of what Name Worshipping takes from mathematics comes from Cantor's absolute infinities, the understanding of a name as something non-arbitrary, bearing some of the power of its referent, would have been ascribed to by both Egorov and Luzin as fervent admirers of Florensky's philosophy (see Graham and Cantor, 2009, p. 83). A name that has its own power is a magic one and this aspect of the Name Worshippers' semantics requires more than a historical approach.

3. TOKEN AND INVOCATION

An appendix to *Naming Infinity* reproduces some interesting remarks from Luzin's notebook, along with illuminating comments. On several occasions, Luzin prefers to use the French verb *'nommer'* rather than the Russian '*imenovat''*. He seems to prefer to keep Lebesgue's concept of naming as delimiting the unanalyzable separate from the connotations of the Russian. Mapping the French and Russian terms related to the semantic fields of MARK/SIGN/WORD and MEANING would clearly indicate why Lebesgue and Luzin and would prefer *nom* over many other comparable terms. The name as that which can be applied to a individual over a class, as it is in both Russian and French, is certainly a far more convincing reason than any Adamic power of naming. In sympathy with this inadequacy, I would like to stir the cauldron with an English term that has no French or Russian equivalent: 'token'. The Russian word '*znak*' – 'sign/mark' – has as its abstract form '*znachenie'* which means 'meaning, intention'. Other derivatives are much closer to 'significance' or 'value'. A token in corpus linguistics is translated by the term '*sluchai*', instance. However not all instances are tokens. Here we will define a token as: 'a heuristically-delimited entity that can call forth a possible referent, including an indistinguishable instance of itself'. The only thing controversial about such a definition is that it does not seem to be particularly indicative, but it will serve our purposes here.

Note that this definition is also included in other tokens: locks of hair, evidence from the scene of a crime, private currency, all meanings given for the term in the *Oxford English Dictionary*. Nor does it require that a token be an instance of a type. In fact, as we will see, the lack of referential understanding of tokens means that it can replace other signs when its referent is mysterious. For example, we may identify a particular instance of a sign as a sign without understanding what about it makes it a sign, like the secretary inside Searle's Chinese Room. A mark in an undeciphered script on a tablet may itself be a sign, but we, as Wittgenstein shows, may not be able to identify what it is about the object that is a sign. Perhaps the colour of the tablet, the material of which it is made is part of the sign. If we have successfully identified the object as bearing a sign (and that itself may not be determinable), then we certainly know that some part of that object must be a token, though we may only have a general impression of what that is before we have determined the type.

Thus the tablet with the unknown token can be taken to someone who can decipher it. They say it means "God". You may believe it was the markings on the tablet and not know it was also the colour and the type of clay which were the decipherable marks. The fact that the token can exist independent of the type makes it similar to names, or signifiers, with signified entities that are unknown. Note also that a token is still different from a name: "Socrates!" screamed three times by his wife, "Socrates" written on a tablet, and a sonogram of the utterance of his name are together five tokens.

To isolate the technical nature of naming and granting tokens, I am going to employ a simple, primitive example of an electronic lock and key as a form of denotation and recognition. The economics of server space dictate that a cypher is to be difficult enough so that the effort it would take to crack the code, the security threshold, would be greater than that to obtain it legitimately. In the traditional terminology: Alice holds a key and Bob holds the locks. In a symmetric key system, the form of Alice and Bob's codes are identical except for the fact that Bob's is connected to a command that provides entry.

Alice's key and Bob's lock could be exchanged and there would be no telling the difference. Two things aid security: the number of keys and the complexity of a single key. In an asymmetric system, Bob has an algorithm which allows him to decipher the key and match it to his lock. This permits issuing many fewer keys ('public keys') with much less security while Bob keeps private keys that process the public keys to open the lock. The layer of encryption aids security while the reduced number of keys aids efficiency. The cost of complexity is either born by Alice (recall the 30 or 40 character-long software licence keys of a decade or so ago), or is inherent to the algorithm itself. In a symmetric key system, Alice's keys can have only one form and that form must also be represented by Bob's locks. In an asymmetrical system, Alice's keys contain cyphers that have to be processed by Bob.

Now we apply this simple communication model to a simple model of computational cognition where Alice sends a key and Bob cognizes it. A key passed in a symmetrical system is only cognized because it is doubled in the cognizer. The characteristics of the key are not dependent upon those of the lock in any sense other than identity. The symmetrical key is a name with no difference between its private language and non-private one, in any cognitive sense it *means* nothing. In the asymmetrical model, both the key and the process of cognition are important for decryption and, thus, cognition. The decryption algorithm determines the characteristics of the key. Without having the process of encryption apparent (and in advanced encryption systems it is mathematically impossible for a private key to be derived by the private one), we have a cognitive model that accounts for token and type, or of particulars (in Aristotle's system primary substances – 'Socrates') and universals (secondary substances – 'a man'). As in *Cratylus*, names are well-formed because someone who "knows the nature of things" has determined them.

Note that instances of both types of keys are tokens. Only one is needed to open the lock, no more. The asymmetrical one however, can refer to a generalised entity even if the algorithm is merely based on relations between elements of the key. The symmetrical key system has two tokens – lock and key – identical with no other form of reference.

The symmetric key heuristically calls forth its referent even if that referent is nothing other than the token itself. These systems are particular and non-analysable. It is in this sense that the token – a bare token – permits us to have a form of signification without typification. The software key can be off by a single letter, the name for 'harpoon' misspelled in the only known glossary of an extinct language, "aba*bra*cada" instead of "abacadabra" and the token will not refer to type even if there is one. Suchness and non-arbitrariness of tokens is what associates them with spells, curses, and incantations (see Flahault, 2010).

This is clearly what the Name Worshippers and, in part, Graham and Kantor are pointing to in their formulation of the creative power of names. There was a great deal of creative symbolism within the Russian school, beyond Florensky. *Naming Infinity* relates the story of Alexander Yessenin-Volpin, who answered the question as to whether he believed each sequential power of 2 was real by answering 'yes' just slightly later for the subsequent power than for the previous (Graham & Kantor, 2009, p. 23). Symbols for paradoxes could be rhythmic, choreographic, ritualized, satirized. It is possible that the services practiced by Name Worshippers in the faculty of mathematics were indeed incantations meant to create an "instantiation of the energies of God" as proponents of

the name givers were said to have done. In this case, the Jesus Prayer under the semantics of [3b] was indeed a spell meant to make the spirit incarnate in the hearts of believers. The incantation of the name, according to Graham and Kantor (2009), in the basement of the Moscow University Chapel (p. 3) would be a ceremony iterating tokens of God that call down the fundamental reality of the absolute infinite set upon the Moscow collective. *Naming Infinity* movingly describes the repression, pain, hunger, and privation of the Moscow School between the Revolutions – Egorov sharing his food rations and students rubbing the frostbite on one another's faces during lectures. Perhaps the Name Worshipping cult instilled a brotherhood and sisterhood, a set of common aims, foundations, and courage in collective spirit.

The Name Worshippers would have taken the name of God as an identity and an elaboration of [1–2] that is a manifest reality articulable but with a referent inherently and supremely beyond analysis. This required believing in the ontological status of a fixed sign on the left side of an equation that had the characteristics of our bare token because the ontological status of what was on the right side of the equation was by its nature indeterminable. This fascination with advanced calculus and number theory alluded to by Losev suggests that the very fixedness of that on the left side was necessitated by the very interminability of that on the right. A reasonable question is whether the necessity holds as much for their theory of free will as it does about statements of the absolute infinite.

4. NAMING CREATIVITY – EXTERNALISM AND ABSOLUTES

It deserves note that Cantor's statement: "Every extension of our insight into what is possible in creation leads necessarily to an extended cognition of God." more clearly resembles the synergetic description of human signs as a kind of inspired collaboration with the divine in [5] than it does the Name Worshippers in [1–3].

In parts, Losev and Florensky mentioned the synergetic element in the power of the name being matched with human striving (see Florensky 1994b, pp. 358–359), but the Platonic power of the name itself often seems to overwhelm both God and humankind. Some of Losev's description of hesychasm read more like the theosophy of yoga than St. Gregory of Palamas.

This is a result the more philosophical of Name Worshippers did not intend. Florensky forcefully believed that set theory offered a means of introducing freedom into mathematics. And absolute infinity offered freedom from potential infinity, whose elements he compared to insatiable denizens of Buddhist hell (Florensky, 1994a, p. 82). Such are the aporias that are so common to Florensky's philosophy. A name for the infinite provides a semantic extension of it, but that extension binds it to a token and turns prayer into magic. The liberation of human will from the confines of deterministic rationality, or Neutonian positivism, as some of the Name Worshippers liked to put it, traps the human into a new type of rationality. As Lorraine Daston has shown, technology has aided humans in creating a form of algorithmic rationality that humans now regard as more essential than their own (Erickson et al., 2013). As we have seen, it is the technology of encryption which can give us a model for the type of tokens used to name the unnameable.

In a famous legend related by Iambilichus, when the mathematician Hippasus discovered the existence of irrational numbers, his rivals of the school of Pythagoras took

him out on a boat to sea and drowned him (Doxiadēs & Mazur, 2017, pp. 1–2). The waves of the inchoate deep were a suitable place for the father of irrationality. Little is known about Hippasus, but it was also said that, in contrast to Pythagoras, he and the members of his school were much less prone to creative innovation in the formulation of theorema and more inclined to rote instruction of fixed rules. It is in some sense a Faustian bargain. Those who sought to define the formless, the limitless, that which evaded all boundaries (the *apeiron*) became bound to the names they had given them, by tokens that could not be checked against their types. Those who argued complex differential calculus would account for free will became subject to the calculus of encryption systems.

A surprising contribution to creativity and mathematics comes in contemporary, cognitive science-based conceptions of meaning. Knowing the mind's "trillion handshakes" of neural connections, everything we can conceive should be able to fit between our ears without any external metaphysics. Creativity comes merely in neural recombination and progress in the acquisition of recombinations by self and others. But could it be possible that some meanings are actually external to the brain? This is the argument by so-called 'meaning' or 'vehicle externalists' who, though not necessarily realists, hold that merely mental representations are not enough. Though most arguments follow Putnam and Davidson's arguments about intention and causality, an excellent contribution to this position has come recently in the proposition of 'extended mathematical cognition' by Vold and Schlimm (2020).

They argue that "there are cases in mathematics where external symbols have content that is not derived either from conventional associations or from the representational states of a cognitive agent" (Vold & Schlimm, 2020, p. 18). We can prove this because mathematicians sometimes themselves do not know what the content is of the symbols they coin. For example, Giovanni Saccheri (1667–1733) attempted to demonstrate the Euclidian parallel postulate by disproving the contrary. Instead, he began to demonstrate that these contraries had unexpected content, content whose features began to be expanded by figures such as Gauss, Lobachevsky, and Bolyai. Finally, Beltrami, Klein, and Poincaré showed the relationship of non-Euclidean objects to Euclidian ones and, by the end of the 19th century, non-Euclidean geometry was normal science (Vold and Schlimm, 2020, p. 15–16). Similar examples could be taken from the mathematical subdisciplines we have been discussing – Reimann space, Lagrange's theorem, for example. Is this not the very nature of creativity itself – a search along a path with aims that often lead to uncharted destinations?[31]

Reading Vold and Schlimm's multiple sources with their Berkeleyian neuro-centrism one is struck by the poverty of the materials in comparison with omniverous Cantor, the Russian Trio, or Losev. The only way to get out of your own head is to find some predicate, any predicate, that might not have already been there in the first place. The list is short. Their aims are, apparently, very different from those of these thinkers. They are not trying to prove that the external nature of 'cognitive representation' is real, nor are they trying to prove it is infinity, or an absolute infinity as the ground of all other

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[31] Florensky (1994a) writes: "Cantor *does not know* where his work is leading. All raise their voices against the possibility of such reckonings, all nod their heads in mockery; but he does not set idols before him. Will he leave his work behind – the source of tradition and science that has nourished him, beyond all temptations, heading forward into the unknown, to the desert of pure thought? What is it he is striving toward? So as to build a temple, a church, a symbol for the Infinite. He wants to see the realisation of the Heavenly Powers, to be convinced that such is possible, and he needs it now" (p. 126) [emphasis in original].

infinities. These predicates could just as well be signs rattling around in social or scientific discourse without their descriptions fully captured, and no more real than any other set of signs.

When Vold and Schlimm make the argument that something cannot be in the mind because it is at some point indeterminate they inevitably argue that such an object is not *present* in the accessible world of appearances. If elliptic geometry were laying around somewhere in an 18th century Jesuit hostel, perhaps in a translation from the Persian, that would mean the solution was apparent. If it were apparent, then it was, or could have been in someone's mind (we are talking about history here and never know all the facts) and is no support for Vold and Schlimm's argument. Thus that these objects can be names without an account of their meaning not only means that the meaning (i.e., forming a predicate) is elsewhere, but that it is in the world of things that could *become present* but have not. Perhaps these predicates lurk in some Hegelian twilight waiting for consciousness to find them. Or perhaps it is no less feasible to conceive that they are real.

The arguments of the Name Worshipping mathematicians and 'meaning externalists' are in an interesting relationship. In the first, a bound name can denote an ever indefinable entity, in the second a particular, but merely heuristic, name can denote an entity perhaps definable but not present. These names are, in the sense we have seen, both token-like, though in the former that semiotics hypertrophises into the mystical. Both, in remarkably similar fashion – one from theology, the other from the history of mathematics – point to a realism making itself present or emanating into the world of appearances. They also point, as Socrates did in the *Cratylus*, to creativity and imagination where poets vie with the gods in the creation of names (391d). Along with visionaries, technology in the formulation of informatic ontologies, or varied systems of encryption, or 'rational' systems of choice, is more than just limitation. Technology is in some sense a fellow striver through human *epinoia*, through craft, along the concatenation of names.

Cantor's legacy points to a theory that is able to return to a scientific basis for essences over processes, after a long absence from the days of Roger Bacon. Cantor's, Lebesgue's, Losev's names denote essences that, like Vold and Schlimm's external vehicles, must exist as whole entities because they cannot be reduced, like a description of the location of an electron or Husserl's ideas – products of the same generation as the Russian Trio. Their realism and idealism was not so much a confessional choice as it was a reasonable deduction from their forward-thinking and dazzlingly synthetic work. Philosophy, in this neuroleptic, neurocentric age, with the aid of information science, might itself need to learn to intone the real by its names.

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Infinity: Divine Paradigm

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Abstract

"In the Beginning was the Word" provides the biblical reference to the word 'Word,' and 'Infinity' touches upon the traditional philosophical conventions that refer to God as the 'Infinite' and the creations of God as the 'finites.' Infinity as a technical artefact, engages the mind with its abstractness and metaphorical rendition as in Basic Metaphor of Infinity (BMI), but also with its concreteness as in programming, modelling and topography. 'Infinity' as a concept and as a numerical entity refers a quantified element to the qualitative divine – with the intention of comprehending concepts that are generally beyond the cognitive imaginative sphere of the human mind. The formality associated with mathematical proofs authenticates ideas that may seem or are abstract to pinpoint, including the notion that 'nature speaks mathematics' and nature as created by the creator embodies the paradigm of 'Infinity' as divine. Can 'infinity' then be conceptualised as a technical artefact by approaching it secularly with mathematics as the language to comprehend the theological cloud that engulfs it? The answer, perhaps will neither be a simple affirmation or an outright negation.

Keywords: Infinity; Infinite as Concept or Entity; Mathematics; Theology; Cosmology

Аннотация

"В начале было Слово" – отсылка к библейскому "Слову", а "Бесконечность" затрагивает традиционные философские представления, которые называют Бога "Бесконечным", а творения Бога – "конечным". Бесконечность, как технический артефакт, привлекает разум своей абстрактностью и метафорическим представлением, как в базовой метафоре бесконечности (BMI), но также и своей конкретностью, как в программировании, моделировании и топографии. "Бесконечность" как понятие и как числовая сущность связывает количественный элемент с качественным божественным – открывая перед нами возможность понять концепции, которые обычно выходят за пределы когнитивно-образной сферы человеческого разума. Формализация, связанная с математическими доказательствами, подтверждает подлинность идей, которые есть или кажутся абстрактными для точного определения, включая представление о том, что "природа говорит математически", а природа, созданная создателем, воплощает парадигму "бесконечности" как божественной. Можно ли тогда концептуализировать "бесконечность" как технический артефакт, если подойти к ней секулярно, используя математику как язык для понимания охватывающего ее теологического облака? Ответ, возможно, не будет ни простым утверждением, ни прямым отрицанием.

Infinity: Divine Paradigm

INTRODUCTION

> The Infinite! No other question has ever moved so profoundly the spirit of man; no other idea so fruitfully stimulated his intellect; yet no other concept stands in need of clarification than that of the infinite….
>
> —David Hilbert (as cited in Maor, 1987, p. vii)

The idea of 'infinity' has long intrigued the human mind. Since time immemorial the concepts and numerical attributes associated with it have resulted in postulates and paradoxes. It appears to encompass a quantified entity objectively as well as a qualitative concept subjectively. The Universe, looked upon as the creator and the created, metaphorically conjoins the human with the divine at an unbounded cosmological scale that is conceivable only with the notion of 'infinity'. Can 'infinity' then be described?

Let us walk through a few narrative scenarios:

(a) A happily married childless couple is often confronted with the question as to why they have no children. The couple responds that the universe had its way of not blessing them with any. The question that follows is how their relationship survived this crisis. The couple always answers: "The universe is our oyster, and we each other's. We are blessed with 'infinity' and by the 'infinite'. Just as subtracting one from infinity, leaves infinity or adding one to infinity, results in infinity, our world together remains one - infinite." The answer is received in awe by some, confusion by others or simple silent skepticism by yet others. The couple's answer serves to share and celebrate the sense of eternal abundance and completeness that a notion of 'infinity' reflects.

(b) A popular story that is often a part of textbooks in India re-enacts the conversation between Alexander the Great and an Indian naked saint on the banks of the river Indus. Alexander was on a mission to conquer the world and had just brought the mighty Persian Empire to its knees, and upon encountering the saint, who seemed to be staring into empty space, enquired as to what the saint was doing. The saint answered that he was experiencing 'nothingness' and posed the same question to Alexander. Alexander replied that he was 'conquering the world.' Each laughed at the other for the same reason. Alexander could not comprehend the fact that one could waste an entire lifetime doing nothing and the sage could not understand how one could devote a lifetime to conquering an entity without limits. Conquering 'limitlessness' versus experiencing 'nothingness' perhaps posited a Greek and an Indian worldview confronting each other. To put it in another way, an Abrahamic tradition was facing an Indic philosophy. A belief of 'one' life encountering an assertion of 'infinite' lifetimes. In biology, cells are the smallest denominator of life. Analogously, if the greatest denominator of life could be determined by the multitude of lives that one believes one lives, then: a) the Abrahamic view of living a single lifetime, emphasizes a linear view of reaching the limit in 'one' lifetime; b) the Indic philosophy of infinite lifetimes suggests a circular view of a bounded infinity of limitless birth-rebirth (Pattanaik, 2015).

(c) One enters a hall and finds oneself in between two parallel mirrors facing each other. Mathematically put, the individual witnesses 'infinite' virtual self-images, with a

visual perception that the images converge at 'infinity.' The images are neither converging nor can one pinpoint infinity.

A short walk through the narrative scenarios confronts us with the idea of infinity, that though perceivable is not comprehensibly definable in a non-mathematical linguistic manner. The concept of infinity, interchangeably used with the notion of the infinite, perhaps aids perception, but evades comprehension. One wonders, if 'infinity' as a phenomenon is elusive and evades an ontological grasp since its magnitude is difficult to comprehend and the vastness that it suggests is too surreal to apprehend. Is the abstraction versus the mathematisation of the concept responsible for the abyss between perception and comprehension? One wonders, if it is at all logically explainable that all that is 'infinite' is correctly describable by all that one can apply 'infinity' to. An infinity of infinites suggests quantification, and therefore, would the measure of such quantification necessarily have to be infinite? The universe debated as being infinite, touches upon the notion of time and space. The unbounded universe is large, unquantifiable and perceivably unmeasurable. Are time and space then infinite? Or are they measurably and thus finitely infinite? History is witness to the geocentric theory that insisted on a spatially finite material universe to accommodate the otherwise inexplicable premise that the stars rotated around the earth in twenty-four hours. Inductively, space then also had to be finite, since it was a structural accommodation for the heavenly bodies. However, the imperceivable and unreachable heaven had to be infinite, since neither the beginning nor the end was known. What was known is that all that was divine was imperishable. A theological take that the divine could neither be created nor be destroyed, derived from the religio-cultural traditions in certain cultures of the world, nestled in the universal scientific affirmation that energy can neither be created, nor be destroyed, but can only be transformed.

It is tempting to relegate 'infinity' to the realms of the unknown by ascribing an aura of divinity to the concept in itself. However, it is engaging and enriching to shed some light on 'infinity' as an interpretative entity in a state of animated oscillation between human cognition of mathematics and an individual's belief system. While human cognition of mathematics renders meaning to the interpretative ability of the mind with respect to mathematical symbols and ideas, an individual's belief system is a congregated projection of the societal interactions and process of identity that an individual conforms to. Intuitively, could such an engagement accommodate the 2-way necessary and sufficient path of interpreting 'infinity'? That is to say: The human cognition of 'infinity' as a mathematical idea leads to the conceptualisation of 'infinity' as an entity that finds acceptance by a process of interpretation based on an individual's beliefs and faiths; Conversely, an individual's belief system influences the process of cognition of 'infinity' as a mathematical idea. Perhaps, a dynamic 'to and fro' equilibrium between the two paths (i) Cognition-Interpretation-Belief and (ii) Belief-Interpretation-Cognition could be the key to understanding the perception of 'infinity'.

Lakoff and Núñez (2000) explain that human ideas based on cognition are not simple to explain, since they are predominantly based and grounded in "*sensory*-motor experience" and the abstract ideas that individuals put forth "make use of precisely formulatable cognitive mechanisms such as conceptual metaphors that import modes of reasoning from *sensory*-motor experience. It is *always* an empirical question just what human ideas are like, mathematical or not" (p. 2).

PERCEIVING INFINITY

How does one look at 'infinity'? Is 'infinity' a thing? Is 'infinity' an endless process? Is 'infinity' a mere mathematical symbol? Is 'infinity' a limitless entity or is 'infinity' the limit of the unbounded? The dilemma of comprehending 'infinity' and nailing it with a definition arises primarily because one does not encounter 'infinity' as an entity or a process in the real world and an individual's sphere of conception and conceptual systems are finite and thereby the mechanisms to perceive 'infinity'. As Núñez asks, "How can human beings understand the idea of actual infinity - infinity conceptualized as a thing, not merely as an unending process? What is the concept of actual infinity in its mathematical manifestations - points at infinity, infinite sets, infinite decimals, infinite intersections, transfinite numbers, infinitesimals?" (Lakoff & Núñez, 2000, p. xii). He reasons "since we do not encounter actual infinity directly in the world, since our conceptual systems are finite, and since we have no cognitive system to perceive infinity, there is a good possibility that metaphorical thought may be necessary for human beings to conceptualize infinity" (Lakoff & Núñez, 2000, p. xii).

Taking a step sideways, let us attempt to analyze the perception and understanding of 'infinity' when it is grasped as being synonymous with 'divinity.' Oppy's (2006) premise that God is 'infinity' and therefore 'The Infinite' is comprehensible without abstraction or mathematization, when God is accepted as an entity that is beyond any definition or quantification. Hence, the unfathomable becomes fathomable. When the term 'infinity' resonates irreplaceably with 'God,' its comprehensibility is no longer associated with perceptibility. It is then an acceptance. However, 'infinity', when engaged with as a technical term becomes measurable. A concept of 'infinity' detached from divinity becomes conceivable. The notion of 'actual infinity', wherein 'infinity' is a technical element, can be discussed as a realizable entity. 'Actual infinity' is then distinguishable from 'transcendental infinity', wherein infinity is beyond human cognition and knowledge. Perceiving and thereby conceptualising 'infinity' as a cognitive activity of defining or theorizing is problematic, since such a process is an inductive thought process. In the case of 'infinity' there is then an absence of an *a priori*, and therefore, a discontinuity in the process of induction.

INFINITY THROUGH LENSES

The discussion up to this point been an oscillating one, with references to infinity in the realm of the divine and as it is in the technical one. Are we then dealing with a multitude of properties of infinity, depending on what lens it is being viewed through? The interdisciplinarity of the concept of infinity becomes apparent from its rendition in the history of mathematics, philosophy, science, arts and theology is proof enough that it has preoccupied formal and informal interactions with humankind. Fictions of infinity in literature as well as the narratives of infinity in the scientific world have had to deal with the difficulty of defining 'infinity.' Why indeed is it so? Is it the nature of infinity that it eludes definition or is infinity as a concept itself infinite and therefore beyond definition? Riedelsheimer (2020) enumerates two properties of infinity that appear as an "aesthetic feature in literature and of what impact such fictions of infinity may have on readers." The properties he enumerates are "(1) The infinite is beset by paradox and resists, or at least challenges human understanding. (2) As a result, infinity likewise resists its own

representation, at least where the representation is anything else but highly abstract" (p. 3). He further opines that an attempt at defining the infinite is a difficult endeavour by quoting Wolfgang Schoberth's observation that a definition is a demarcation and the consequence of this demarcation is that a boundary is imposed on the concept that is being defined. Therefore, "a definition of infinite, deprives it of infinity (the first and in many ways central of plenty of paradoxes of the infinite), or, conversely, the definite is also finite." He elaborates his present view that "there is no metalevel at which infinity may be safely contained" by qualifying it with Waldenfels' 'basic aporia' of infinity, i.e., "How is it possible to think infinity without rendering it finite? Rather, infinity is fundamentally at odds with our - necessarily finite - *experience* of infinity, resulting in an antagonism between what we experience (the infinite) and how we experience it" (Riedelsheimer, 2020, p. 4).

The mathematician Rudy Rucker (2007) touches upon the history of infinity and explains that the appropriateness of the symbol ∞ lies in the fact that it is seen as allowing one an endless travel around a curve and that "Endlessness is, after all, a principal component of one's concept of infinity." Interestingly, he goes on to suggest that other notions which are associated with infinity, namely indefiniteness and inconceivability, have had negative connotations. Due to these negative connotations, according to him, infinity "inspires feelings of awe, futility and fear. Who as a child did not lie in bed filled with a slow mounting terror while sinking into the idea of a universe that goes on and on, for ever and ever?" (p. 2). Rucker (2007) refers to the history of foundations of mathematics and suggests that the mathematical universe has progressively expanded to include a multitude of infinities, for boundaries, limits, quantities, numbers, etc. Vedic mathematics of India refers to '*ananta'* which is the Sanskrit word for infinity and which literally translates as 'the one without any end.' It captures the essence of all that is unlimited. Unlimited, here, does not exhaustively pertain to the infinitely large but also to the *infinitesimal*. '*Purnam'* - another Sanskrit word that means whole and complete, refers to a notion of infinity wherein the completeness is an attribute to the creator of the universe. The symbol of '*ananta*' as visualised in the Indic worldview reflects the lemniscate that draws its origin from the mythological depiction of the Hindu God Visnu lying on the coiled serpent *Adi Ananta Sesha,* floating on an ocean of milk and supporting the earth upon an extension from his navel. *Adi* - the primal, *Ananta* - infinity, and *Sesha* - the limitless symbolises the triad one-infinity-zero, the circular representation of life and the infinite life cycles (Pattanaik, 2015).

The Greek word for infinity that has been more popular in usage is *apeiron*, its literal translation 'unbounded.' It is often interchangeable used to mean infinite, indefinite, undefined, etc. Rucker (2007) explains that for the ancient Greeks, *apeiron* was the original chaos out of which the world was created. Although the idea of divine creation in the Indic, Greek and Abrahamic traditions similarly involves the terms of infinity, nothingness and orderliness, the point of differentiation lies in the way the terms are interpreted. The Indic view is based on a cyclic birth-rebirth phenomenon wherein nothingness precedes the beginning, which in turn gives rise to the limitless. The infinity circle is bounded but limitless. The Greek worldview is one where the starting point of the world was chaos until God brought in order. The Abrahamic view, that talks of the world being created out of nothingness and emphasises a single lifetime of existence, suggests a bounded linearity of life.

INFINITY - PHILOSOPHY AND MATHEMATICS

In order not to get entrapped into a debate surrounding the religious interpretations of infinity, let us take the unifying intersecting point that in major religious traditions, acceptance of infinity is derived from its synonymity with a divine supreme God. However, the transformation of infinity comes with the mathematized linguistic real world in which the concept of infinity and thereby of the infinite took on a technical character, e.g., with Aristotle distinguishing between 'potential' and 'actual' infinity.

Mathematics, as a subject, seems to accommodate infinity graciously. In contrast, since a linguistic ascription in literature to the same effect is lacking, the concept of infinity is looked upon as transcendental and a representation in language seems problematic to pinpoint. Riedelsheimer (2020) opines that though there is an infinity of numbers in mathematics, with the largest countable number being non-existent, one runs out of names before running out of numbers. Yet, many mathematician-philosophers or, rather, philosopher-mathematicians, have a powerful tendency to let nature speak mathematics. Often quoted is Blaise Pascal's thought that relates to the disproportion of humans when compared to nature and the universe. Nature according to Pascal (1670/1910) is "an infinite sphere, the centre of which is everywhere, the circumference nowhere. In short it is the greatest sensible mark of the almighty power of God, that imagination loses itself in that thought" (p. 26). If humans could let their imagination soar and were to evaluate their position as against infinite nature, what would their stature be? Pascal opines that humans are nothing when compared to nature, that they are an all when compared to nothing, thus rendering human existence as a mean between nothing and everything. The thought, though attributed to the Christian belief that Pascal dedicatedly conformed to, seems to take a cue from the origins of Hinduism, which emphasises the whole philosophy of life to be an infinite eternal circle of nothingness and infinity.

Irrespective of the history of the traditional religious beliefs, one can clearly witness the similarity across cultures when relating humanity to infinity and divinity. Pascal's obvious reference is to God, when he talks of the 'Author' understanding the marvellous processes transcending the bounds between nothingness and infinity. Humankind's inability to comprehend that it is was created from nothing and shall be swallowed up into infinity renders the individuals in a state of suspended animation, once the realisation dawns upon them that one is in the middle of a process, trying to either grasp its beginning or its end. Nature in all its grandeur, although looked upon by humans as a collection of material objects, cannot, according to Pascal, be perceived or imagined as divisible beyond a limit, although nature is infinitely divisible. The notion and belief that nature is infinitely divisible has often been associated with the infinitely small or the infinitesimal. The concept of the infinitesimal - an essential element in Hindu and Indic philosophy of science and mathematics and often seen as the precursor to the modern theory of calculus - forms an essential cornerstone in the history of world mathematics. The perception of infinity as the unattainable large is thought to be imaginable when associated with the greatness of God. However, the infinitesimal or the infinitely small is perceptibly less obvious. Pascal opines that an infinite capacity is required for both and the capacity to attain the nothing is no less demanding than attaining the all. These extremes according to him do "meet and reunite by force of distance, and find each other in God, and in God alone." Pascal's thoughts open up the idea that in being the infinite, God is 'everything' and in the 'smallness' of man as being a part of infinitely divisible nature, the human

being is 'something.' The smallness of humans conceals the infinite and perhaps that is the reason why humans believe in their capabilities to reach the converging centre rather than the expanding circumference of the world around them. Pascal's contention that it is in God that the extremes are contained and that the human being is nothing but a material object in between these extremes, leads to the view that everything that is not infinite is always distant from the extremes that are comprehended as being infinity, and these then are the finites which in comparison to the infinite, are equal.

INFINITY IN HISTORY

Taking a step back in history, there is Aristotle (ca. 350 B.C.E./1930) who is critically engaging Zeno's paradoxes that were formulated upon infinite divisibility. In response he put forth the idea of 'types of infinity,' thereby introducing and distinguishing between potential and actual infinity. Actual infinity is popularly referred to as the complete or completed infinity (Maor, 1987). This distinction, put forth by Aristotle seemed to mitigate the negative connotation that the ancient Greeks traditionally associated with infinity as the chaotic and the unintelligible. The distinction lent a technical sense to the word 'infinity' which was until then a conception of abstractness and incomprehensibility, until and unless synonymised with the epitome of the unfathomable - the divine.

The notion of actual infinity was perhaps the first time that 'infinity' was seen as a whole completed entity in the real world. It reflected a sense of accuracy and definability that could aid in viewing infinity objectively and effectively, that is, in the modern world the basis of modelling of what can be viewed as the finite. What does one then associate with the notions of potential and actual infinity? Let us revert to the classical Zeno's paradoxes to shed some light on the potentiality and the actuality of infinity. Zeno's Achilles paradox suggests that a runner can never reach the finish in a race, since in order to do so, one has to first to reach the halfway mark. Once the mark is reached, the next halfway of the remaining half distance must be reached. Proceeding with this line of argument, the runner is caught in an infinity of half-ways and even though the end point seems to be approachable, it is supposedly not reachable. The potential infinity is then a process that is taken as a never-ending process over an unbounded timeline, but viewed within a specified time span, is finite. Absolute or completed infinity on the other hand is not a factor of a time process, but rather, it is an existential whole existing at any given time. The grasping of the difference between the potential and the actual has been problematic and intriguing even in the field of mathematics during the medieval and renaissance era. The potentiality characterised by the never-ending was readily accepted as opposed to the idea of the actual that seemed too abstract to be viewed as realisable. Let us consider the popular mathematical infinite sequence of polygons with n sides, obviously starting with n=3: triangle, square, pentagon, hexagon, and so on. As n tends to infinity the resulting figure that the sequence is potentially leading to is no visually perceivable polygon whatsoever: The visually perceived figure is that of a circle - without distinguishable sides. However, as n tends to infinity and the lengths of the sides decrease infinitely with the distance from the centre to the vertices remaining constant, say r, the resultant perimeter of the figure closes on to $2\pi r$, which is a resultant figure of a circle. The circle is then a regular polygon with an infinite number of sides denoted by n. The

idea of the actual infinity in mathematics is what makes propositions perceptible and imaginable. One must also refer to what mathematicians call the "worst evils" (Núñez, 2005), wherein absolute infinity assumes a very controversial role, say, in the case of equations. A constant a divided by 0 is equal to infinity: $\frac{a}{0} = \infty$. This of course is based on the idea that as the denominator in a fraction tends to an infinitesimally small quantity, the resultant fraction tends to an indefinitely large number. The problematic is that, the acceptance of the resultant of an equation where the denominator is zero to be infinity, automatically implies that the multiplication of infinity with zero results in a constant, say a. These absurdities resulted in many mathematicians rejecting the idea of absolute infinity. Notwithstanding the controversies and subsequent rejection of the idea by a certain segment of the mathematical fraternity, the mathematician Georg Cantor (1932), drawing upon the work of Bernard Bolzano (1851) and Richard Dedikind (1901), thematized the idea of absolute infinity in one of the path-breaking works in mathematics which saw the birth and development of transfinite numbers. As Núñez (2005) explains

> "[…] The 19th century was a very productive period in the history of mathematics, one that saw fundamental developments such as non-Euclidean geometries, and the so-called arithmetization of analysis. The latter, a program led by Karl Weierstrass, Richard Dedikind, and others intended to ban geometrical and dynamic intuitions (thought to be the source of paradoxes) by reducing the whole field of calculus developed in the 17th century by Newton and Leibniz, into realms of numbers. Counting and focussing on discrete entities, like numbers became essential. It is in this *zeitgeist* that Georg Cantor, originally interested in the study of trigonometric series and discontinuous functions, was brought into his development of transfinite numbers, dispelling the well-established views that abolish the use of actual infinities in mathematics. Today, Cantor is best known for the creation of a mathematical system where numbers of infinite magnitude define very precise hierarchies of infinities with a precise arithmetic, giving mathematical idea of some infinities being greater than others." (p. 1723)

CANTOR- INFINITY AND THE TRANSFINITES

Cantor's ideas and theories were always a subject of controversies, perhaps owing to the fact that his concepts and propositions challenged the established structures, while the unknown and unimaginable infinity was being given a structure. Interestingly, the mathematical theory of Cantor had its origin and basis in his deeply devout Lutheran beliefs. Bruce A. Hedman (2019) attributed his decision to study philosophy and mathematics to being ordained by God. In theorizing transfinities Cantor was of the firm belief that they had been revealed to him by God and was convinced of his function to spread the word of God's creation for the benefit of the church and the world. Apparently, his firm belief in following the revelation of God was what saw him through the phase of rejection by the established mathematical communities and structures of the times. Kronecker, Cantor's former professor in Berlin and an early proponent of constructionism, completely rejected Cantor's approach and, according to Hedman, regarded Cantor as a "corrupter of youth." With his suggestion of transfinites Cantor was offered no support from his colleagues in philosophy, who were either materialist,

determinist, or positivist. Cantor insisted that the universe was neither eternal nor unbounded and that this was amply emphasised by the transfinites. What exactly are the transfinites that Cantor put forth and that projected infinity as a realisable and completed entity? Until Cantor's theorization of numbers, infinity was in the numerical sense taken to be a number larger than all others, and since each number can be succeeded by another number, there could be no such entity as the largest number. Infinity continued to be associated with the very large as well as the very small. The well-established views promoted by the mathematicians of those times were not only against the concept of 'actual infinity,' but also opposed to the use of 'infinity' as an ordinary number that followed simple arithmetic rules. Cantor, while insisting on the existence of actual infinity as a mathematical being, supported his theory further by stating that an infinite set must be regarded in totality, that is, as an object which the human mind perceives as a whole. He justified his claims by emphasising that the denial of an actual infinite effectively denies the existence of irrationals in number theory. Strengthening his theory, he further elaborated the existence of many classes of infinity and not just one infinity. This then suggested that there were not only hierarchies of infinites, but also infinities that were greater than others. Cantor's theory is based on the simple 1:1 correspondence in set theory, exhaustively explaining that an infinite set, could be matched 1 to 1 with a subset of itself. As an example, the set of natural numbers being infinite can be matched 1:1 to the set of squares of each of the natural numbers, which is itself a subset of the set of natural numbers: If Set A is [1,2,3, 4….] and set B is [1,4,9,16….], there exists a 1:1 correspondence between the two infinite sets, despite set B being a subset of A. The insistence on the uncountable being countable was a direct challenge to extant theories which conformed to the idea that the whole is greater than its parts. Though the view was met with scepticism, Cantor in effect demystified the vagueness surrounding an infinite set by highlighting the most fundamental property of an infinite set, namely that it could be matched 1:1 to a proper subset of itself. This was possible because a set of elements could be arranged irrespective of the magnitude of the elements. With this rearrangement the 1:1 correspondence could be elucidated and an infinite set could be shown to correspond to a set of 'counting numbers' and hence to be denumerable. Another significant part of Cantor's thesis was that all infinite sets could not be denumerable, because there are sets that correspond to the real number line, and the points constituting the real number line are infinite and any segment of this infinite real line was also infinite and hence, denumerable. This form of infinity of the infinites was termed by Cantor as the infinity of the continuum.

Though Cantor was faced with significant opposition from his colleagues, philosophers and mathematicians, it is interesting, as Hedman (2019) points out, that Cantor first received support from Roman Catholic scholars. He explains that this support was conditional, however. Cantor's argument was supported by his reference to Augustin's *City of God* as quoted by Hedman: "All infinity is in some ineffable way made finite to God, for it is comprehended by his knowledge" (p. 170). Cantor's mathematical concept of a 'completed set' was a completed infinite *Ding für sich*. Cantor had advanced it with the set of natural numbers which he designated as a set in themselves and defined that set as the first transfinite number. Hedman (2019) clarifies that Cantor referred to Plato as providing an intellectual precedent for this step: "All things that are even said to be consist of a one and many, and have in their nature a conjunction of limit and

unlimitedness" (p. 170). Though critical of Cantor's belief in the actual infinity of the created order, the Roman catholic scholar Fr. Constantin Gutberlet was satisfied that Cantor's set of infinite magnitude was consistent with God's unique infinity. Though Cantor insisted that the universe was infinite neither in duration, nor in existence, he did conceptualise an infinite number of elementary particles - monads as Hedman explains, in order to justify that the transfinites existed in the physical universe. To promote acceptance of his theory, Cantor in a letter to Cardinal Johannes Franzelin (Gutberlet's teacher) clarified the distinction between absolute infinity and the *Transfinitum* (transfinites) by stating that the absolute was the "eternal and uncreated, reserved for God and his attributes, and the Transfinitum as created in the physical universe and in the mind of man." An endorsement from the cardinal, that suggested that there was "no danger to religious truth" in Cantor's concept of the *Transfinitum* facilitated acceptance of the mathematical theory from religious quarters. Cantor's theory not only revolutionized the field of science and mathematics, it also provides a new perspective to philosophers and theologists to address the idea and notion of infinity as an entity, viewed objectively but not in conflict with the divine.

As a thought corollary, one could ask, if Cantor's theory would have found immediate acceptance, if it had sought the endorsement of theologists with a Hindu or Indic worldview. The answer probably would be in the affirmative. From the Hindu point of view God is infinity and the creations of God derived from God are complete wholes and therefore infinities in themselves. This suggestion that the creations of God, despite being the subsets of God, are infinite themselves, does not take away the supremacy of God, but rather emphasises the hierarchy of the infinite and therefore infinity.

PINPOINTING INFINITY

Cognitively, theologically or perceptibly, the concept of 'infinity' is seen as one that cannot conform to a notion of bounded embodiment. Given that our experiences are bounded, and therefore finite, a notion of 'infinity' simply as a negation of the finite will be a reductionist view of trivialising 'infinity' to a symbol or a word describing the lemniscate. The Basic Metaphor of Infinity (BMI) as proposed by Lakoff and Núñez (2000), engages with 'infinity' as an entity to which a cognitive metaphor may be assigned. Núñez (2005), commenting on Cantor's transfinite cardinals, explains that the creativity displayed in Cantor's work by way of his counterintuitive and paradoxical results, go a long way towards understanding the ability of "human abstraction through conflicting conceptual structures." He opines that "contrary to many mathematicians' and philosophers of mathematics' beliefs, the nature of potential and actual infinity can be understood not in terms of transcendental (or Platonic) truths, or in terms of formal logic, but in terms of manipulation of meaningless symbols in human *ideas,* and *human cognitive mechanisms*" (Núñez, 2005, p. 1738). To be able to relate to the idea of 'infinity', as a conception of the human mind, Lakoff and Núñez (2000) suggest that one must delve into what linguists call the "*aspectual system*" - one in which the individual structures events as they are conceptualised. In the real world, processes that are called 'infinite' are those that continue endlessly without a limiting point, and this is what they call *"the literal concept of infinity."* The idea of an iterated action that may be characterised by the metaphor "Indefinite Continuous Processes" may then be attributed

to the idea of mathematical 'actual infinity' as a metaphor. The metaphor then addresses an unending process as a series of infinitely "iterating step-by-step processes," and these steps are countably finite but infinitely finite processes, therefore approaching the limitless infinity. The obvious take of the metaphorical reference is to the concept of infinity as reflected in Zeno's paradoxes. Lakoff and Núñez's BMI allows for a cognitive conceptualisation of 'potential infinity' and distinguishes it from the notion of 'actual infinity.' This lends the status of entity to 'infinity,' offering a possible cognitive explanation of the nature of 'infinity.' They argue that BMI in conjunction with other mechanisms of cognition offers the opportunity to appreciate transfinite cardinals and pinpoint infinity as an entity in order to see that "the portrait of infinity has a human face" (Lakoff and Núñez, 2000, p. 9).

CONCLUSION

Infinity, as a mathematical entity, assumes the conceptual precision that is universally characteristic of the language of mathematics. The technical usage of 'infinity,' though distinct from its comprehensibility as a concept, is deeply rooted in the cognitive association of 'infinity' as synonymous with God, the supreme divinity. The essay, has been an attempt to analyse 'infinity' qualitatively and quantitatively, in order to catch its secular reflection in a theological mirror. 'Infinity' resists ontological grasp, while on the one hand it finds easy acceptance as a metaphor, linguistic artefact, and as the 'word' that symbolizes the infinite divine; while on the other hand, as a technical mathematical artefact, it is used as a tool to scientifically conceptualize the abstract.

Joseph Bracken's suggestion of "generalized structures of intelligibility" (Bracken, 1995, p. 2) to address the metaphysical perception of infinity, can perhaps be seen as a harmonizing or balancing view of 'infinity.' He views 'infinity' not just as an entity, but as an activity. He reasons that an understanding of the infinite has to be both qualitative and quantitative. He is thoughtful when he suggests that all inter-religious dialogues refer to the relationship between the finite and the infinite in one way or another. He deliberates whether the infinite should be "[…] conceived in entitative terms as the sole enduring reality" - or "[…] regarded as a principle of existence and activity which is actual only in its instantiations or manifestations?" Bracken contemplates whether there is indeed a way to "understand in some measure the reality of the Infinite or is one necessarily reduced to silence before what transcends human imagination and/or conception?" (Bracken, 1995, p. 139-140). Perhaps, a reflective, albeit inexhaustive response to these questions could be Bracken's (1995) words:

> "[…] My own understanding of the Infinite as an all-encompassing 'matrix' or 'energy-field' for the divine persons and all their creatures is only one possible response to these questions. But, insofar as it offers at least a somewhat plausible explanation to these vexing philosophical questions, it may encourage others out of their own religious traditions to offer alternative solutions." (p. 140)

The essence of 'Infinity' in a verse:

> ॐ पूर्णमदः पूर्णमिदं पूर्णात्पूर्णमुदच्यते ।
>
> पूर्णस्य पूर्णमादाय पूर्णमेवावशिष्यते ॥
>
> ॐ शान्तिः शान्तिः शान्तिः ॥- (Sivananda, 2017, 1.3.28)

Om Purnam adah purnam idam purnat purnam udachyate|
Purnasya purnam aadaya purnam evavashishyate||
Om Shantih shantih shantih (Phonetical version of the Mantra in Sanskrit, by C.C)

The verse is Sanskrit, taken from the Yajurveda. It can be translated and is indeed translated in a multitude of ways depending on how one translates or interprets the word '*purnam.*' However, the essence of the meaning remains the same, since '*purnam*' means infinite, complete, eternal, unity, full, total. The verse means that the 'divine' is infinite, and what comes out of the infinite is infinite, and upon taking the infinite from the infinite, what is left is the infinite.

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Utopian Grammars of Human-Machine Interaction

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Abstract

In his essay in the inaugural issue of this journal, Alfred Nordmann suggests that we can speak of a language of mechanics and that machines – in which, according to Franz Reuleaux, movement is domesticated or civilized – can be conceived of as structures that enable the self-expression of things, or as elements of a grammar of things. He points out that the journal is dedicated to exploring interactions between the sphere of ideas (of which language is often seen as being part) and the sphere of technical practice, and to reflecting fundamentally on 'technology as language' and on 'language as technology'. In our article, we thus explore attempts to develop new grammars of human-machine interaction such as those created in literature as well as in engineering and labour studies in the early Soviet Union. We specifically discuss Alexei Gastev's thinking on labour, technology and poetry. We are interested in the utopian aspects of his grammar of things and bodies, and in the role of the body between technology and language. Given that the two are perhaps the two most common answers to the question of what makes us human and distinguishes us within or from the animal kingdom, experiments with the triangle of technology, language and human corporeality, such as those conducted by Gastev, deserve attention beyond the historical context.

Keywords: Alexei Gastev; Engineering and labour studies; Poetry; Human-machine interaction; Utopianism; Biomechanics; Avant-garde

Аннотация

В своем эссе в первом номере этого журнала Альфред Нордманн высказывает мысль, что мы можем говорить о языке механики и что машины, (в которых, согласно Францу Рёло, движение приручено или цивилизованно) могут быть поняты как структуры, делающие возможным самовыражение вещей, или как элементы грамматики вещей. Он подчеркивает, что журнал посвящен исследованию взаимодействия сферы идей (к которой зачастую относят язык) со сферой технической практики и фундаментальному переосмыслению "технологии как языка" и "языка как технологии". В соответствии с этой задачей, в статье исследуются попытки разработки новых грамматик взаимодействия человека и машины в литературе и в исследованиях труда и инженерии в ранние годы советского периода. В частности, мы обсуждаем идеи Алексея Гастева о труде, технологии и поэзии. Нас интересуют утопические аспекты его грамматики вещей и тел, а также роль, которую тело играет между технологией и языком. Технология и язык – пожалуй, наиболее частые ответы на вопрос о том, что делает нас людьми и отличает нас в животном царстве или от него, поэтому эксперименты в триаде технологий, языка и человеческой телесности, – такие как работы А.Гастева, – представляют собой не только исторический интерес.

Utopian Grammars of Human-Machine Interaction

INTRODUCTION

In his essay in the inaugural issue of this journal, Alfred Nordmann writes that in the tradition of Western philosophy language belongs to the sphere of ideas, to the head and the mind, and not to the hand and the manipulation of matter, the sphere of technical practice. "This is what we tend to say: It is one thing to talk and think, to learn and write, to express ideas – and quite another thing to build and make, to construct and design, to create material devices" (Nordmann, 2020, p. 86). This journal *Technology and Language*, Nordmann continues, would however defy the tradition by exploring interactions between both spheres in a wide variety of fields and by providing space for fundamental reflection on "technology as language" and on "language as technology". He also suggests that we can speak of a language of mechanics and that machines – in which, according to Franz Reuleaux, movement is domesticated or civilized – can be conceived of as structures that enable the self-expression of things, or as elements of a grammar of things.

In our article, we aim to explore significant interactions across both spheres by looking at the attempts to develop new grammars of human-machine interaction that were undertaken in poetry and in engineering and labour studies in the early Soviet Union. We specifically discuss Alexei Gastev's thinking on labour, technology and poetry, and we are interested in the utopian aspects of a grammar of things and bodies, and in the role of the body in this grammar. Given that technology and language are perhaps the two most common answers to the question of what makes us human and distinguishes us within or from the animal kingdom, experiments with the triangle of technology, language and human corporeality, such as those conducted by Gastev, deserve attention beyond the historical context.

THE NEED FOR A NEW WORLD

In World War I, the bankruptcy of traditional culture under capitalist and imperialist conditions had become shockingly evident. The old world having been utterly destroyed, not only human bodies in their fragility – and the (now often mutilated) male human body in particular – but also traditional culture, and thus language, had become suspect or dubious. Obviously, a new world was needed, and both human bodies and words were increasingly seen as being deficient in comparison to modern technology. People were widely seen as having a moral duty to create communism or overcome capitalism in some other way, those movements fighting for this cause being lent moral legitimacy by the disaster of the Great War. For many, as well as for some who abhorred modern warfare, machines now had to be seen, for good or bad, as the measure of men. This overlapped with visions of a new relationship between humanity and nature instigated by modern science and technology that reveled in metaphors of a merger or union of humans with machines.

In the second half of the 1920s, Walter Benjamin argued that humans "can be in ecstatic contact with the cosmos only communally" and that it is "the dangerous error of modern men to regard this experience as unimportant and avoidable" (Benjamin,

1928/1978, p. 93). It is not, he wrote, and its hour strikes again and again, as was "made terribly clear by the last war", which he characterized as "an attempt at a new and unprecedented commingling with the cosmic powers" (Benjamin, 1928/1978, p. 93). Benjamin continued: "Human multitudes, gases, electrical forces were hurled into the open country, high frequency currents coursed through the landscape new constellations rose in the sky, aerial space and ocean depths thundered with propellers, and everywhere sacrificial shafts were dug in Mother Earth. This immense wooing of the cosmos was enacted for the first time on a planetary scale, that is, in the spirit of technology. But because the lust for profit of the ruling class sought satisfaction through it, technology betrayed man and turned the bridal bed into a blood bath" (Benjamin, 1928/1978, p. 93).

The notion that the mastery of nature is the purpose of all technology is criticized by Benjamin as imperialist ideology. He asks: "who would trust a cane wielder who proclaimed the mastery of children by adults to be the purpose of education? Is not education above all the indispensable ordering of the relationship between generations and therefore mastery, if we are to use this term, of that relationship and not of children?". And he argues that "likewise technology is not the mastery of nature but of the relation between nature and man" (Benjamin, 1928/1978, p. 93). In Benjamin's view, humankind as a species is just beginning its evolution and modern technology is playing a key role in it: "In technology a *physis* is being organized through which mankind's contact with the cosmos takes a new and different form from that which it had in nations and families" (Benjamin, 1928/1978, p. 93; *italics in the original*). Humanity is developing a kind of new, collective body for interacting with the cosmos.

Figure 1. Konstantin Yuon, 'People' (1923)

For Benjamin, the "revolts" after World War I, as he called them, were "the first attempt of mankind to bring the new body under its control" (Benjamin, 1928/1978, p. 94). He emphasized that "the power of the proletariat is the measure of its convalescence", adding: "If it is not gripped to the very marrow by the discipline of this power, no pacifist polemics will save it. Living substance conquers the frenzy of destruction only in the ecstasy of procreation" (Benjamin, 1928/1978, p. 94).

Alexei Gastev's literary and scientific projects were remarkable elements of most important such attempt undertaken in those years: the Russian Revolution and the early phase of the Soviet Union. His projects took place at the intersections of language, modern technology and the human body, aiming to create a new, all-encompassing discipline. Gastev was one of the few prominent Bolsheviks to have experience in the high-tech jobs and professions of his time, having been employed (in France and Russia) for example as a factory worker and as a tram driver. One remarkable aspect of his political activism was his often considerable sympathy for anarcho-syndicalist approaches. Highly unusually, he was also a famous poet who became the key figure in Soviet Taylorism – as head of the Central Institute of Labour in Moscow, which he founded with the support of Vladimir Lenin and Leon Trotsky in 1921.

In *On the Tendencies of Proletarian Culture* (1919), also known as 'Gastev's manifesto', he argued that the new proletariat, with its unprecedented psychology, would eventually also have to develop a new artistic style (for the following, see Gastev, 1919, p. 45). Specifically, new artists of the word would no longer have to solve the problem the futurists had set themselves – namely word-creation ('slovotvorcestvo') – but a much higher one: the proletariat would thus not reform the word itself grammatically; rather it would venture, so to speak, into the technicization of the word ('texnizacija slova'). Already, the word taken in its everyday expression is no longer sufficient for the productive goals of the proletariat; and it is highly questionable, Gastev emphasizes, that it will suffice for such subtle and new creativity as in proletarian art. He wrote: "We do not prejudge the form of the technicalization of the word, but it is clear that sound will not only be amplified but gradually separate itself from its living carrier – the human being. Here we are very close to a truly new kind of combined art, where purely human manifestations (…) will recede into the background" and we are heading "for an unprecedentedly objective manifestation of things (…) that knows nothing of the intimate or lyrical" (Gastev, 1919, p. 45).

We have translated носителя as 'carrier' rather than as 'host' or 'medium' because we had in mind such definitions of the 'word' as being the smallest independent, acoustically and orthographically isolable 'carrier of meaning' in a sentence and because we wanted to avoid both biological connotations and misunderstandings concerning the term 'medium'. Human beings are the native speakers of (any) language, one could say, but now, with the technicization of the word, there will be other speakers or, perhaps more precisely, one new speaker: a new entity that will be at once technicized humanity and humanized technology.

What we do *not* want to allude to here with the notion of 'carrier', however, is the image of the human body being the carrier of the mind, for example in the sense of a substrate that embodies individual information patterns, as in one favourite idea of current transhumanism. It appears to us that, at least when it comes to understanding Gastev's utopian grammar of human-machine interaction, it is more appropriate to start with a

conception of language that understands it as originally material and in essence practical: as the element of thought itself – the element of thought's living expression – that has a sensuous nature (as Karl Marx described in the *Paris Manuscripts* as being a key aspect of the 'natural science of man'), or as in the following quote from the (formerly) canonical version of *The German Ideology*: "From the start the 'spirit' is afflicted with the curse of being 'burdened' with matter, which here makes its appearance in the form of agitated layers of air, sounds, in short, of language. Language is as old as consciousness, language is practical consciousness that exists also for other men, and for that reason alone it really exists for me personally as well; language, like consciousness, only arises from the need, the necessity, of intercourse with other men. Where there exists a relationship, it exists for me (…)" (Marx & Engels, 1845, Ch. 1, 'Feuerbach').

Figure 2. Alexei Gastev (book illustration by Zinovii Tolkachev, published 1923)

If we conceive of technology – like Benjamin did – as a kind of mastery of the relationship between nature and humankind, and of language – like the young Marx did – as being the practical, material means by which human beings relate to each other, any technicization of the word must have a direct impact on social relations; which in our context would then need to be understood by means of a new 'natural science of man' that included humanity's technical artefacts, and at the same time as an artistic engineering project.

Gastev's last literary work, the cycle of poems *Pachka orderov* (*A Packet of Orders*), published in 1921, may be regarded as an attempt to create the new proletarian artistic style that he foresaw as being necessary: "[w]ords and ideas would come to have precise, technical meanings devoid of nuance and emotional connotations, so that they could be plugged in and unplugged as needed" (Johansson, 1980, p. 70). Poetry would become an "action", a "performance of a man-machine" (Vaingurt, 2008, p. 229), language a technology.

LANGUAGE AS TECHNOLOGY

The move from his earlier poetry, such as in *Poetry of the Worker's Blow* (1918) that made Gastev famous as a poet, to *A Packet of Orders* can be deemed a radicalization of his creative destruction of language. The former, despite being – according to one of his contemporaries – "unprecedented" in its "pathos of industrialism" (Pertsov, 1927) and despite its innovative combining of poetry and prose, was quite straightforward at the level of denotation. The semiotic space is comprised of readily comprehensible elements: bodies, machines, objects and actions (of which death is the ultimate yet mundane act) moving from the historical "before" into the "after" that is under construction. The viewpoints were clearly stated: the worker poet himself, a female worker, the collective subject ("We"), and finally, the super-subject of a generalized Worker, for which "I" was used merely as a metonymy. The catastrophic optimism of "Poetry of the Worker's Blow" was in line with what Gastev considered to be crucial to the worldview of the proletariat. "The new industrial proletariat," he wrote in 1919, "its psychology, its culture, are above all characterized by industry itself (…). The entire life of modern industry is imbued with movement, catastrophe, at the same time framed by organization and strict regularity. Catastrophe and dynamics, constrained by a grandiose rhythm, are the basic, illuminating moments of proletarian psychology" (Gastev, 1919, p. 44). The *Poetry of the Worker's Blow* was published in several editions over the next few years and, performed on stage, served as the source for the syncretic art of Proletcult.

In *A Packet of Orders*, Gastev focused on the second principle he ascribed to the proletarian worldview: organization. The work is composed almost exclusively of nominal sentences and imperatives, its temporality being reduced to a short circuit. The 'orders' aimed to restructure reality, mobilizing its different layers: the mechanical, chemical, physiological, demographic, urban and industrial processes were activated, split into procedures, regulated ('normalized') and arranged into comprehensive machinery. Its new morphology was described in terms such as "brain-machines", "cine-eyes", "electro-nerves", and "artery-pumps".

For Gastev, 'normalization' (development and application of norms and standards) was a defining characteristic not only of the labour regime of the working class, having its fullest expression in Taylorism, but of its whole existence, including "aesthetical, intellectual and sexual demands" (Gastev, 1919, p. 43). In particular, normalization of language, its objectivization or objectification, of which *A Packet of Orders* itself was a pilot experiment, would pave the way for the internationalization of language – the prospects of which were widely debated at that time in view of a coming world revolution: Gastev wrote: "The mechanization not only of gestures, not only of labor-production methods, but the mechanization of everyday thinking, combined with extreme

objectivism, strikingly normalizes the psychology of the proletariat. Even though there is no international language yet, there are international gestures, there are international psychological formulas possessed by millions. It is precisely this trait that gives proletarian psychology its striking anonymity, allowing it to qualify the individual proletarian unit as A, B, C or as 325,075 and 0, etc. … as if there were no longer a million heads, there is one world head. In the future, this tendency will imperceptibly create the impossibility of individual thinking, translating into an objective psychology of an entire class (…)" (Gastev, 1919, p. 44).

As often discussed, these contours of the future have been mirrored in a diametrically opposed manner of interpretation in the visions of Yevgenj Zamyatin (*We*, 1924) and of subsequent authors of dystopias. However, disagreements within Proletcult also deserve attention in this context. Probablythe most serious accusation in Marxist circles – that of abstract thinking – was immediately made by Alexander Bogdanov (1919). Gastev (1919) had characterized Bogdanov's preoccupation with continuities in the social system as "Eastern conservatism" (p. 35). According to Bogdanov, Gastev misinterpreted the mobilization and centralization of modern industry (including of the non-proletarian unskilled workforce) that took place during the First World War, falsely regarding it as progressive. The organization of the working class itself and the world around it should not be reduced to the principle of subordination, however. From this perspective, Gastev's idea of total normalization appears to be a fetishization of machinery and the result of a thirst for authority. In Bogdanov's view moreover, Gastev appeared on a theoretical level to be unable to distinguish between norming ('normalization'), regulation and organization, the latter not being able to be subjected to mechanization because organizational creativity requires the individual skills along with collectively accumulated experience, linking a human organizer to the inherited culture. Likewise, proletarian art, including "poetic consciousness", will not be created from scratch, according to Bogdanov, but will sublate the legacy of "the feudal and bourgeois worlds" (Bogdanov, 1923). Similarly, Bogdanov was sceptical about the possibility of an invented international language. He argued that internationalization of language is an objective historical process, most obvious in technological terminology (which Gastev in fact used extensively in *A Packet of Orders*), the historical task of the proletariat being "to establish objectively which language is historically destined for this role, and to help it to play" this role (Bogdanov, 1925, p. 331). Bogdanov believed that optimizing English orthography could be a useful step in this direction.

Apart from the 'normalization' and 'objectification' of language as suggested by Gastev, and Bogdanov's idea of English being promoted and adjusted as a transitional stage, the Futurist project of a global linguistic revolution deserves attention in our context: 'Zaum'. Just a few years before the October revolution, expressiveness of exclamation, immediacy of "proto-sounds", dismembered morphology and arbitrary semantics were prescribed by them as elements of a language of "high-speed modernity" (Kruchenykh & Khlebnikov, 1913). At the same time, the phonetic experiments, such as the completely undecipherable "Dyr bul shchyl" by Alexei Kruchenykh, which is reminiscent of a spell or incantation, linked modernity to the archaic syncretism of folklore. In 1921, Kruchenykh wrote that 'Zaum', although national in origin and initial character, might give birth to a global poetic language – evolving organically, "unlike Esperanto". Word as an action, gaining a universal character – that was the common

ground for Gastev's alliance with futurists, especially with Velimir Khlebnikov, whom he described as a genius who found ways leading to the "engineering of a word" and the "mathematizing of an image" (Gastev, 1926).

A particularly marked common feature of Gastev's and Futurist poetry is the disappearance of a subjective perspective. The collective actor – who was "growing out of iron" in Gastev's earlier works that were cited by Bogdanov as an example of the emerging proletarian "poetic consciousness" – was later anonymized in *A Packet of Orders* and became the self-addressing subject and the object of ordering at the same time. The Futurist fascinations with new ontology, especially with the recently discovered spacetime, and with pre-modern animist and magical thinking, also helped to blur the subject-object opposition. Accordingly, the 'concept vs. perception' and 'theory vs. practice' dichotomies were to be overcome by artistic action (Vygovskii, 2019) and the borders between art and reality removed: "when a society overcomes the social antagonism (…), the profession of an artist starts disappearing gradually, giving space to an engineer – be it an engineer in production or an engineer of social interactions" (Zhilyaev, 2015, p. 26). Gastev's poems were quoted and literally enacted in Arseny Avraamov's *Symphony of Factory Whistles*, performed by an orchestra with industrial, transport and military sirens, horns, cannons and guns. And Gastev himself turned his attention to creating the Central Institute of Labour, which he called his major work of art, as well as to organizing the League of Time and to participating in the Committee on Standardization. In Gastev's version of "scientific organization of labour", the self-observation of the man-machine interaction – the second-order observation (Velminskii, 2010) – implies the need to incorporate the outer perspective, that which is exterior to both the machine and the action (Saimiddinov, 2019).

Writing about *A Packet of Orders,* Julia Vaingurt explains that the "mechanistic rhythm of the poems, their technical and austere language, and their form of industrial and military orders are all consistent with Gastev's experimental usage of words as a technical medium for creating a new world", adding that "the result of his experiments approaches the Futurists' idea of the universal language closer than their own creations ever did" (Vaingurt, 2008, p. 229). She argues that in Zamyatin's bleak but humorous parody of Gastev and Proletcult in *We*, the bodily aspect of hand-writing, in connection with sexual desires, is – exemplified by "D", the main protagonist, an engineer increasingly sceptical of the regime – the key to understanding the instability and fragility of the OneState's (un)emotional regime: "Zamyatin has his OneState commit a crucial mistake: in directing that propaganda be composed, it does not disseminate the proper instruments for doing so. In so essential a realm as writing, the life of OneState citizens is unmediated by advanced technology. It is not surprising, then, that the act of writing brings D closer to his body – with all its wants, pains, and disrepairs – and hence closer to his self. The human body is an imperfect machine, and hand-writing its blemished product and reflection: as if in a mirror, D sees himself in his writing, noticing all his shortcomings. D has been trained to see his body as a well-functioning machine, but in his diary-keeping he constantly stumbles upon signs of illness and infection" (Vaingurt, 2013, pp. 93-94).

Language is unruly, especially when it is a non-mechanized bodily activity. Intimate feelings, such as passionate love, are alien to the OneState, and when they intrude into it, "they wreak havoc on its icy harmony" (Vaingurt, 2008, p. 215).

TECHNOLOGY AS LANGUAGE

However, Gastev's ideal world is not without passion, as Vaingurt also rightly points out. In several of his writings, he emphatically announced that everyone will be part of a harmonious collective, and, as Vaingurt writes: "Gastev's language here plays the role of the stimulant; it invokes desire for an absent, future man, for an abstraction. A live body has been substituted by a sign, a symbol of a unified being. And technology plays a fundamental role in the achievement of this transformation. Gastev exclaims, 'This beautiful, this marvelous thing can be created by the modern force of machinism!' Machinism here means the modeling of man upon the machine (…)" (Vaingurt, 2008, pp. 215-216). In many respects such emphatic declamations are reminiscent not only of the Cosmist tradition, which Vaingurt and others have discussed as an important context framing Gastev's thought, but also of Western proto- or early transhumanism (Coenen 2014a, 2014b, 2019), such as Winwood Reade's (1872) early visions of a future god-like (post)humanity and Desmond Bernal's (1929) scenario of a total technicization of humanity and, ultimately, of all life in a (post)human conquest of the entire universe.

For Gastev, the body lies, according to Vaingurt's analysis, somewhere on the border between the natural and the cultural; he deems it an embryonic machine. In order to improve the body according to the model of the machine, language needs to be as strictly and cautiously regulated as all other bodily activity: "Gastev does not tire of repeating the necessity of limiting the waste of time and energy on empty talk – 'The most complex thought can be laid out in five minutes' – and so just as he wishes to restrict and regulate the flow of food and air through the body, so too does he wish to restrict the free flow of language" (Vaingurt, 2008, pp. 223-224). Gastev wants to turn poetry into an instrument of 'sharp verbal impact', as he calls it.

Everything in *A Packet of Orders*, including the preface, is designed as and for a technicization of language; words emphatically appear as nothing but technical artefacts or means, and the old language in its diversity, complicatedness and verbosity needs to be replaced with radically novel techno-human communication (Johansson, 1983, pp. 154-155):

> Ордер 05
> Панихида на кладбище планет.
> Рев в катакомбах миров.
> Миллионы, в люки будущего.
> Миллиарды, крепче орудия.
> Каторга ума.
> Кандалы сердца.
> Инженерьте обывателей.
> Загнать им геометрию в шею.
> Логарифмы им в жесты.
> Опакостить их романтику.
> Тонны негодования.
> Нормализация слова от полюса к полюсу.
> Фразы по десятеричной системе.
> Котельное предприятие речей.
> Уничтожить словесность.

Огортанить туннели.
Заставить говорить их.
Небо – красное для возбуждения.
Шестерни – сверхскорость.
Мозгомашины – погрузка.
Киноглаза – установка.
Электронервы – работа.
Артерионасосы, качайте.

Order 05
Requiem at the graveyards of the planets.
Roar in the catacombs of the worlds.
Millions, into the hatches of future.
Billions, hold the guns tight.
Drudgery of mind.
Shackles of heart.
Engineer the everymen.
Beat geometry into their necks.
Logarithms into their gestures.
Profane their romance.
Tons of indignation.
Pole-to-pole word normalization.
Phrases in the decimal system.
Boiler-house of speeches.
To destroy literature.
To larynx the tunnels.
To make them speak.
The sky is red for excitement.
The gears – superspeed.
Brain-machines – loading.
Cine-eyes – installation.
Electro-nerves – work.
Artery-pumps, start. (Gastev, 1921/2010, translation by authors)

Gastev's biomechanics, which he developed with his team at the Central Institute of Labour, are also characterized by Vaingurt as being a relatively successful attempt to help create a universal language – relatively successful as compared to the Futurists. The tasks of poetry and of practical labour studies are two sides of the same coin: "In essence the former task is part of the latter one, since language is a form of bodily technology and is subject to the mechanics of the organism as a whole. If the body works like a machine, the language that it produces to communicate its needs also responds to the machine-like rhythm" (Vaingurt, 2008, p. 225). The leading Futurist Sergei Tret'iakov (1923/2011) wrote in 1923 that from the cultural point of view the Soviet New Economic Policy was "the smelting of the primordial pathos of the first years of the revolution into a trained practical effort that will succeed not by dint of emotions and flights of the imagination, but because of organization and self-control" (p. 344). This anti-utopian wording is similar to some of Gastev's writing from the same time (Sochor, 1988). Tret'iakov

(1923/2011) added that "if the maximal program of the futurists is the integration of art and life, the conscious reorganization of language according to the new forms of life, and the struggle for the emotional training of the producer-consumer's psyche, then the minimal program of futurist-speech-producers is to place their linguistic mastery at the service of the practical tasks of the day" (p. 344). Here again the programmatic difference to Gastev appears to be small. So how can biomechanical practices be deemed a universal language?
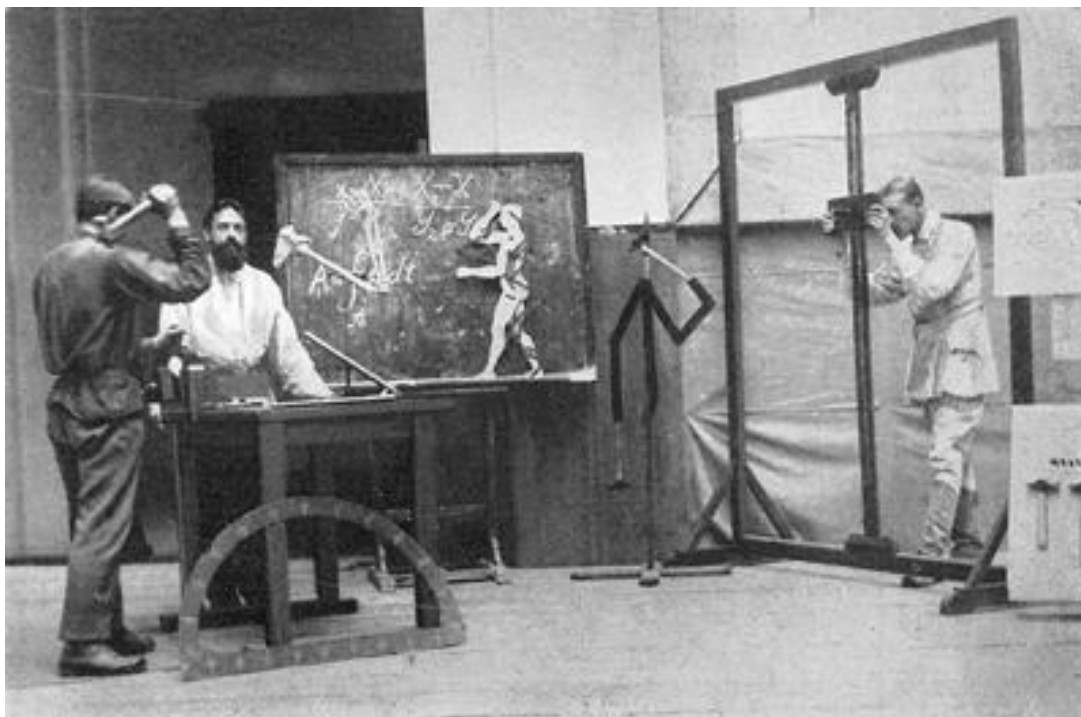

Figure 3. Central Institute of Labour (CIT) laboratory, 1923 <in: R. Fülöp-Miller (1926). *Geist und Gesicht des Bolschewismus*. Amalthea>

In his manifesto of 1919, Gastev had expressed the expectation that in 'mechanized collectivism' the movements in human-machine interactions will increasingly resemble the movements of things without any traces of human peculiarities. The "iron mechanics" of the collective and the increasingly 'engineerist' mindset of the masses will thus transform the proletariat into an unprecedented social automaton. If Gastev was much concerned at the same time "for the fate of the individual worker" (see also Ings, 2018) and had "his own clear-cut individuality", how could he think that this was a desirable future, asks Johansson (1983) and writes: "Gastev's experiences during the war and revolution and the precarious situation of industry seem to have convinced him that the best solution for the future was a rational, productive world that functioned like an efficient machine. In that world the workers' collective must be brought into harmony with technology and thus be mechanized" (pp. 68-69). The movements in increasingly highly complex human-machine interaction that is modelled after machines will function like a globally synchronized universal language, supported by a technologized version of human natural language. The proletarians are the machines' breathing, their impulse, as Gastev put it in *The Factory Whistles* (1913). If history is inscribed in the body, Gastev's

project can be seen as a radical attempt to obliterate the history of oppression by deleting the inscription, to create, so to speak, a new body language from scratch.

Despite all its glorifying of the mechanization of humanity, his project was arguably more humanistic than digital capitalism today, or at least than that practiced by such companies as *Amazon* (Coenen, 2019). Moreover, it was obviously highly relevant to Soviet Taylorism and had significant real-world impact, in particular on work organization and art (Bailes, 1977; Stites, 1989; Vaingurt, 2013). Nevertheless, it may also have been utopian in the everyday understanding of the term (which corresponds with its etymology): Gastev's vision may simply have been unrealistic. Nikolai Bernstein, who joined him at the Central Institute of Labour in 1922 and worked with him for three years, appears to have realized there that human bodily movements are never so uniform as to be fully mechanizable (Ings, 2018). Like human language, human bodies may also be too unruly to be suitable for a full-fledged merger of humanity with technology.

CONCLUDING REMARKS

If the unruly nature of both human bodies and language means that Gastev's hope to fully technicize human language and corporeality was in fact vain, one might argue that the critique is valid that his (and similar early Soviet) techno-utopian thinking amounted to magical thinking and to a large-scale but futile attempt to re-enchant the world through technology. In any case, however, some of his ideas appear more relevant today than they were during his lifetime. When he predicts, for example, that machines will direct or manage humans, this is a much more reasonable idea now, in our age of so-called 'intelligent' machines, than it was in the 1920s. Moreover, his notion of the human body being the best machine and his emphasis on further qualifying it supported tangible practical improvements.

Going back to our introductory remarks concerning Benjamin and Marx, we can conclude that Gastev's project was clearly a conceptual and practical attempt to improve mastery over the relationship between humanity and nature, including human nature and society. If, in Nordmann's (2020) words,"[t]echnology is our way of relating to things" and "how we organize or pattern the material world" and thus "akin to language, because language is our way of relating to people" and "how we organize or pattern social interactions" (p. 87), then the new human-machine collective that Gastev imagined and tried to experiment with, makes uses of this similarity and aims to dissolve remaining differences. Humans may become conceived of as things but this may also be seen as a necessary consequence of the further technicization of our societies.

When it comes to the visions of overcoming the boundaries between art and engineering, one is reminded of Bernal (1929): "The art of the future will, because of the very opportunities and materials it will have at its command, need an infinitely stronger formative impulse than it does now. The cardinal tendency of progress is the replacement of an indifferent chance environment by a deliberately created one. As time goes on, the acceptance, the appreciation, even the understanding of nature, will be less and less needed. In its place will come the need to determine the desirable form of the humanly-controlled universe which is nothing more nor less than art" (pp. 78-79). Paraphrasing Nordmann (2020), one could say then that there will be a grammar of human-machine interaction for socio-mechanical artist engineers; and "our symbolically and

technologically constituted info-techno-sphere" (p. 90) may in the future indeed be best conceived of as Benjamin's new *physis* for humanity, from which will follow, perhaps similarly as in Ernst Bloch's 'Allianztechnik' (Nordmann, 2007), new relationships with non-human nature and, perhaps even more so, within increasingly technicized human societies.

If the human body is seen as a machine and thus as technology, and language can be understood as technology (and vice versa), a universal language of human-machine interaction may not remain a utopian project forever. Of course, the question of how such language-technology will be designed remains unanswered, as does the question of what future mastery over the relationship between humanity and non-human nature, and between human beings in highly technologized societies, will look like.

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A Word at the Limit

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Abstract

The article discusses the reasons for the pronounced interest of cubo-futurists in the possibilities of the poetic word and the nature of their experiments with linguistic material. The author proceeds from the fact that for the artists of the early Russian avant-garde, the laws of language and the system of cultural conventions are an artificially created barrier that protects the sphere of human existence from the surplus of naturally emanating energy. This protects society from shocks, but at the same time deprives it of the opportunity to develop. All the poets of the "Gilea" group saw as their most important task the elimination of this gap between objective reality and the sphere of semiosis, but the most convincing solutions were offered by Vladimir Mayakovsky, Velimir Khlebnikov and Alexei Kruchenykh. The purpose of this article is to characterize the strategies developed by these artists for overcoming the linguistic dogma of the previous culture and to determine the range of possibilities for the future. A structural-semiotic approach to the analysis of avant-garde texts was used. In this way it can be shown that the poetic work with words and the variants proposed by the three authors proceeded in different directions and was in many respects mutually exclusive. While the poetics of Mayakovsky assumed the convergence of words and things, Khlebnikov's experiments were carried out to balance both, and Kruchenykh's zaum creativity took the word out of any control, except for the author's will. Even if different poets used the same words to denote the genres and types of creativity they discovered, they were talking about dissimilar phenomena. This is demonstrated by comparing the zaum of Khlebnikov with the zaum of Kruchenykh. Each of the creative projects proposed by the three poets was an experiment to identify certain limiting possibilities of the word, therefore, in the work of all three poets it did not lose its meaning.

Keywords: Cubo-futurism; "Gilea"; Semiosis; Universe; Creative strategy; Zaum; Suprematism

Слово на пределе возможностей

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Аннотация

В статье рассматриваются причины подчеркнутого интереса кубофутуристов к возможностям поэтического слова и характеру их экспериментов с языковым материалом. Автор исходит из того, что для художников раннего русского авангарда законы языка и система культурных конвенций – это искусственно созданный барьер, который ограждает сферу человеческого существования от притока разлитых в природе энергий и тем самым защищает общество от потрясений, но одновременно лишает его возможности развиваться. В устранении этого разрыва между предметной реальностью и сферой семиозиса видели свою важнейшую задачу все поэты группы "Гилея", но наиболее убедительные её решения предложили Владимир Маяковский, Велимир Хлебников и Алексей Кручёных. Цель данной статьи – охарактеризовать выработанные художниками стратегии преодоления языкового диктата прежней культуры и определить сам диапазон футуристических поисков в этом направлении. Использовался структурно-семиотический подход к анализу авангардистских текстов. Его применение позволило убедиться, что предложенные названными авторами варианты поэтической работы со словом велись в разных направлениях и во многом были взаимоисключающими. Так, поэтика Маяковского предполагала сближение слова и вещи, эксперименты Хлебникова велись, чтобы уравновесить то и другое, а заумное творчество Кручёных выводило слово из-под любого контроля, кроме авторской воли. Даже если разные поэты пользовались одними словами для обозначения открытых ими жанров и типов творчества, речь велась о непохожих явлениях. Автор статьи доказывает это, сравнивая заумь Хлебникова с заумью Кручёных. Каждый из предложенных тремя поэтами творческих проектов был экспериментом по выявлению неких предельных возможностей слова, поэтому при любых результатах не утратил своего значения.

Ключевые слова: Кубофутуризм; "Гилея"; Семиозис; Универсум; Творческая стратегия; Заумь; Супрематизм

Слово на пределе возможностей

ВВЕДЕНИЕ

Исследователи литературы не раз замечали, что ни одно из художественных направлений не изучало возможности слова так упорно и последовательно, как это стали делать первопроходцы отечественного авангарда, кубофутуристы. Они превратили язык в "реального протагониста поэзии" (Марков, 2000, с. 383), сделали его главным героем своих произведений, но одновременно – и главным испытуемым (чтобы не сказать "истязаемым"!) при проведении любых художественных экспериментов.

ПОСТАНОВКА ПРОБЛЕМЫ И ЦЕЛИ ИССЛЕДОВАНИЯ

Для художников раннего русского авангарда законы языка и система культурных конвенций – искусственно созданный барьер, разгораживающий мир на "природу" и "цивилизацию". Он ограждает сферу человеческого существования от притока разлитых в природе энергий и тем самым защищает общество от потрясений, но одновременно – от возможности развиваться, а это ведёт к постоянному оскудению жизни. Поэтому свою главную задачу кубофутуристы, видели в преодолении дистанции между "первой" и "второй" реальностью – миром осязаемых вещей и областью семиозиса. Предполагалось, что, заново воссоединив их, удастся вернуть жизни утраченное единство, а человеку – доступ ко всем проявлениям бытия.

При этом выработка коллективной художественной стратегии и теоретическое осмысление уже достигнутого в "Гилее" откладывались на будущее, и так и не были осуществлены. В результате творческий облик группы определялся поэтами, нашедшими свой собственный путь решения основной задачи – устранения разрыва между материальным и семиотическим универсумом. Как мы полагаем, именно это выдвинуло на первые роли Велимира Хлебникова, Владимира Маяковского, а позже – и Алексея Кручёных, – каждого с собственной творческой стратегией, особым пониманием природы слова и логики его художественных трансформаций. Сразу отметим принципиальную разнонаправленность этих версий работы со словом, не только противоречащих друг другу, но во многом взаимоисключающих. Задача данной статьи – определить и продемонстрировать их специфику.

СЛОВО В ХУДОЖЕСТВЕННОЙ СИСТЕМЕ ВЕЛИМИРА ХЛЕБНИКОВА

Для Хлебникова семиотическая реальность значительнее и могущественнее, чем предметно-материальная:

Я не знаю, Земля кружится или нет,

Это зависит, уложится ли в строчку слово. (Хлебников, 1986, с. 61)

При таком понимании участь мира зависит от судьбы языка, и, значит, работа с языком должна стать средоточием поэтических усилий. Большинство хлебниковских нарративов – истории роковых недоразумений, возникших из-за отсутствия у людей возможности однозначного понимания сказанного. Так, в "Маркизе Дэзес" живое и мёртвое меняются местами из-за того, что человек забыл о своём долге обеспечивать разумный баланс между естественным и искусственным, природой и людьми. Главному герою напоминал об этой обязанности "голос с небес", но приказ "смерить!" был понят как приговор – "смерть!" В результате возможность спасти мир была упущена.

В понимании Хлебникова "смерить" – значит добиться разумной соразмерности явлений, соблюсти баланс сил природы и цивилизации и тем самым перевести мир с пути природно-катастрофического развития в колею осмысленно-управляемого существования. Добиться искомого равновесия разных сторон бытия способен помочь язык, но для этого сам он должен быть сбалансирован и отлажен. Между тем, современные люди имеют дело с омертвевшим языком – словами, утратившими смысл. По убеждению Хлебникова, язык не был "нем" изначально: "онемение" – результат его "старения", своего рода склеротический процесс, в результате которого, прежде всего, утратилась внутренняя форма слова, оправдывавшая связь предмета и знака, а затем, как следствие, демотивировались связи между словами (приключилась "закупорка вен языка"), то есть в целом язык потерял прежнее богатство семантических возможностей, творческую продуктивность. Произошла деградация языка, и в намерениях Хлебникова – что-то вроде операции по его омоложению (Казарина, 2005, с. 171-172). Способы "оживления" языка для Хлебникова связаны с прояснением семантики слова: "Новое слово не только должно быть названо, но и быть направленным к называемой вещи" (Хлебников, 1986, с. 627).

Предложенные поэтом лексические новообразования – комбинации из корней и флексий, сохранивших смысловую прозрачность, так что смысл слова складывается из смысла составляющих. В большинстве своём неологизмы Хлебникова призваны заново, и более надёжно, скрепить означающие с означаемыми – уравновесить план выражения с планом содержания. В представлении поэта, это создаст лучшие условия для движения мысли. И действительно, те хлебниковские тексты, которые практически полностью составлены из словесных новообразований, обладают вполне внятной семантикой. Например, в "Зангези":

Иди, могатырь!
Шагай, могатырь! Можарь, можар!
Могун, я могею!
Моглец, я могу! Могей, я могею!
Могей, моё я. Мело! Умело! Могей, могач!
Моганствуйте, очи! Мело! Умело!

Шествуйте, моги!
Шагай, могач! Руки! Руки!
Могунный, можественный лик, полный могебнов! (Хлебников, 1986, с. 484)

Но, поскольку заумные слова сами по себе одинаково апеллируют и к разуму, и к чувству, они, по мысли Хлебникова, могут быть понятны не только человеку. Это рождает у поэта веру в возможность создания "звёздного языка" – будущего мирового языка, общего для "людей, богов и звёзд". В этом отношении хлебниковские неологизмы не более чем его заготовки, "зародыши". Мечта поэта о создании "звёздного языка" – это мечта о мире, где могут быть устранены все фундаментальные противоречия и, ради устранения конфликтов, достигнуто "согласие" между явлениями самого разного порядка. Хлебников изначально отказывается верить в существование несопоставимых явлений, какими бы разноплановыми они ни были:

Язык человека, строение мяса его тела, очередь поколений, стихии войн, строение толп, решётка множества его дел, самое пространство, где он живёт, чередование суши и морей – всё подчиняется одному и тому же колебательному закону. (Хлебников, 1985, с. 170).

Видимо, можно сказать, что универсум воспринимается Хлебниковым как своего рода художественное целое, все элементы которого находятся в едином смысловом поле. Поэтому, характеризуя явления этого мира, поэт свободно сопрягает те, которые обыденному сознанию представляются совершенно разнородными. Само произведение у него существует как способ приведения в равновесие разнородных, разнокачественных и разноуровневых явлений мировой жизни. Приведём пример:

Мои походы
Коней табун, людьми одетый,
Бежит назад, увидев море.
И моря страх, ему нет сметы,
Неодолимей детской кори.
Но имя веры, полное Сибирей,
Узнает снова Ермака –
Страна, где замер нежный вырей,
И сдастся древний замок А.
Плеск небытия за гранью Веры
Отбросил зеркалом меня.
О, моря грустные промеры
Разбойным взмахом кистеня! (Хлебников, 1986, с. 117)

Текст семантически непрозрачен и нуждается в смысловой "дешифровке". "Коней табун, людьми одетый" – это, по всей вероятности, отряд всадников:

сидящие на лошадях, они могут быть восприняты как конское одеяние: у Хлебникова слово "одеть" часто означает "увенчать" (Ср.: "Быть может, нам новую гордость / Волшебник сияющих гор даст, / И, многих людей проводник, / Я разум одену, как новый ледник" (Хлебников, 1986, с. 112).

Эти всадники поворачивают назад при виде моря, – по-видимому, речь здесь идёт о непреодолимом и неизмеримом ("ему нет сметы") страхе всего живого перед пределом, границей досягаемого пространства. Но упоминание о Сибири, вере и Ермаке вводит в стихотворение тему преодоления границ, считавшихся незыблемыми.

"А" – начальная буква алфавита, и значит, она может пониматься как символ всякого начала, в том числе – поступков, на которые прежде никто не отваживался. В данном случае "замок А" – бастион, опорный пункт на рубежах завоёванной территории. "А" (и не только в этом стихотворении) связано у Хлебникова с образом башни, замка, – твердыни, созданной человеком на границе своих владений. Например, в стихотворении "Бог 20-го века" (так Хлебников называет электровышку):

Как А,
Как башенный ответ – который час?
Железной палкой сотню раз
Пересечённая игла,
Серея в небе, точно Мгла,
Жила… (Хлебников, 1986, с. 97)

Вера, когда о ней упоминается в отношении к Ермаку, – это, по всей вероятности, православие, которое Ермак распространял на Восток, но в отношении к поэтическому "я" – импульс к победе над любыми ограничениями, изначальная уверенность в их преодолимости (показательно, что слово "Вера" дано с прописной буквы). Второе четверостишие, таким образом, о победе веры над страхом и о возможном смещении нерушимых преград – не только географических.

Поэт готов стать "новым Ермаком", но граница, штурм которой он предпринимает, это рубеж не пространственный, а метафизический – между жизнью и смертью ("плеск небытия за гранью Веры"). Эта граница всякий раз "отбрасывает" человека назад, в освоенную реальность – как отражение в зеркале "не пускает" отражённого в "зазеркалье" ("плеск небытия… отбросил зеркалом меня"). Таким образом, перед нами текст о тяжести поэтического удела – необходимости совершать невозможное, раздвигая рубежи освоенного человеком смыслового пространства.

Создавая произведение, автор воплощает в его поэтике как раз тот принцип, о котором повествует: он постоянно смещает границы смысла, заставляя воображение совершать невероятные прыжки – сопрягать конкретное (например, вырей) и абстрактное (вера), историческое (Ермак) и метафизическое (небытие), принадлежащее физическому миру (кони) и сфере языка (А). Некоторые из этих

сближений уже стали для Хлебникова привычными, устоялись в его поэтическом сознании (как "замок А") и вводятся в текст в качестве определённых величин с постоянным значением, в то время как для читателя они загадочны, скрывают в себе труднообъяснимую связь явлений (Казарина, 2005).

В этом случае происходит семантическое расширение, "раздвигание" семантических границ слова: его конкретный смысл заменяется более ёмким, захватывающим совсем новые области. "Ермак" начинает означать "тот, кто отвоёвывает для творчества новые сферы бытия", "Сибирь" – "очередная победа в этой борьбе" и т.д. Такое преображение слова решительно противоречит первоначально поставленной Хлебниковым задаче семантической конкретизации языка, закрепления за каждой лексемой строго определённого значения. Установление смысловых границ и размывание смысловых границ – две тенденции, сосуществующие в рамках хлебниковской поэтики, и это делает неосуществимой предложенную автором глобальную программу обогащения языка.

Замыслы Хлебникова имели утопический характер, поэтому в восприятии потомков этот поэт воспринимается как "гениальный мечтатель", поставивший перед искусством не просто сложные, но невыполнимые задачи.

МАЯКОВСКИЙ: ОВЕЩЕСТВЛЕНИЕ СЛОВА

Художественные намерения Маяковского принципиально отличались от хлебниковских. Власть слов над вещами кажется ему, скорее, пагубной: в его представлении словесные "игры" затемняют реальный смысл простых вещей, дезориентируют человека, непрерывно создавая сложности – путаницу личных отношений, социальные барьеры и т.д. Путь к победе над этим хаосом Маяковский видел в возвращении слову его предметности. Носителем смысла, с такой точки зрения, является предметно-вещный пласт реальности, всё остальное (знаковость любого рода) – только ограничивает его смыслопорождающие возможности. Выражение не нуждается в языке: выразительна сама плоть бытия, его, как любил говорить поэт, "мясо". И, если язык – прибежище абстракций, надо урезать его возможности, дать "слово" самой реальности, то есть позволить ей заменить слово собою:

> Долой высоких вымыслов бремя!
> Бунт
> муз обречённого данника.
> Верящие в павлинов
> выдумка Брэма! –
> верящие в розы
> измышление досужих ботаников! (Маяковский, 1973а, с. 174)

От триединства денотат-означаемое-означающее Маяковский готов оставить один лишь денотат, считая только его смыслосодержащим элементом триады.

Действие в стихах этого поэта, как правило, последовательно ведёт к опредмечиванию любых сущностей. Каждому обобщающему понятию, всякому абстрагирующему обозначению эмоций, художник подыскивает вещные эквиваленты, среди его метафор преобладают те, что Дж. Лакофф и М. Джонсон называли "онтологическими". Сходную роль играло пристрастие к грубой лексике и ситуациям, оскорбляющим изысканный вкус – то есть жизни неодухотворённой и языку низменно-материального – такому, который максимально "оплотняет" слово.

В перспективе это вело к отказу от языка, о чём проницательно писал Е. Фарыно:

> Классический треугольник Фреге предельно сжимается, стремясь превратиться в одну точку – вещь… Язык как таковой в семиотике Маяковского принципиально упраздняется. Языковые единицы превращается у него в звуко-графические объекты, либо же отождествляются с обозначаемым, в результате чего в высказывания Маяковского попадает исключительно мир. (Faryno, n. d., 1992)

Иначе говоря, слово начинает восприниматься как элемент материальной реальности:

> Футуризм сообщил смыслу свойства вещи, материализовал семантику художественного знака, уравнял идеологическую среду с эмпирической. (Смирнов, 1977, с. 54)

Важнейшее следствие избранной Маяковским стратегии – упрощённое и огрублённое понимание человеческих отношений, при котором они тоже оцениваются как отношения между вещами – утилитарно. Людские эмоции и даже жизни людей (включая собственную) начинают восприниматься как нужные – или ненужные, полезные или бесполезные.

С точки зрения общественной выгоды может оцениваться даже внешность возлюбленной:

Мы
  теперь
    к таким нежны –
спортом
    выпрямишь не многих,-
вы и нам
    в Москве нужны
не хватает
    длинноногих.
Не тебе,
    в снега
      и в тиф

шедшей
   этими ногами,
здесь
  на ласки
     выдать их
в ужины
   с нефтяниками. (Маяковский, 1973b, с. 27)

Здесь возлюбленная отождествляется с частью своего тела (ногами) и возможные варианты её судьбы – с "приключениями" ног, что в дальнейшем рождает непредусмотренные комические эффекты: например, когда в финале поэт зовёт:

Иди сюда,
   иди на перекресток
моих больших
   и неуклюжих рук! (Маяковский, 1973b, стр. 28)

– ничто не мешает читательскому воображению представить это свидание влюблённых как встречу "рук" одного с "ногами" другой, а не как контакт "полноформатных" людей. Этот казус симптоматичен: овеществление человеческого образа неизбежно его снижает и примитивизирует.

Показательно, что у этого поэта никакие человеческие или даже "сверхчеловеческие" заслуги никого не выводят из-под той же оценочной шкалы, какая применяется к вещам. Например, в трагедии "Владимир Маяковский" лирический герой спасает мир от бесплотности, а людей – от страданий. Но, по логике автора, даже у мессии есть что-то вроде "срока годности": завершив свою работу, он лишается права на существование, и единственным разумным выходом из этой ситуации становится самоубийство:

Лягу,
светлый,
в одежде из лени
на мягкое ложе из настоящего навоза,
и тихим,
целующим шпал колени,
обнимет мне шею колесо паровоза. (Маяковский, 1973a, стр. 42)

В дальнейшем такие эстетические представления совпали с большевистскими идеологическими установками, что позволило Маяковскому – пусть и небезболезненно – вписаться в круг советских поэтов.

ЯЗЫКОВЫЕ ЭКСПЕРИМЕНТЫ АЛЕКСЕЯ КРУЧЁНЫХ

Алексей Кручёных известен прежде всего как автор "заумных" текстов – не слишком многочисленных, но выводящих работу со словом на новый уровень: "заумь" исключала слово из разряда означающих. Заумное слово теряло связь с миром референций и больше не было именем тех или иных вещей. Кручёных первым отметил родство между заумью и супрематистской образностью: в обоих случаях творческий продукт не обладал свойствами знака (поскольку не отсылал ни к каким предметам или явлениям), и, несмотря на свою материальность (пятна краски в одном случае, звуки – в другом), не мог оцениваться с утилитарной точки зрения. И, значит, там и там речь могла вестись о создании принципиально нового явления, не знакомого прежней культуре и не доступного рациональному осмыслению. Так, создатель "Чёрного квадрата" Казимир Малевич считал, что появление этого полотна равнозначно "переходу в новое измерение" – нечто не менее фантастичное, чем изобретение машины времени или создание вечного двигателя, ведь искусство в этом случае рождало принципиально новую реальность, отличную и от материальной, и от знаковой!

Известность пришла к Алексею Кручёных после того, как в маленькой книжке 1913 года "Помада" были опубликованы три стихотворения, навсегда ставшие его "визитной карточкой" и символом футуристического языкового радикализма в целом:

№ 1	№ 2	№ 3
Дыр бул щыл	фрот фрон ыт	та са мае
убещур	не спорю влюблён	ха ра бау
скум	черный язык	Саем сию дуб
вы со бу	то было у диких	радуб мола
р л эз	племен	аль

(Кручёных, 2001, с. 55)

"Дыр бул щыл", безусловно, укрепил позиции Кручёных: создатель заумного языка с периферии футуристической "команды" переместился в её центр. Это сказалось на его отношении к зауми как несомненной ценности. Вплоть до 30-х годов, когда это действительно стало опасно, он будет писать заумные стихи и страстно пропагандировать этот тип творчества. Возможно, настойчивые попытки читателей наделить заумные тексты семантикой, подсказали ему, что это "адамическое", по его же словам, право должно принадлежать поэту. Заумные слова стали рассматриваться Алексеем Кручёных как "плавающие означающие", способные вступать во временные контакты с самыми разными означаемыми. Возможность выбирать, что надлежит означать придуманному слову, принадлежала поэту, который, таким образом, приобретал особую власть над языком и его восприятием. По отношению к собственным заумным текстам он

выступал как единоличный "держатель кода" – единственный, кто знает, в каком смысловом ключе его произведение должно восприниматься. Его особый статус поддерживался тем, что сам смысловой ключ, то есть способ прочтения текста, регулярно менялся – как "пароль", без которого нельзя войти в семантическое пространство. Например, Кручёных неоднократно объяснял, "о чём", с какой целью он написал знаменитое "дыр бул щыл", и всякий раз по-новому. Первоначально – как попытку возрождения подлинно-русского языка: "В этом пятистишии больше русского национального, чем во всей поэзии Пушкина" (Кручёных и Хлебников, 2000, с. 144). Позже – как явление "интернациональное": как "глухой и тяжёлый звукоряд (с татарским оттенком)" (Кручёных, 1925, с. 28). Затем – как способ вернуть языку связь с бессознательным – той областью, в которой этот поэт видел исток всякого творчества (Кручёных, 1999, с. 51). Ему казалось, авторство давало право на любое истолкование написанного. И это принципиально отличало заумь Кручёных от зауми хлебниковской.

"Заумный язык" Хлебникова возник из стремления преодолеть "произвольность" языкового знака: находя звуковые соответствия неким явлениям реальности, Хлебников опирается на интуитивное ощущение их внутренней близости, но действует рационально. Так, в знаменитом "Бобэоби пелись губы..." поэт заменяет знакомые нашему сознанию слова на те, что подсознательно воспринимаются как эмоционально более точные, уменьшающие зазор между означающим и означаемым. И это осуществляется методично и последовательно: из слов отвергнутых и предлагаемых выстраиваются однотипные ряды, а в финале оценивается итог этой творческой работы:

> Бобэоби пелись губы,
> Вээоми пелись взоры,
> Пиээо пелись брови,
> Лиэээй – пелся облик,
> зи-гзи-гзэо пелась цепь.
> Так на холсте каких-то соответствий
> Вне протяжения жило Лицо.   (Хлебников, 1986, с. 54)

Как мы видим, здесь учтено и привычное звучание слов, и варианты, подсказанные поэтической интуицией (подсознанием), но за соответствие между планом выражения и планом содержания у Хлебникова всегда отвечает одна и та же контролирующая инстанция – разум. И какими бы неожиданными и причудливыми ни были конкретные художественные решения этого поэта, важнейшая для Хлебникова цель языковых преобразований – превращение языка в орудие разума. Поэт владеет словом, но распоряжается им не по своему капризу и не в личных целях: он верен собственной максиме "человек должен быть мозгом мира" и не выходит из этой роли.

У зауми Кручёных иная природа, в противном случае после языковых нововведений Хлебникова она не воспринималась бы как нечто сенсационное. "Несуществующие слова" не должны ассоциироваться у читателя с чем бы то ни

было определённым, и право соотносить их с явлениями реальности принадлежит только автору. Он подбирает не имена для вещей, а вещи для имён и тем самым утверждает зависимость предметного мира от собственных языковых манипуляций. Настойчивому рационализму Хлебникова Кручёных противопоставляет своего рода магию, и заумное слово выступает в роли волшебной силы, подчиняющей себе порядок вещей, а поэт – в образе единственного укротителя всемогущей словесной стихии.

По-видимому, Кручёных оценивал это именно так. Когда в первые постреволюционные годы ему удалось увлечь своими идеями и текстами широкий круг людей (практически всю интеллигенцию Тифлиса), его выступления перед слушателями приобрели "мистико-медицинский характер": со своей аудиторией он больше не говорил на равных, – он её заклинал и погружал в транс, явно ища дорогу к подсознанию слушателей. Кручёных всегда был первоклассным декламатором, но теперь его чтение, по словам С. Третьякова, "давало эффект шаманского гипноза". Ещё один свидетель, Д. Молдавский (1989), рассказывал:

Мне приходилось слышать заговоры деревенских колдунов. Я записывал русские песни и внимал пению таджикских гафизов. И вот то, что произошло тогда, заставило меня вспомнить всё это сразу!.. Кручёных провёл подлинный сеанс шаманства. Передо мной был самый настоящий колдун, вертевшийся, покачивавшийся в такт ритму, притоптывавший, завораживающе выпевавший согласные, в том числе и шипящие. Это казалось невероятным! Какое-то синтетическое искусство, раздвигающее рамки привычной словесности". (с. 127-128)

Можно предположить, что теперь создание и исполнение заумного текста преследовало цель обдуманного, планомерного воздействия на подсознание читателей. В экспериментальном пространстве такого произведения разрабатывались методики подчинения чужой воли. Для тех "сеансов массового гипноза", которые устраивал Кручёных, заумь подходила как нельзя лучше. Прежде всего потому, что заумное творчество не допускает равноправия автора и слушателя. Реципиент неизбежно оказывается в позе подчинения, ведь там, где слово перестаёт "быть логосом", человек (слушатель, читатель) – больше не homo sapiens.

Для экспериментов подобного рода история отпустила слишком незначительные сроки, и трудно утверждать наверняка, что избранная Алексеем Кручёных стратегия была способом овладения чужим сознанием и чужой психикой. Но тенденции, которые успели проявить себя в его позднем творчестве, вели именно в этом направлении (Казарина, 2005).

Если у Маяковского и Хлебникова человек – орудие тех перемен, которым искусство подвергает мир, то у Кручёных он сам выступал инициатором и источником любых задуманных им трансформаций. Таким образом, использование зауми становилось путём к абсолютизации роли творческого субъекта.

ВЫВОДЫ И ДИСКУССИЯ

Важно подчеркнуть принципиальную разнонаправленность языковых преобразований, предложенных разными поэтами кубофутуристической группы. Она особенно очевидна, когда определённые художественные практики выступают у них под одним именем. Например, как давно замечено, заумь Кручёных и заумь Хлебникова – явления совсем не родственные, и исследователи, как правило, противопоставляют их по тому или иному важнейшему признаку – как язык "практический" и язык "поэтический" (Шкловский, 1990), как "аполлонический" и "дионисийский" (Марков, 2000) варианты зауми (в терминологии А.Н. Чернякова, это противопоставление "системности vs. внесистемности" / "регламентированности vs. нерегламентированности" / "статичности vs. динамичности", а также как "язык" и "речь" (Черняков, n. d.).

Признавая обоснованность всех этих интерпретаций, считаем нужным обратить внимание на то, что заумь в обоих её разновидностях существовала как язык, обращённый к подсознанию реципиента. Само слово "заумь" поначалу использовалось с ударением на втором слоге, – таким образом подчёркивалось, что заумная поэзия адресуется не "уму" читателя или слушателя, а тому, что находится глубже – "за умом". Оба поэта, Хлебников и Кручёных претендуют на контакт с этой стихией – сферой подсознательного – но с противоположными целями. В понимании Хлебникова, всё живое обладает зачатками разума и способно к "пониманию" происходящего вокруг на уровне своего рода "пред-сознания", или подсознания. Это и делает возможным создание языка, который свяжет человека и природу, станет общим для них. Но это будет не уступкой природе (которая, по мнению поэта, гениальна в своей творческой мощи, но не доводит ни одно начинание до конца, обрекая всё живое смерти), а попыткой наладить контакт между теми сферами бытия, которые только тянутся к разумности, и теми, которые ею обладают. Это и есть "путь сделать заумный язык разумным" (Цит. по: Черняков, n. d.). А если так, то неверно говорить о "статичности" хлебниковской зауми: она призвана динамизировать, ускорить процесс эволюции всего живого.

Кручёных прагматичнее Хлебникова и выстраивает отношения не с мирозданием, а с читательской аудиторией. И не ради взаимопонимания: заумь позволяет сделать эту коммуникацию односторонней: здесь слушатели должны внимать поэту, а не он им. В этом отношении хлебниковский и крученыховский варианты зауми противостоят друг другу не как язык и речь, а как язык, предельно расширяющий зону коммуникации и язык, предельно её сужающий – дающий к ней доступ одному лицу – поэту.

Подводя итоги, можно сказать, что, следуя общей программе уничтожения всех фундаментальных противоречий бытия, гилейцы стремились соединить в произведении творческую энергию автора, онтологическую укоренённость предметного мира и динамику языка. Но на практике какая-то из этих сил начинала играть главенствующую роль, так что в итоге обнаружилось несколько способов решения поставленной задачи (Казарина, 2005). Поэтика Маяковского вырабатывала способы сближения слова и вещи, эксперименты Хлебникова велись, чтобы уравновесить то и другое, а заумное творчество Кручёных выводило слово из-под любого контроля, кроме авторской воли. Всё это даёт основания воспринимать кубофутуризм не просто как очередную литературную школу,

которая претендует на пересмотр художественных принципов своих предшественников. Хотя большинство исследователей воспринимает футуристические новации именно так (и здесь можно назвать едва ли не всех серьёзных исследователей русского литературного авангарда: сошлёмся на работы таких авторов, как Иванюшина, 2003; Крусанов, 1996; Сироткин, 2003; Тюпа, 1998; Тырышкина, 2002; Ханзен-Лёве, 2001; Цвигун, n.d.; 2001; Цуканов, 1999; Шапир, 1995; Эпштейн, 1989; Baak, 1987; Burger, 1974; Faryno, 1992, n.d.; Miller, 2005; Pomorska, n. d.; Quine, 1960 и многие другие), на наш взгляд, гилейцы покушались на большее – не на принципы искусства, а на фундаментальные основания культуры – базовые представления о законах бытия, задачах человечества и пределе человеческих возможностей, ожидающих мир переменах и глобальных трансформациях материального мира, социума, языка. Кубофутуристы выступали в роли художников-проектировщиков принципиально новой реальности, и работа с языком – "субстанцией", скрепляющей элементы этой реальности – понималась как дело первоочередное и безотлагательное. И хотя мировые сдвиги, происходившие в течение последнего столетия, носили совсем другой характер, каждый из предложенных кубофутуристами творческих проектов был экспериментом по выявлению неких предельных возможностей слова, поэтому при любых результатах не утратил своего значения.

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Non-linguistic Systems as a Way to Make a Password Secure but Memorable

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Abstract

This article is based on the study of ways to create a secure password by integrating symbols from non-linguistic sign systems, in order to combine cryptographic strength and ease of memorization. This is relevant, as the old ways of complicating the password become obsolete, in view of their triviality and, as a result, susceptibility to hacking. Our research is based on the use of a system of symbols from various fields of interest (chemistry, programming, music, etc.) in the password. We take into account the individual preferences of users, so that it would be easier for them to build an associative chain when remembering a password, and also consider the susceptibility of passwords obtained using the password techniques we proposed to the most common cyber-attacks. The respondents created one password on their own, and the second with the help of the proposed methods. The complexity and security of the password was estimated in terms of entropy, as well as using specialized programs. Using the proposed methods reduced the number of insecure keys.

Keywords: Password; Entropy; Reliability; Cyber Attacks; Cryptographic Strength; Symbol Systems; Passphrase; Keys; Hacking; Symbol

Аннотация

Данная статья базируется на исследовании способов создания надежного пароля с помощью интеграции символов из нелингвистических систем знаков, с целью совмещения криптостойкости и легкости запоминания. Старые способы усложнения пароля изживают себя, в виду их тривиальности, как следствие – подверженности взлому. Исследование основано на использовании системы символов из различных сфер интересов (химия, программирование, музыка и др.) в пароль. В работе принимались во внимание индивидуальные предпочтения пользователей, чтобы им было проще построить ассоциативную цепочку при запоминании пароля. Рассмотрена подверженность паролей, полученных с помощью предложенных техник, к наиболее распространенным кибератакам. Респонденты создавали один пароль самостоятельно, а второй с помощью предложенных способов. Сложность и надежность пароля оценивались в понятиях энтропии, а также с помощью специализированных программ. Использование предложенных способов сократило количество небезопасных ключей.

Non-linguistic Systems as a Way to Make a Password Secure but Memorable

INTRODUCTION

The Internet, electronic services and social networks have significantly changed the life of a modern person with a confident step (Bylieva et al., 2020). People, using these facilities, in most cases use their personal information, give sites access to their private communication within the network and personal data. When registering on a certain resource, the user sets a password, the purpose of which is to keep the confidentiality of information. Many sites that require a password to be entered, as well as a large daily flow of information, often push a person to create an easy password that he can easily and quickly remember. This leads to such negative consequences as: leakage of personal data, loss of user access to the personal information he needs, as well as loss of funds from accounts.

Concerns about his data are forcing the user to use a difficult password to enter the site. A complex password is considered to be a combination of different letters (uppercase and lowercase), numbers and symbols, in an amount of not less 12 signs, which does not fall into the list of most frequently used passwords (for example, Google, Apple account requirements). In most cases all the requirements will be met by a random set of characters, which is difficult to crack using a selection method, but at the same time it is difficult to remember. This is where the main problem lies when setting an account password. Linking cryptographic strength and ease of memorization is rather a difficult task. With the growing number of methods for cracking passwords, as well as with the expansion of the databases of merged and frequently used passwords, the use of words and standard structures of natural language (dates, addresses, etc.) is losing its relevance. Thus, modern passwords approach cherished doors, not only in terms of the functions performed, but also in terms of the dominant form of expression –meaningless for the uninitiated. That is why it is worth turning to alternative systems of symbols when creating a password, as this will preserve simplicity and ease of perception, without reducing its reliability.

LITERATURE REVIEW

As password-based authentication is widely used today, passwords are always susceptible to cyber-attacks, and it is difficult for users to create complex passwords (Haeussinger & Kranz, 2017; Ur et al., 2017). Let's take a quick look at the main ways to crack passwords because of the more complicated passwords.

The most common are: "Brute force" and dictionary attack. The brute force method is based on an automated sequential iteration of various combinations of signs. This method is certainly successful, as the number of signs in the password is determined. Therefore, Brute force allows you to crack any password. However, complex combinations can take years to determine. It is possible to counter this attack by increasing the number of characters in the password and the absence of repeated signs one after another. The use of personal information in a password, for example, date of birth, first or last name, phone number, also makes it more vulnerable to brute force

attacks, as it is with the substitution of such basic combinations that the selection of a key from a user account or any other personal information begins (Bosnjak et al., 2018; Guo & Zhang, 2018; Narendar et al., 2020).

The dictionary method is another popular hacker method for cracking passwords and keys. Analysis of attacks on personal data shows that the percentage of hacked passwords using the dictionary method ranges from 17% to 24% of the total number of attacked passwords (Guo & Zhang, 2018; Singh & Pandey, 2019).The essence of this method lies in the fact that the key that must be matched is checked for matches in various bases of dictionary words and expressions that are often used by people as a password. The larger the quantitative base of the dictionary, the higher the probability of guessing the password. Some mechanisms are also tuned to look for typical sign substitutions in dictionary words, such as "a – @", as well as search for words letters of which are simply written in reverse order (Guo & Zhang, 2018; Singh & Pandey, 2019).

In general, the security and usability of entering passwords is opposite, as secure keys with a high degree of protection are difficult to remember, and passwords that are easy to remember can be cracked fairly quickly. More often than not, a user has many accounts that require passphrases to be protected, but it is quite difficult to create and remember multiple secure combinations (Li et al., 2018; Guo et al. 2020). Users tend to choose easy-to-remember passwords that include names, short words, dates, and patterns, resulting in a quick brute-force attack (Alomari et al., 2019; Bonneau, 2012; Veras et al., 2012; Yan et al., 2004). Many Internet services, including those offered by Microsoft and Google, have established lists of common, weak passwords that are prohibited from using on their servers (Habib et al., 2017).

Remembering a password is based solely on a person's memory, which has limited capabilities. Stanton & Greene (2014) studied how memorable complex character strings of varying lengths are memorable, which can be used as passwords with a higher degree of protection against cracking. Participants were shown a password once and asked to remember and recollect it. The results showed that the longer a character string, the longer it takes a person to remember, recall, and type it. Longer lines also increased the chance of errors. Another experiment aimed at studying the effect of password length on memorability found that the system-generated 4-digit combinations outperform 6-, 7-, and 8-digit combinations in long-term memorability at 48 hour intervals (Huh et al., 2015)

Ur et al. (2016) investigated how users rate the security and memorability of a range of passwords. They found that participants perceived the password to be significantly less memorable if it was longer or contained numbers. Some organizations and researchers on the topic have proposed some mnemonic techniques such as passphrases (Bonneau & Shutova, 2012) and mnemonic strategies (Kuo et al. 2006) to improve the ease of use and remembering of passwords.

Seitz (2017) argued that existing password generation methods do not account for individual differences between users and cannot effectively balance the usability and security of passwords relative to a specific person. Users with different personalities and interests have different preferences when creating a strong password (Bosnjak & Brumen, 2016; Guo et al., 2020; van Schaik et al., 2017).

Nowadays, some users use mnemonic hints to generate passwords. Passwords created with the help of these techniques are believed to be fairly easy to remember and more secure than simple passwords of similar difficulty to remember. For example, the

authors of the article Bei et al. (2019) considered 4 techniques that can solve the problem of combining memorability and password complexity:

1) "SenSub: Sentence substitution" – replacing each word of a well-remembered sentence with the first letter of this word

2) KbCg: Keyboard change – a memorable word moves one by one across the keyboard button in any direction

3) UsForm: use of an arithmetic expression written in signs, partly, numbers, partly words. As passwords, the authors of the article propose to use formulas, for example, mathematical and write them down or describe it in words with a whole formula, or replace, for example, the signs in the formula with words.

4) SpIns. Special character insertion. The authors of the article suggest inserting easy-to-remember similar symbols into the base password, for example, a – @

Password complexity is estimated by different methods, but most often the concept of entropy is measured in bits. Password strength or entropy is the amount of information per elementary message from a source generating statistically independent messages. We can say that this is a conditional coefficient that shows the distribution of unique elements in the data array. Instead of the number of attempts required to accurately determine the password, the base 2 logarithm of this number is taken, which is called the number of "entropy bits" in the password. To crack a 40-bit password using brute force, you need to make 240 attempts, checking all possible options (Volokitin & Volokitina, 2020).

The N-bit entropy corresponds to the uncertainty of the choice of passwords (for example, generated by a random number generator), the entropy is calculated simply, it is equal to the logarithm based on two numbers of possible passwords for the given parameters. To calculate the entropy of a random password, use the formula [1]:

$$H = \log_2 N^L = L \log_2 N = L \frac{\log N}{\log 2} \qquad [1]$$

where N is the number of possible password characters; L – the number of characters used in the password; Entropy H is measured in bits. Increasing L or N will multiply the generated password. If the password is generated not by an impartial random number generator, but by a person, then calculating its entropy is much more difficult. The most common approach to calculating the entropy in this case is the approach proposed by the American Institute NIST: – the entropy of the first character of the password is 4 bits; – the entropy of the next seven signs of the password is 2 bits per sign; – entropy from 9 to 20 signs – 1.5 bits per sign; – all subsequent signs have entropy of 1 bit per sign.

If the password contains uppercase and non-alphanumeric signs, its entropy is increased by 6 bits. According to this approach, a human-selected eight-sign password with no uppercase letters or non-alphabetic signs is estimated to have an average of 18 bits of entropy (Volokitin & Volokitina, 2020)

There are also programs for assessing password strength. For example, programs "zxcvbn" is based on the analysis of 30 thousand common passwords, first and last names of US citizens from the census data, searching for classic combinations such as "123", "qwerty", phrases from movies and TV shows, as well as searching for pattern combinations: phone numbers, date of birth. Using "zxcvbn" allows for more flexibility in determining password strength, as it covers not only dictionaries, password length,

different case and the presence of signs, but also various combinations of signs that are often used by users to complicate passwords (Wheeler, 2016).

USING NON-LINGUISTIC SYSTEMS TO CREATE A PASSWORD

Despite the proliferation of new methods of protection against unauthorized access, in particular those related to bio-identification (fingerprints, iris, voice, face, etc.), the need for strong passwords entered from the keyboard is very high today. The most common for natural languages of combinations of signs – words and dates – have a clear meaning, therefore, they are remembered, but are not suitable as passwords, as they are very easy to crack by guessing. Senseless combinations of letters, words, symbols and numbers are a reliable system of protection, but they are poorly stored in a person's memory, as he cannot associate this reliable combination with anything. It is possible, of course, to transfer the memorization function to technical devices – for example, a secure hardware password manager (Gupta et al., 2020). But if we consider only the capabilities of a person, then, the problem of memorizing a rather complex password is associated with giving it meaning. This can be solved either with the help of mnemonics(Al-Ameen et al., 2015), aimed at creating associations with a randomly generated obviously cryptographically strong password, or creating a password that makes sense for the user, but it is not a lexical unit. The first step in this direction was the idea of using a multilingual password (Bonneau & Shutova, 2012; Maoneke et al., 2020). However, in this study, we propose to express the meaning not by means of natural language and not only by letters, as such combinations of symbols are most vulnerable. Within the framework of the second approach, this paper explores the possibilities of using non-linguistic sign systems existing in human culture to create a password.

The purpose of this article is to propose a system of signs that is alien to natural languages and to test its reliability and ease of memorization. Let us examine this method using the combination of symbol systems from chemistry, music, mathematics, physics, programming, languages and drawing.

Chemical elements for creating passwords

Chemistry is known to be a system of elements, chemical formulas, and reactions. Those who know this science well can store in their memory a lot of standard symbolic combinations expressing basic knowledge. An entire chemical formula or reaction can be used as a password. The best way to create a long and complex password is to use complex compounds and reactions with them. For instance

$[Cu (NH_3) 4] SO_4 = [Cu (NH_3) 4] + SO_4$ – dissociation of tetraamminomed sulfate

This password without transformations can already be considered cryptographically strong, but it is quite long, which can cause accidental input errors. Therefore, as an option, it is worth considering simpler chemical formulas that can be combined with natural language, for example:

$K_3PO_4 = 3K + PO_4$ – dissociation of potassium phosphate

When integrating, we can get: $POTASSIUM3PO_4 = 3POTASSIUM + PO_4$ and many other spellings, at the discretion of the user. It is worth noting that the length of the password turns out to be quite impressive, which makes it quite reliable, but at the same

time, remembering this password for a chemist will not be difficult, as this is the simplest formula.

Another option available for quick memorization is to write the formula of a substance in the form in which we pronounce it. For instance:

Na2 SO 3 – NATRIYDVAESOTRI in Russian and SODIUMTWOSULFATEFOUR in English.

This is the simplest possible option. To complicate things, it is worth using a different register, which can also advise the dimensions in a chemical formula, for example: SODIUMtwoSULFATEfour or SODIUMtwoSULFATEfour. It is also possible to use transliteration (transferring text using someone else's alphabet), numbers and printing in another language layout: NATRIdvaES03, or any other options that will be understandable to the user and easy to remember.

Another way of using the sign system related to chemistry does not imply a serious basic knowledge of this science. In this case, the periodic table is used as an encryption key that allows you to translate numbers into letters denoting chemical elements. Using the data from the periodic table, the user can encrypt any information in memory containing numbers (date, phone number, address, etc.). Any numbers from 1 to 118 can be substituted for the corresponding chemical elements. Consider several examples:

1. Al08Ca05 (Date of birth 13.08.2005, in which several numbers are replaced by chemical elements)

In this case, the "Al" element has a serial number 13, which corresponds to the date of birth. "08" – month of birth and "2005" year of birth, if desired, can also be replaced by "8" --- "O" – oxygen (serial number 8), and the numbers from the year "20" and "5" can be converted into the corresponding "Ca" (calcium) and "B" (boron) in, that is, the result will be: Al0OCa0B This integration system is quite mobile and variable, so the user can choose the most easily remembered version for himself.

2. FeMgZn0F0Li (Numerical components of the address written down by chemical elements: apartment 26, house 12, post code 300903)

Here, the elements are replaced in a similar way, the digit in the address corresponds to the ordinal number of the element in the final password. Zeros can be left to increase the length of the password, as well as to complicate it.

Musical notation for creating passwords

Music is another vast area, with its own complete system of symbols. Music that users know by heart is a promising basis for creating a strong password. Moreover, to create a password, you can use both notes (for example, in letter notation) and tablature (a type of musical notation, a schematic recording of music for keyboards, some strings and wind instruments). The use of sharp and flat allows you to add special characters to the recording, uppercase and lowercase letters can indicate major and minor inclinations.

Let's look at the example of Ludwig van Beethoven's Moonlight Sonata and observe how you can make a password from a guitar tablature. The scheme of the whole piece is quite voluminous, so you can use the opening passage, or any other part that the user knows.

EADGBE – Letter designations of notes that correspond to 6 strings on a guitar. 0123 is the fret number on which you need to clamp the string. Thus, from the Moonlight Sonata we get the password: A0D2G2B1D2G2B1D2G2B1D2G2B1E3.

Chords can also be used to set a password for your account. Consider this method with the example of "Nirvana – About A Girl"

The first verse has 2 chords, the combination of which is repeated 4 times:
E5GE5Gx4
The first two lines of the chorus use 3 chords, which are repeated 2 times:
C # G # 5F # mx2
Combining the resulting lines, we get a password with a high degree of protection, as it is composed of letters, numbers, symbols, and it also has sufficient length:
E5GE5Gx4C # G # 5F # mx2

Another possible way to integrate a musical symbol system is to represent the keyboard as a staff or guitar fretboard. In the first case, linear notation is used, in the second, the lines of letters and numbers correspond to the strings of the guitar, and the columns correspond to the frets. The keyboard has three full letter rows and one numeric row, which will correspond to 4 strings on a guitar. This amount is quite sufficient to record a simple melody as a password. Let us consider the example of the aforementioned work of Ludwig van Beethoven, Moonlight Sonata.
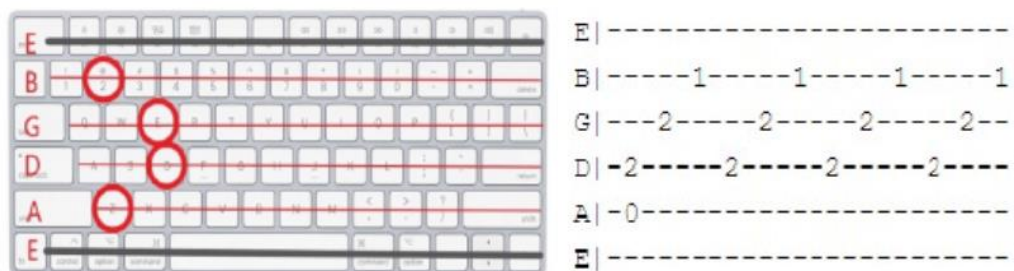

Figure 1. Transferring the tablature scheme to the keyboard

Figure 1 shows an easy-to-understand tablature for the beginning of a piece, as well as its integration into the keyboard. For A0 – we will have "Z" responsible, for D2 – "D", G2 corresponds to "E" on the keyboard, and B1 – "2"
Let's write down the result of our integration:

ZDE2DE2DE2DE2

In the above example, one of the simplest tablature options is disassembled; musicians can use much more complex options for recording a piece of music using keyboard tools.

Using formulas to create passwords

Next, we will analyze the use of mathematical and physical formulas as a password. This method is suitable even for people who are not professionals in the exact sciences, as basic knowledge from the school course can be used to create a strong password.

sin ^ 2 (A) + cos ^ 2 (A) = 1 is the basic trigonometric identity. It is easy to remember, but at the same time meets the requirements of a password with high cryptographic strength. This identity can also be written in the format:

sineAsquared + cosineAsquared = 1, which is similarly possible to use as a password.

Physical formulas, along with mathematical ones, can be used to protect your account. People who understand physics can use any formulas that they know well. We'll look at a trivial example:

I = q / t – current formula

When converting to a password, you can use the form:

Iequallyq / time

To complicate things, you can use formulas that have fixed numeric elements, for example, the formula for the area of a circle:

S = π * r2, where r is the radius, π is a constant that expresses the ratio of the circumference to the diameter, it is always 3.14

As a password, you can use:

Areaofthecircle = 3.14 * r2

This option is quite easy to remember, but it still retains a high degree of reliability, as it includes letters, numbers, symbols and contains more than 8 characters.

Dynamic and graphical languages for creating passwords

In addition to using alternative sign systems, languages that do not have a generally accepted sign expression can be used to create passwords. In this section, we will consider options for turning into a motion password. There are many sequences of movements that have the meaning for a person. A striking example is dance, but a person remembers the sequence of daily exercises, and the way to the place of study, and how to assemble a meat grinder.

However, the simplest use of a dynamic password is a picture. The easiest way to memorize a sequence of finger movements is to depict a familiar image. This technology is used to a limited extent as a "graphic password" of a smartphone, but if you consider the keyboard as a space for drawing, you can create a rather complex image. For example, a flower – figure 2

Figure 2. Image of a flower on a cleavage

This password will look like this:

23ew56ygfrthjmn – for complication, you can change the case of letters, at the discretion of the user.

A similar "drawing" option is suggested by Guo et al. (2019) and Schweitzer et al. (2011). However, the possibilities of using visual and "bodily" memory are very wide. Another easy option is – a sequential description of a drawing you are familiar with – figure 3.

Figure 3. Possible variant of a familiar drawing

This image contains simple shapes, namely 6 triangles, 2 circles and 2 rectangles, as well as two dogs and a grate on the windows, which resembles a "+" sign. By integrating it into the password, we can get:

6triangle2circles ++ 2rectangle @@

The complexity of the picture, as well as the final password, depends on the user's imagination and memory.

Text smilies are a fun way to use symbols alternately. Those who are fond of the artistic expressiveness of ordinary signs are able to create a whole picture. The use of many special characters makes passwords consisting of emoticons especially cryptographically strong.

For instance:

(^_^) is a combination of symbols that denotes joy. There are several ways to write this emotion: (n_n) \ (^ _ ^) /
Sadness can also be depicted symbolically: (v_v) or (<_>)
Embarrassment: * ^ _ ^ *
Kiss: ^} {^
A meaning close to crying: (; _;) or (T_T)

The user can easily associate these symbols with human emotions. It is best to make a small combination of emotions (emoticons) and use it as a password. For example, "I am embarrassed, happy, kissing." We integrate into smiles:

* ^ _ ^ * \ (^ _ ^) / ^} {^

Or "The cat is sad":
(= ^ - ω - ^ =) (v_v)

Habitual actions or movements can serve as the basis for a password. Despite the lack of a generally accepted system of signs for describing dynamics, for example, a mixed system can be used that combines words of a natural language and arrows (^ – straight, <- – to the right, -> – to the left).

Such a record will allow you to describe the usual route, from the kitchen to the bedroom ∘ Bedroom ^ <- <--> ^ -> Kitchen or from home to the bus station ∘ Home ^ x3 -> x4 <----> ^ x3-- > x2BusStation

Programming languages for creating passwords

Programming has recently become an increasingly popular skill. This area is rich in combinations of characters that are suitable for use as a password. The most understandable and accessible option for ordinary users is to use the path to a folder or file known to the user, for example:

C: \ Windows \ System32

More advanced specialists can use commands created using programming languages as passwords.

Both specific commands related to projects important to users and standard commands can be used. For example, for the Java language, to enable the program, you need to write the required construction in the source code:

```
public static void main (String[] args) {
```

Programming languages are extremely promising, as they allow you to express by your own means belonging to other sign systems. For example, the mathematical formulas we are considering can be programmed. Calculating the area of a circle in Pascal will look like this:

```
const Pi = 3.1415;
begin
  var r: = ReadReal ('Enter the radius of the circle:');
  var S: = Pi * r * r;
Println ('The area of the circle is', S);
end.
```

As a password, you can use any line from the above program, for example "var S: = Pi * r * r"

Pictures and colors can be written using a combination of symbols, which is used for web programming and design. So you can write the sequence of colors of the Russian flag as # FFFFFF#0000FF#FF0000. The heart-eyed emoticon (☺) is written & # 128525, and the color MediumAquamarine is # 66CDAA. Combining the designation of the image and color together, we get the password: & # 128525 # 66CDAA.

There is a paradox here associated with the use of a language "understandable" by computers to protect against machine hacking that is tuned to human language.

METHODOLOGY

To study the ways users create a password, as well as to study their ability to compose and remember a new password, based on the techniques given above, a survey was compiled. 526 relevant responses were received using the Google Forms service. All participants consented for using the data provided by them in an anonymous form. Most of the respondents were in the age range of 14-18 years (63.8%) and 19-25 (29.2%). 54.9% of the respondents are women, 37.8% are men, and 7.3% refrained from answering.

The respondent reported the number of cases of hacking of his page and their possible reasons. At the next stage, the respondent came up with any password that the user does not use anywhere – Password No. 1 (hereinafter in the text "First password", 1 password option, Password No. 1) Then the survey participants were asked to choose their area of interest. The choice was between chemistry, mathematics and physics, drawing, rare languages, programming, music. People who could not find their interests among the above could choose the direction "The Way Home".

After a person chose the area of his interests, he was asked to study a little help on how to create a password based on the direction he chose. After reading the creation technique and familiarizing himself with the signs that are used in this area, the user had to set a password based on the knowledge gained – Password No. 2 (hereinafter referred to as "Second password", second password option, Password No. 2)

The purpose of the study is to evaluate in practice how effective the proposed methodology is when creating a password and remembering it. For this, it was necessary to compare the complexity of passwords created spontaneously (Password # 1) with those that were created after reading the recommendations (Password # 2). The password complexity was estimated in terms of information entropy; the password analysis was also used using the demo version of the Zxcvbn program.

RESEARCH RESULT

41.63% of the respondents said that they had been hacked at least 1-2 times, this once again confirms the need to use strong passwords to protect data and, in general, to study the topic of the cryptographic strength of the password and how to remember it. 18.82% – have been hacked 3-4 times, but at the same time 30.04% state that they have never been hacked. 50 respondents were hacked more than 5 times, which is 9.51% of the respondents.

Because the National Institute of Standards and Technology (US) (NIST) recommends using a password with 80-bit entropy for the best security, we concluded that 332 (63.11%) survey respondents entered a password that was not strong enough. The average entropy value for Password 1 is 75.9509, which does not meet the requirements for reliability according to (NIST). The average number of characters in this attempt was 12.9.

Most of the first passwords are too easy to crack with the simplest methods. As an example, we give the most illustrative cases:
"Qwerty2", "password", "Qwertt1234" "nikname123" – standard combinations, break through in the first place when hacked. Sometimes users do not think about the password and enter the first combinations they come across, for example, 5 characters from the top

line of the keyboard "qwerty" or use the words "password" "login" – this is what the user sees first when registering an account. Adding combinations of numbers or their sequences to these data weakly increases the password strength, since they are just as predictable.

"88005553535" – numeric combination, pattern "phone number"
"Kamila2701" – personal data, word from a dictionary, pattern "number"

Let's analyze the above examples using the program "Zxcvbn" and calculate their entropy by the formula.
1. "qwerty2" – 7 characters.
The coincidence with the "Dictionary" pattern immediately drops out, entropy according to the formula = 32.9031 is a low indicator. As for the time of cracking, with one hundred attempts per hour the password will be cracked in 3 days (throttled online attack), with 10 attempts per second in 14 minutes (unthrottled online attack), 10 thousand attempts per second will lead to cracking this password in less than in 1 second (offline attack, slow hash, many cores).
2. "nikname123" – 10 characters
The element "nik" is quickly selected by brute force, "name" is a vocabulary word, "123" is a sequence pattern. Entropy calculated by the formula = 51.6993. At 100 attempts per hour, the password will be cracked for 100 years (throttled online attack), at 10 attempts per second – 5 months (unthrottled online attack), 10 thousand attempts per second will lead to password cracking in 4 hours (offline attack, slow hash, many cores), and 10 billion attempts per second will result in less than 1 second (offline attack, fast hash, many cores)
3. "Kamila2701" – 10 characters.
"Kamila" is a vocabulary word, "2701" is a date pattern, entropy = 59.5420. As for the time of cracking, with 100 attempts per hour the password will be cracked for 100 years (throttled online attack), with 10 attempts per second – 4 months (unthrottled online attack), 10 thousand attempts per second will lead to cracking the password in 3 hours (offline attack, slow hash, many cores), and 10 billion attempts per second will result in less than 1 second (offline attack, fast hash, many cores).
At the same time, 194 respondents (31.17%) have already coped well with the task, the entropy of their first invented password was above 80, several users immediately created a strong password option. This shows that a number of respondents are aware of the existing problems with creating passwords, and are thinking about what a secure password should be. At the same time, some of the respondents, it can be assumed, came up with a complex password at random, without implying that one day the password will have to be remembered. For example, "C1XQqcWkK8 ~ 9R2Z | O # hecWv5 $ 4SoEEHV" – this password is created using a 95-character alphabet (that is, a set of characters from ASCII) and contains 32 characters. This password meets all security requirements and belongs to strong ones, as it is resistant to brute force attacks and dictionary attacks. Password entropy = 210.2354 – high. The breaking time even with 10 billion attempts per second (offline attack, fast hash, many cores) is measured in centuries.

A smaller part of the respondents approached the issue more seriously, using the mnemonics they knew. For example, a fairly often described example is the use of changing a familiar line by adding signs – and a number, for example:

22 Forge-t-Withou-t-Burnin-g-. –30 characters

The element "With" is a dictionary word, "Burnin" is the same, but due to the fact that the rest of the password is subject only to brute-force attacks that will take a long time to find the necessary combination, the password can be considered highly reliable. Password entropy = 197.09. As for the time of cracking, it will be measured in centuries even with 10 billion attempts per second (offline attack, fast hash, many cores).
Let's consider how passwords were created after receiving information, how you can use the knowledge of sign systems to create a password.

137 respondents still created a password that does not reach 80 values of entropy, but the average value of entropy in Password 2 (that is, the password created after receiving recommendations) increased from 75.95 to 128.95, and the average number of characters in vein increased from 12.9 to 20.4.

Users managed to create strong passwords using translation from one character system to another, as an example worth considering:

1. "rjks, tkm --->cflbr --->irjkf --->eybdthcbntn ---> hf, jnf ---> --->byjqvbh" - "– 62 characters.

This password was obtained by entering Russian words in the English layout "lullaby ---> kindergarten ---> school ---> university ---> work ---> another world". Entropy calculated by the formula = 407.33 is an extremely high indicator.

"Eybdthcbntn" - an element subject to dictionary attack, "---" - repeating characters that reduce password strength. Due to the fact that this version of the key contains 62 characters, some dictionary matches do not greatly affect its reliability, which is confirmed by the calculation of the time of cracking in the program "zxcvbn"
The time to crack this password at 10 thousand attempts per second (offline attack, slow hash, many cores) and at 10 billion attempts per second (offline attack, fast hash, many cores) will be more than a century.

2. "LiNaKMgAlK [Fe (CN) 6] geksacianoferratkaliya2002 [] 7000r" – 52 characters.

"Aliya" is a vocabulary element, "2002" is a date pattern. Entropy calculated by the formula = 341, 63. The time to crack this password at 10 thousand attempts per second (offline attack, slow hash, many cores) and at 10 billion attempts per second (offline attack, fast hash, many cores) will be more than a century ...

3. «_0) | (X_X) | : v | (^ _ ^;) | " – 30 characters. Entropy of this password = 197.09
It does not contain a single vulnerability when evaluated using "Zxcvbn". The break-in time with such a high entropy is similarly measured in centuries, even with the most powerful attacks. At 10 thousand attempts per second (offline attack, slow hash, many cores) and at 10 billion attempts per second (offline attack, fast hash, many cores) it will be more than a century.

All of the above passwords, which were invented using the proposed techniques, were created using a 95-character alphabet (that is, a set of characters from ASCII) and contain at least 30 characters. These keys meet all security requirements and are reliable

(according to NIST), since they are resistant to brute force attacks and dictionary attacks (according to the "zxcvbn" program)

Let us compare the graphs of the entropy of the first password entered by the respondents and the second password, which was compiled on the basis of the proposed symbol integration system (fig. 4).
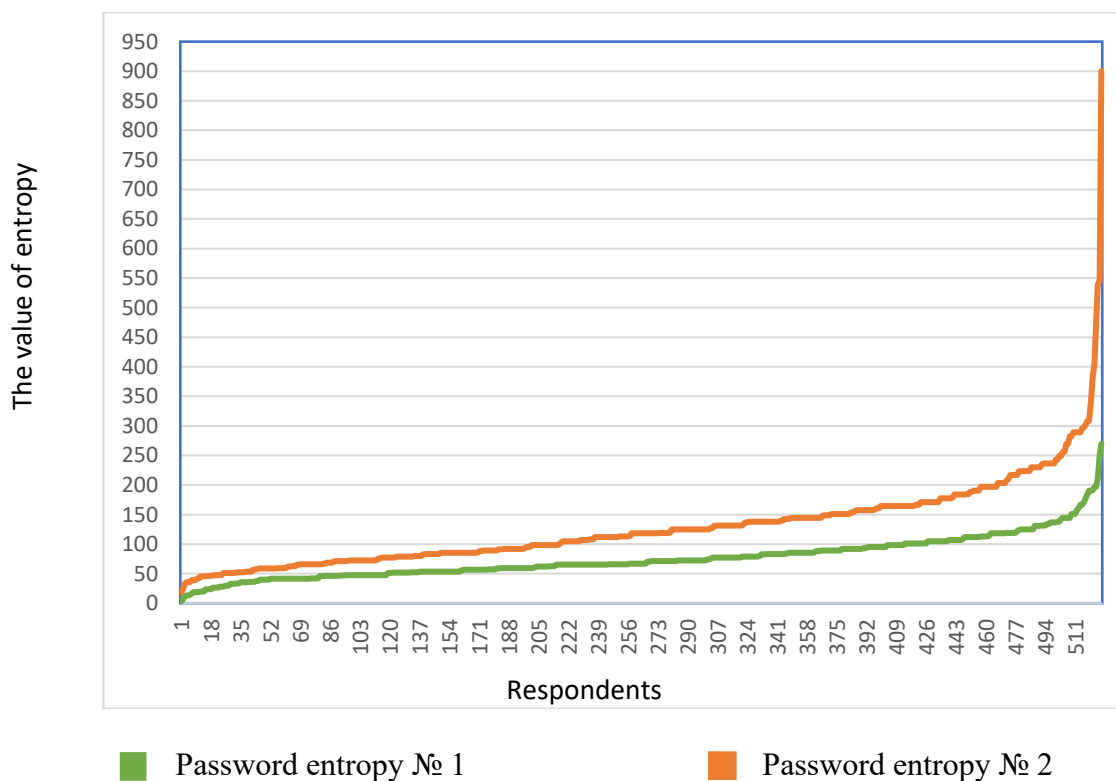

Figure 4. The difference between the entropy of the first password and the second

When comparing the entropy of password №1 and the entropy of password №2, we see a significant difference. The calculations were carried out according to formula (1).

Average entropy of first 526 passwords = 75.95

Average entropy of 526 second passwords = 128.96

In option № 2, the entropy and number of signs are significantly higher than in option №1. This was achieved by the fact that users began to actively use various symbols, numbers and letters, namely, 346 respondents in the second attempt applied exactly the 95-character alphabet (a set of characters from ASCII) That is, symbols from such spheres of life as "chemistry", " mathematics ","programming "and others proposed, allow us to use the alphabet recommended by the National Institute of Standards and Technology (USA) (NIST), but at the same time make associations and are easier to memorize.

As for the perception of the password created by the proposed method, the respondents' answers are rather ambiguous.

In total, 214 people rated the created password at 4-5 on a five-point scale, which indicates the ease of remembering the received password for these respondents, but at the same time 112 people rated the received password as "3", and the remaining 200 chose "1" and

"2" , which suggests that more than half of users still experienced difficulties remembering the key, even using the techniques we proposed for creating it.

Consider the popularity and complexity of passwords relative to the areas of interest our respondents indicated.

Chemistry – 19.39%, drawing – 19.96% – the most popular hobbies of the people who passed the survey. The way home was chosen by 17.87% of respondents, 15.59% preferred mathematics and physics, 8.37% – programming – 8.37% – music and 6.65% Let's consider how users' passwords changed after studying the techniques and symbols of a specific environment of human culture. Further in the text "№1" and "№2" will correspond to the first password entered by the respondent independently and the second password, which was created on the basis of the proposed techniques.

1. Chemistry – 102 respondents chose

Average value of the number of characters in the first password = 12,068.

After respondents got acquainted with the techniques for creating a password based on chemical characters, the average value of the number of characters in the password increased to 18,294

As for entropy, in the first case, the average value was 70.52. In the second case, it increased to 115.49

Let's look at examples of how users managed to improve the password strength by integrating it into the chemical language, using the example of specific passwords entered by the respondents.

1) №1 – Vola34, 6 characters, entropy – 35.72.

No. 2 – $NaCl + AgNo3 = NaNo3 + AgCl$, 21 symbols, entropy 137.96

2) № 1 – BubenetsOleg143010, 18 characters, entropy – 107.17

No. 2 – 1,3,5,5-tetrametil-2,2-dietilnonen-4, 36 characters, entropy – 236.51

3) №1 – Rfgh146ila, 10 characters, entropy – 59.54

№2 – NaKRdZn2356780SiFeG, 18 characters, entropy – 113,129

The dynamics of the average indicators can be seen on the fig. 6
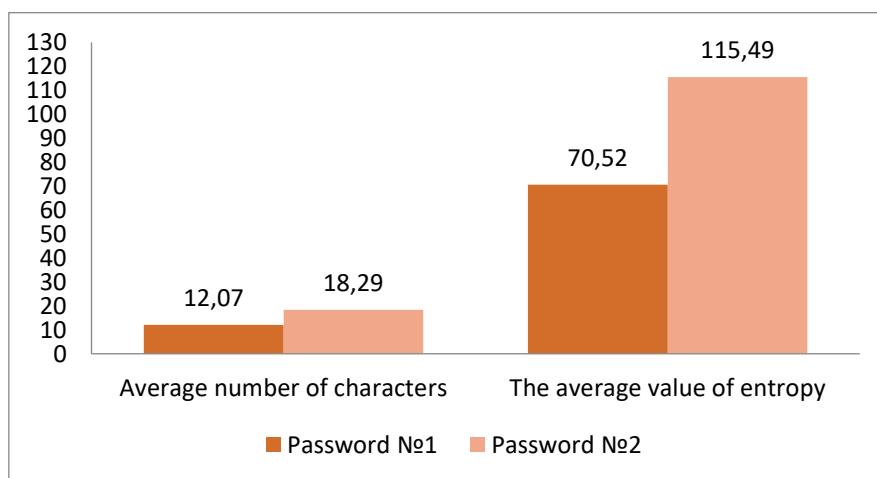

Figure 6. Dynamics of indicators in the "Chemistry" section.

2. Drawing – selected by 105 respondents

Average number of characters in the first password = 12,095.

After the respondents got acquainted with the techniques of creating a password by drawing, the average value of the number of characters in the password increased to 19,257 – as we can see, a little more than in chemistry.

As for the entropy, in the first case the average value was 69.96. In the second case, it increased to 118.56 – the increase in entropy is also more significant than in chemistry.

Let's take a look at examples of how users applied drawing techniques while creating a strong password.

1) № 1 – ghbdtn12, 8 characters, entropy – 41.35

   №2 – '(0_0) (^ _ ^) () (@ _ @) (X_X) | : v | , 31 symbols, entropy 203.66

2) № 1 – Al = in896_nA564310, 17 characters, entropy – 111.68

   №2 – 8xcircle11xsquare2xellipse, 26 symbols entropy – 154.80

3) № 1 – bonkbonk69420, 13 characters, entropy – 67.20

   № 2 – rdcvgfrdcvgfdcfvgrfctg, 22 characters, entropy 103, 40

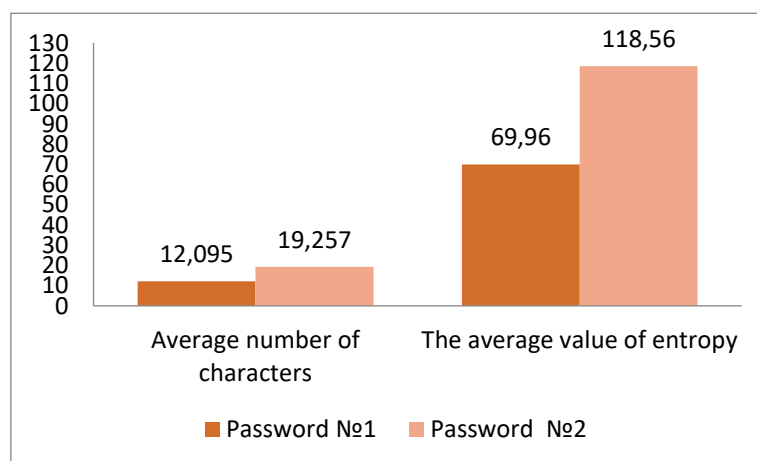The dynamics of the average indicators can be clearly seen on the fig. 7.

Figure 7. Dynamics of indicators in the section "Drawing".

3. "The Way Home" – 94 respondents chose.

The average number of characters in the first case is 13.7. After studying the recommendations for creating a password, based on their usual daily movements, the average number increased to 25.1.

Entropy also increased significantly in the second case. If in the first variant of the password it was 80.51, then the entropy of the second variant in its average value reached 169.2 (Figure 8)

1) № 1 – Polikika543, 11 characters, entropy – 65.49

      №2 – Dom | -> | -> | -> ○ -> | -> Uni, 21 symbols, entropy – 137, 96

2) № 1 – FD43mixyil, 10 characters, entropy – 59.54

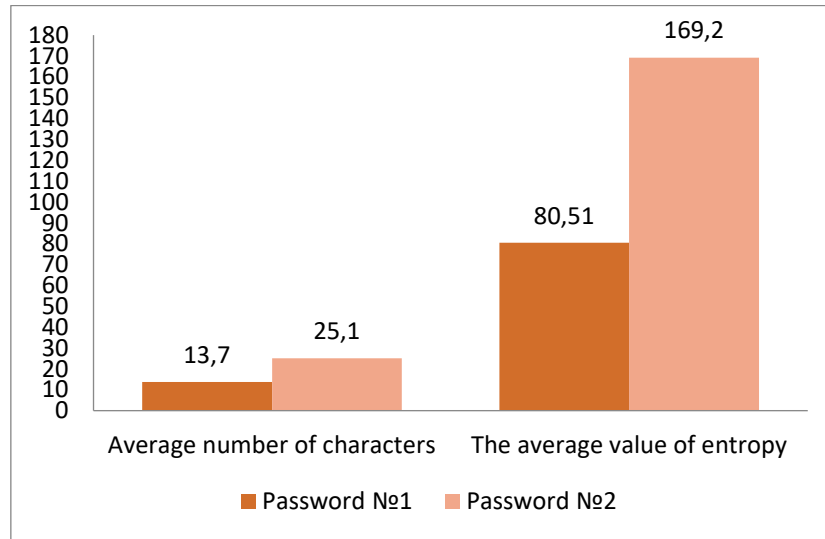   №2 – Home ^ <----> ^^^> ^ -> Kitchen 26 characters, entropy – 170.81

Figure 8. Dynamics of average indicators "Way home"

4. Mathematics and physics – 83 people

The average number of characters in the first password is 11.91, in the second 16.63. The average value of entropy in the first case is 70.63. After studying the ways of using various formulas as a password, the entropy increased to 106.84 (figure 9)

1) № 1 – wjbswjksnsnsksk, 15 characters, entropy- 70, 5

   №2 – cosinus (65) * pi * 2718281, 22 symbols, entropy – 144, 53

2) № 1 – Brido4277 # UU, 12 characters, entropy – 78.83

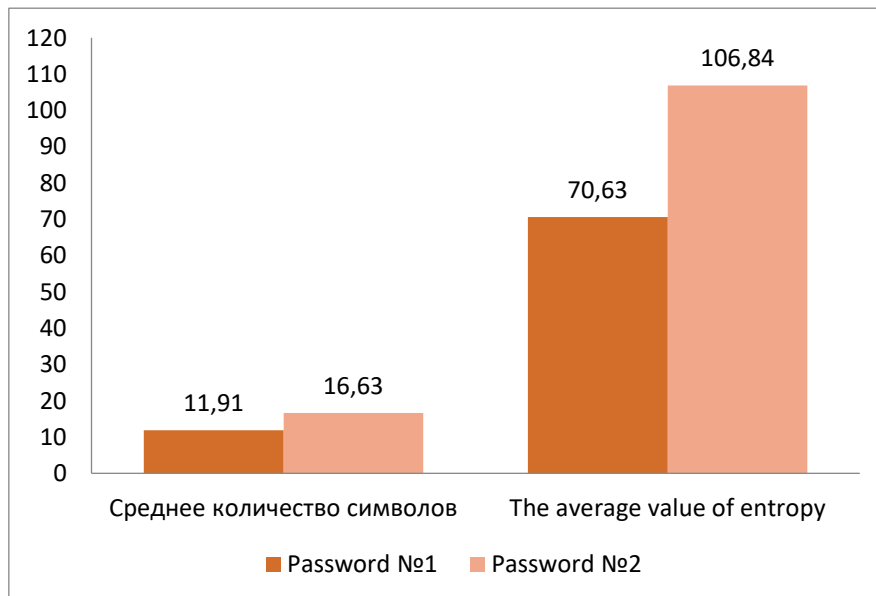   № 2 – 'Mendeleev-Clapeyron: pV = vRT, 26 characters, entropy – 170.81

Figure 9. Dynamics of average indicators in the section "Mathematics Physics"

5. Music – this area was selected by 64 respondents

If we consider the average number of characters in the first password, then we get a value equal to – 14.01.

After learning how to integrate music and its typical symbols into the password creation process, users created passwords with an average number of characters equal to 19.51 (figure 10).

As for the entropy, it also increased in the second case, although not as much as, for example, in "The Way Home". The average value of the entropy of passwords in the first case is 82, 21. The average value of the entropy of passwords in the second case is 116.9 (figure 10).

Consider how the respondents applied the suggested methods:

1) №1 – SuperJack154 (, 13 characters, entropy –85, 4
   №2 – AmEmG7CDmAmA7EmCG7F #, 20 characters, entropy 131.39
2) № 1 – Traueifk4551; / 82, 16 characters, entropy – 105, 11
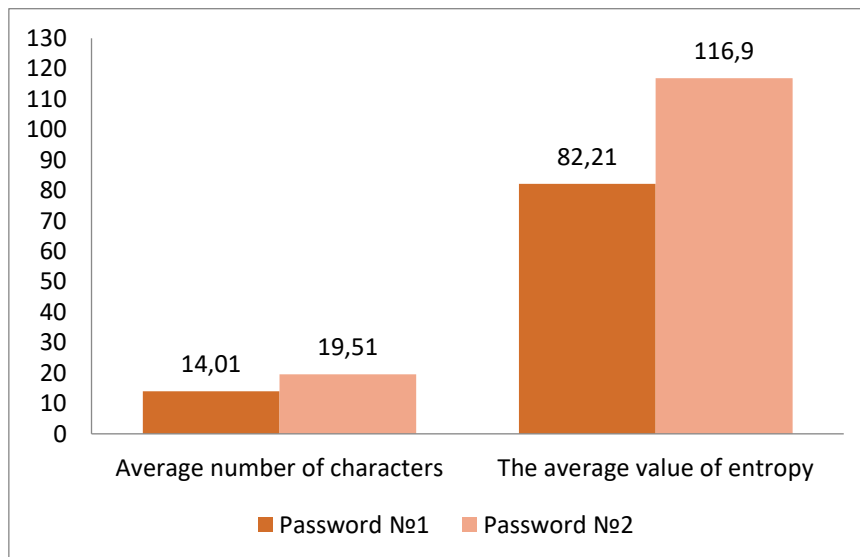   №2 – mollT53T6T64S53SFHSKSLD6D64, 27 characters, entropy – 160, 76

Figure 10. Dynamics of average indicators in the "Music" section

6. Programming – selection of 44 respondents

The average number of characters in the first password is 13.79, in the second it has increased to 26.65.

The increase in entropy in programming is especially remarkable, since it is maximal relative to other interests to choose from.The initial password had an average entropy value of – 84, 30. After the recommendations on integrating the system of programming symbols into the password, the respondents created keys, the average entropy of which reached 170.37 (figure 11).

Let's illustrate it with the examples:

1) No. 1- Hpetr3794 characters 9, entropy –53, 58
   №2 – System.out.println ("Poka"), characters 9, entropy – 170.81
2) № 1- Swft24671dF characters 11, entropy –65, 4953
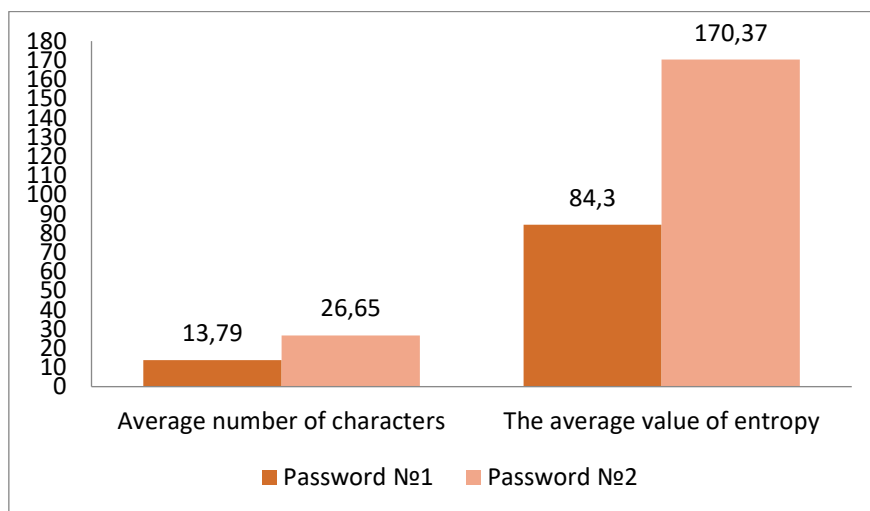   №2 – W: // document / copy2 / team25, characters 25, entropy – 164.24

Figure 11. Dynamics of indicators in programming

Entropy scores "Programming" and "The Way Home" are significantly higher than in the other sections. As for programming, then, most likely, this is due to the fact that the address, for example, to a folder will always contain characters like: ": //" and have a large number of characters. Commands in programming languages also include characters like ")." And most often consist of phrases that are easy to remember. It is also worth considering that people who chose this interest most likely already had information about the methods creating a strong password, which could affect the results of entropy. For clarity, let's compare how the average indicators increased in each of the proposed categories. Consider Figure 12.
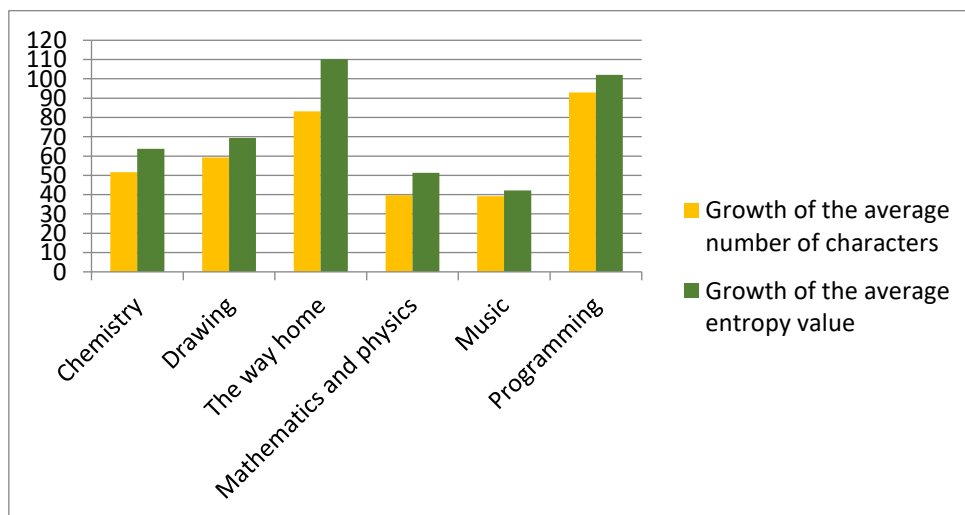

Figure 12. Percentage of growth in the average number of characters in a password and growth in entropy after respondents read the recommendations.

In the graph above, we can see that coding and driving home yielded the largest percentage gains. The use of the "Way Home" technique made it possible to increase the average number of password characters by 83.21%, and increase the entropy by 110.2%. Programming the average number of characters gave an increase of as much as 93%, and

the average value of entropy increased by 102.02%. At the same time, "Mathematics / Physics" and "Music" showed the lowest results. Growth in "Mathematics/physics "on average was 39.63%, and in entropy 51.26%. "Music" gives similar results, namely an increase of 39.26% and 51.26%. "Chemistry" and "Drawing" – turned out to be average in terms of values. The growth in chemistry was 51.59% and 63.76%, respectively, and in painting – 59.21% and 69.47%.

It is also worth considering the number of respondents in each category and the average value of the entropy of the second password (figure 13).
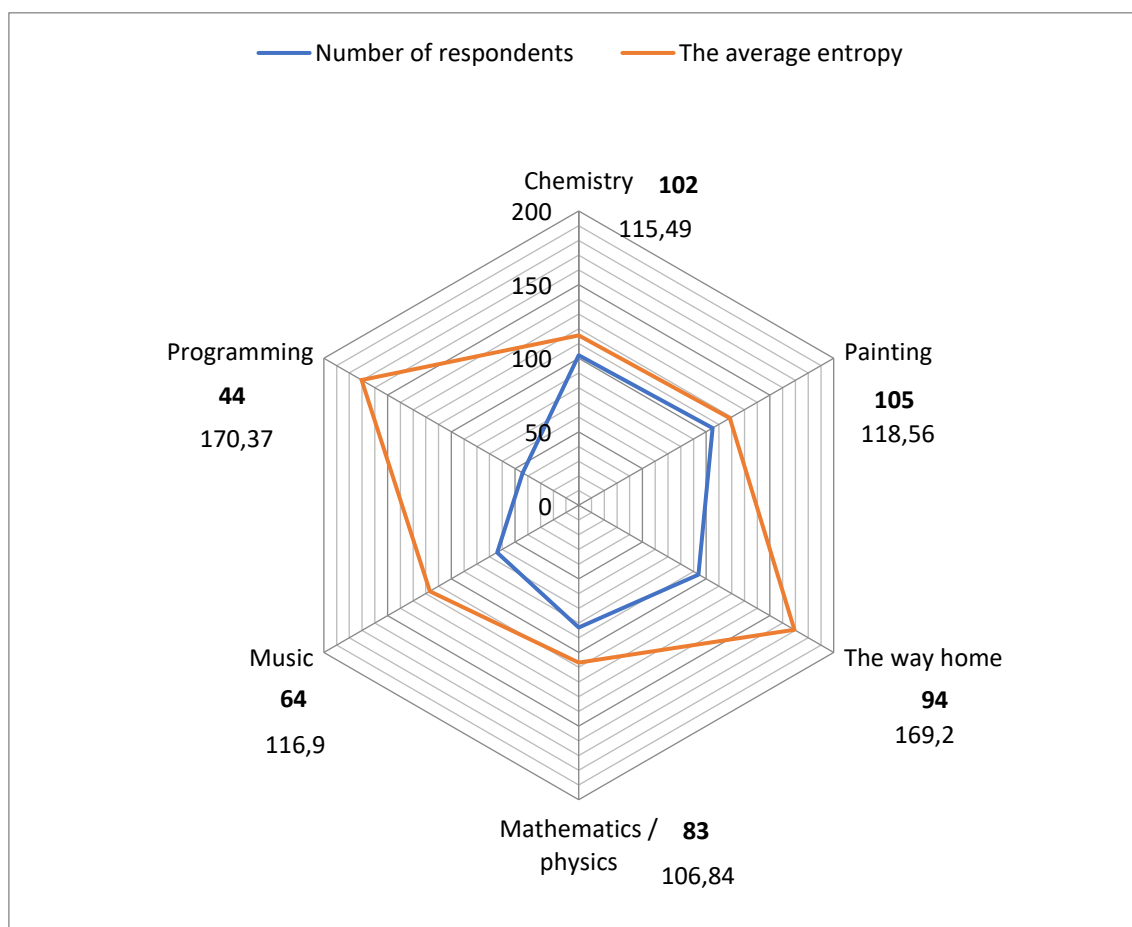
Figure 13. The number of respondents in each category and the average entropy of the second password

CONCLUSION AND DISCUSSION

As a result of our research, we found that 71.70% of our surveyed respondents are not able to create a strong password by themselves. Indeed, in most cases, they entered passwords that were easy to remember and yet completely unreliable in (Guo et al., 2020; Li et al., 2018). Some users have taken serious attempts to create their first password, and several respondents have already known some of the techniques from the Bei et al. (2019) study.

Our recommendations and schemes for composing reliable, but at the same time memorable passphrases using a non-linguistic sign system have reduced the number of unsafe keys from 71.70% to 26.2%, which can be called a good result.

The increase in the entropy of passwords from the first option to the second is associated with several reasons:

1. Respondents in the first case were not reminded of the need to use a strong password, while in the second attempt, users were clearly assigned the task of creating a strong password using the proposed techniques.

2. The selected areas of interest had their own system of symbols, which, when integrated into a password, in most cases met all modern requirements regarding password security, such as: more than 8 characters in length, different case, numbers and symbols.

As for the memorability of the password, according to the survey results, difficulties arise even when using the techniques we proposed, but since they have direct associative chains with music or chemistry, which can facilitate the process of remembering a more reliable password. Memorization problems may indeed be related to long strings, as has been argued in research Stanton & Greene (2014) and Huh et al. (2015)

Users have successfully applied the symbol systems from the areas of interest that they themselves have chosen. The resulting password, in most cases, remained reliable, but at the same time was understandable to the user. This is confirmed by studies (Guo et al., 2020) and (Seitz, 2017) that users tend to choose passwords based on their personal characteristics and interests.

In general, we can say that the proposed techniques justify themselves, since they allow you to create a password that is composed using a 95-character alphabet (that is, a set of characters from ASCII) and contains at least 30 characters. The resulting passwords will meet all security requirements (according to NIST), but at the same time they are easy to associate with, for example, chemistry or programming, which should make them easier to remember. It should be noted that if the proposed techniques become popular, then the databases of dictionaries used by hackers will certainly be replenished with chemical and mathematical formulas, for example. This is obvious from the example of the previously popular method of complicating the password – the use of transliteration, when the words of the Russian language were written in Latin letters, or case switching when the user presses a sequence of keys that would form a Russian word, but the case is at the same time adventurous in Latin letters, so it turns out meaningless set of letters. However, the variety of sign systems suggests that even the introduction of some of the above-mentioned elements into dictionaries will not make these techniques irrelevant in the future.

As for the prospects for researching this topic, it is worth paying attention to the quality of memorizing the password obtained using the techniques given in the article, since the ideal password should ultimately remain easy to remember with its maximum reliability.

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The Technical Transformation of the Literary Epigraph

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Abstract
In this article, the author analyzes 2000 literary epigraphs over a certain period of their existence in terms of their transformation due to the development of social thought and technological progress. The development of printed, information and computer technologies, as well as the changes that have taken place over the centuries in public consciousness, have led to the appearance of new epigraphic types of texts, as well as epigraphic discourses. If the epigraph itself is a technology for directing the reader's attention, it functions differently when it employs quotations from published texts, audio-visual sources, or invented quotes. The survey of technical possibilities demonstrates the staying power of the literary epigraph.

Keywords: Literary Epigraph; Gloss; Flash Epigraph; Epigraphic Text; Creolized Text

Аннотация
В данной статье автором анализируются 2000 литературных эпиграфов за известный период их существования с точки зрения влияния развивающейся общественной мысли и технического прогресса на их трансформацию. Развитие печатных, информационно-компьютерных технологий и изменения, происходящие на протяжении веков в общественном сознании, привели к появлению, помимо традиционных печатных литературных эпиграфов, аудиоэпиграфов, флэш-эпиграфов, новых эпиграфических типов текстов, а также эпиграфических дискурсов, разнообразных с жанровой точки зрения источников литературных эпиграфов.

The Technical Transformation of the Literary Epigraph

Many millennia have passed since the first word was uttered by a human being, but it has become the primary basis, the grain of sand with which the formation of humans, development and growth began. Some grains of sand create pearls, some create stones, but their value is not diminished. Some serve beauty, others serve construction, and together they create our world. So words are the basis of our way of life, create and regulate relationships between people. Words start and stop wars, destroy and save people, create and destroy families, and shape our intelligence. It is thanks to words that the development of technical thought and knowledge of the world became possible. One century follows another, for many millennia words have filled most of the mental space, but, like once powerful streams of water, the streams of words began to lose their power, turning into quiet waters, in which it is sometimes difficult to see the bottom behind the water column and understand what it is: whether it is strewn with precious stones or covered with a thick layer of silt – fertile soil for beautiful gardens. And then there is a need to find a word or words that hide their beautiful cut, not allowing us to enjoy their radiance, highlight them and present them to the world in all their glory. These words are designed to influence people in a special way, to encourage them to think or act, they can affect our attitude to reality, consciousness and self-consciousness, but, of course, not in isolation from other lexical units, but leading them along like a skilled commander. Such words, such generals became literary epigraphs, followed by a text that is perceived by us through the prism of their charisma, their confidence in their rightness.

The literary epigraph, which for the first time preceded written speech, as a literary device appeared not with the appearance of written texts, but much later. It is almost impossible to reliably determine when the epigraph appeared as a literary phenomenon. Based on the sources available for analysis, we can conclude that at the beginning of the XVI century, this literary technique already existed. The subject of research in this paper is the process of change of literary epigraphs overmore than five hundred years of their existence. These changes concern volume, means of allocation, rhythmic organization of speech, types, sources of citation, references to the source of citation, the appearance of new types of texts and discourses, or functions.

The transformation of literary epigraphs takes place as human society develops in all its manifestations from the dominant way of thinking in each of the time periods to technological progress. Its starting point is considered to be the Bible published in 1517, and translated into the Belarusian dialect by Francysk Skaryna (1517/n.d.).

This analysis of the transformations covers the period from the appearance of the first known epigraphic text, created by Francysk Skaryna, to 2020. The *Book of Job* is preceded by a literary epigraph in the form of a poem written by Skaryna. Literary epigraphs created a little later by Pinitian (1478-1542) specifically for Francesco Petrarca's (1610) treatise *De remediis utriusque fortunae* are also a poetic text in the form of distichs. An analysis of literary epigraphs based on the material of the German language (Timakova, 2006, p. 187, 193, 199) showed the predominance of prose literary epigraphs over poetic ones. Indeed, with the development of literary styles, the percentages of prose and poetic literary epigraphs began to change in the direction of a

significant predominance of prose epigraphs over poetic ones especially in the scientific and technical texts and newspaper-journalism.

According to its position in the text, the literary epigraph of Francysk Skaryna (1571/n. d.) in the *Book of Job* occupies an unusual central position for us, in that it is not conspicuous, but is lost among the short content that was then accepted at the beginning of each Chapter. In Jean-Jacques Rousseau's (1781) *Discourse on the Sciences and Arts*, the literary epigraph, while maintaining its central position, is separated by two lines (p. 13). In Stendhal's (1870) novel *Red and Black*, the literary epigraph moves to the right (p. 1), but in some epigraphic texts, the shift to the right may not be present (Augstein, 2001, p. 142). Over time, some of them moved down a separate page (Lindenbaum, 2003, p. 54). To attract attention to the literary epigraph, modern printing houses use various fonts and their combinations (Holzmann, 2003; Zeh, 1990). If initially literary epigraphs were not separated from the text using graphostylistic means, now you can also find literary epigraphs in quotation marks (Schmidt-Knabel, 2003). Modern technical capabilities in publishing make it possible to emphasize as much as possible one of the main features of a literary epigraph – isolation from the text it precedes, on the one hand distancing it from the author, on the other hand helping to attract the reader's attention to it. These include the following tools (table 1):

Table 1. Means of separating literary epigraphs

means of separating literary epigraphs	
typographic tools	immediately before the text
	on separate pages
	offset left, right, up, down pages
	various fonts and their combinations
	framing
graphic and stylistic tools	quotation marks

With the development of information and computer technologies, literary epigraphs have acquired a completely new form. Two forms of audio epigraphs appeared. In the first case, the literary epigraph is nonverbal; in the second case, it is creolized, which is a mixture of different sign systems – verbal and nonverbal signs. For example, in the article *Aibolit-66. Musical plot* (Kulichkin Blog-2, 2011), a literary epigraph is an audio recording of a musical fragment – a non-verbal sign system that precedes a verbal text. It can also be a link to an audio recording, as, for example, in blog posts (Varandej, 2016). In the first case, the literary epigraph is nonverbal; in the second case, it is creolized. On the one hand, this form of literary epigraphs allows you to better understand the author's intent, on the other hand, listening to a literary epigraph by way of a link or reference can be ignored by readers for various reasons: from personal preferences of each person to technical capabilities. Thus, the linked epigraph expands the reader's ability to interpret the text, at the same time, since it is hidden, it reduces its effectiveness. Here we are talking about the emergence of new types of literary epigraphs which can be called implicit and explicit. The less explicit, somewhat hidden epigraphs have fewer opportunities for deeper interaction with the text. In contrast, website design technologies allow you to create completely non-verbal, well-visualized literary epigraphs, for example, in the form of a banner image on a dating site of carefully tending to a fledgling

plant (The Dating Direct, n.d.). Such images, simple to grasp perceptually, can quite strongly affect the reader, sometimes much more so than verbal signs. While printed literary epigraphs include verbal, nonverbal, and creolized epigraphs, literary audio epigraphs will always refer to creolized texts with a greater or lesser degree of creolization, depending on the type of audio text. For example, literary audio epigraphs that precede a lesson contain non-verbal communication methods: intonation, facial expressions, and gestures. And literary epigraphs to a radio broadcast from non-verbal means attract only intonation.

Creating some literary epigraphs requires good computer skills and knowledge of computer programs. In this case, we are talking about recently appeared, but quickly loved by many flash epigraphs. The flash epigraph is based on flash technology, which allows to create "live" animated images, videos with audio effect. A flash epigraph, as a highly creolized text, contains a flash object, often a combination of text, static and animated images, audio or video text. Such epigraphs have the ability to adapt to the blog user, to the individual reader, and to the time of day when they visit the pages preceded by them. Thus, in flash epigraphs, the individual impact on the addressee is increasingly evident, and the text receives an increasing number of adequate interpretations. Thus, the literary epigraph expanded its boundaries from a purely verbal text printed on paper to the following forms (table 2):

Table 2. Types of literary epigraphs

types of literary epigraphs				
printed epigraphs			audio epigraphs	
verbal	nonverbal	creolized	nonverbal	creolized

With the development of science, technology, and the emergence of new social formations, the number of types of texts that become sources for literary epigraphs also increases. The development of road transport has led to the use of quotations from the rules of the road as literary epigraphs (Ilf & Petrov, 1931/2018). The well-established, quotable advertising of goods has given rise to advertisements being used as literary epigraphs (Dik, 1969/1988). Even poems are provided with literary epigraphs from advertisements (Kurochkin, 1867/n.d.). One of the unusual sources of literary epigraphs was the dagger (Bestuzhev, 1831/2015). Tattoos, which appeared at the dawn of human society and have become a form of avant-garde art in the modern world, also served as a source of literary epigraphs (Weller, 2017).

In the history of literature, borrowed literary epigraphs are known as well as epigraphs by the authors themselves. Borrowings include quotations from other works, sayings that do not belong to the author of the epigraphic text. Authors' literary epigraphs are created directly by the author of the work. In the case of the translation of the *Book of Job* of the old Testament by Francysk Skaryna, it may be more about the author's literary epigraphs with which Skaryna prefaced his translation, a text that came from his pen and which essentially explained the purpose and necessity of the translation. In this way, it introduces the reader to an essentially new text. Pinitian "decorated" the original text of Petrarca, his epigraphs are in Latin. These are probably the only literary epigraphs that are neither borrowed nor self-authored.

The desire to hide their thoughts behind other people's words, which when quoted become authoritative by definition, led to the appearance of mystifying literary epigraphs. Literary epigraphs that mystify the reader were usually written by the author himself. But, of course, not all literary epigraphs written by the author are mystifying.

The main feature of mystifying literary epigraphs is a false reference (Poe, 1838/1999; Pushkin, 1836/n.d.; Skaryna, 1517/n.d.). In this regard, it is legitimate to ask whether literary epigraphs without reference can be considered mystifying. To answer this question, it is necessary to clarify what is meant by a literary epigraph in the first place. *A literary epigraph is an independent text or part of a text from a source that is authoritative for the author of an epigraphic work.* Thus, the reader, when reading a literary epigraph, treats it with more confidence than just a quote, and the author's words gain additional weight due to a similar opinion expressed in another source. A quote that has become a literary epigraph, even without reference to the source, is perceived by the reader as words from a reliable source, and in most cases the addressee does not consider them to be mystifying, which would limit their possible impact on the reader. Therefore, literary epigraphs which do not have a reference are mystifying only when the author is sure that the person to whom the text is intended will refer them to mystifying ones without the reference. These include the literary epigraphs to Philip K. Dick's (1969/1988) novel *Ubik*, in which the reader can clearly see the connection with the work. A literary epigraph in its modern sense indicates that the words contained in it are a quote.

The original literary epigraphs to the Bible by Francysk Skaryna and the translation of the treatise of Petrarca were composed by the translators themselves, and they had no reference. Do they refer the reader to an authoritative source, or are they mystifying? Modern readers who expect reading a literary epigraph that is a quote from a reputable author's source might be mystified. Without a reference, most likely these epigraphs should not have performed a mystifying function, although based on the concept of a literary epigraph, we cannot be certain of this. We can only hypothesize that at the beginning of the XVI century, literary epigraphs could not be associated with a quote from an authoritative source, and the words of the author himself were used as a literary epigraph, which could affect the perception of the text following them.

The analysis of 2000 literary epigraphs showed that for more than five centuries of history, these were the sources of literary epigraphs (table 3):

Table 3. Sources of literary epigraphs

sources of literary epigraphs	
1	biblical and religious sources
2	works of fiction
3	private statements
4	scientific and popular science sources
5	folklore sources
6	song sources
7	musical works
8	inscriptions on the dagger
9	fortune telling books

10	Epitaph
11	Motto
12	Periodicals
13	public speaking
14	personal records
15	reference publications
16	official-documentary sources
17	Ads
18	avant-garde art
19	unreal works of fiction
20	fictional scientific sources
21	fictional reference publications
22	fictional personal records
23	fictional plays
24	fictional conversations
25	the thought of a fictional hero

With the development of society and a gradually changing way of life, the concept of text is expanding. Now the text is understood not only as written in a certain sequence of characters on paper. The expansion of the text with the concept of discourse has brought a change in its graphic emphasis and the way it is presented. An interesting experience was the placement of literary epigraphs in musical notes at the request of the publisher. The texts that became creolized in this manner include Tchaikovsky's *Seasons* (Tchaikovsky, 1876/n.d.). The development of technological progress increases the degree of creolization of texts. Films with literary epigraphs, which include the famous ones of Viktor Sergeev *Genius* and Nikita Mikhalkov "*12*", have been distributed. In addition to creolizing texts preceded by literary epigraphs, the literary epigraphs themselves are creolized using various means of different sign systems. This holds, for example, for the literary epigraph that precedes the program *Obvious-improbable*, creolization of which is achieved as a result of its synchronous reading which uses prosodic means, or the literary epigraph in Mikhail Weller's (2017) book *All about life* which is a purely conventional sign, namely a formula.

Based on the position of some authors (Dymarsky, 2001, p. 39-40; Kubryakova & Aleksandrova, 1997, p. 19; Kostrova, 2004, p. 10; Valgina. 2003, p. 20) in this article, discourse is considered as a form of oral speech that includes, based on the speaker's intention, paralinguistic means of communication and is not a record from any medium. Based on this attitude, discourse is always a creolized text, since it contains elements belonging to non-verbal sign systems: kinesics, proxemics, and chronemics.

The fundamental difference between discourse and text is its obligatory creolization, which occurs as a result of the use of non-verbal means in discourse such as kinesics, sensorics, proxemics, and chronemics. Among epigraphic discourses, school lessons, lectures in higher educational institutions, presentations and reports with both educational and commercial purposes are most widespread. Literary epigraphs to them

can either be voiced orally, written on the Board, or displayed on the screen. Thus, an epigraphic discourse may include a text as a literary epigraph in some cases, when it is written on a blackboard or screen and is not voiced.

Epigraphic works are now epigraphic texts and discourses (table 4):

Table 4. Epigraphic texts

Epigraphic texts		
epigraphic text		epigraphic discourse
uncreolized	creolized	creolized

During the existence of the literary epigraph, the genre palette of texts preceded by it has significantly expanded. If initially literary epigraphs preceded only biblical texts, popular scientific treatises and works of art, they can now be found in texts of all existing styles: colloquial and book (scientific, official business, journalistic, artistic). Most rare are, of course, epigraphic texts that are official business, but nevertheless, literary epigraphs are present, for example, in many Annual Reports on the activities of the Commissioner for human rights in the Russian Federation (Annual Report on the Activities, 2019) or even a questionnaire (Nedel'ko et al, 2008). Currently, the literary epigraph can be found in various types of text and discourses (table 5):

Table 5. Epigraphic texts and epigraphic discourse

epigraphic text	epigraphic discourse
artistic	lessons
educational	lectures
reference	presentations
newspaper and magazine	reports
advertising	
programs of performances	
biographies	
catalogs	
movies	
programs of political parties	
reports	
questionnaires	
notes	
instructions	

One of the most important features of a literary epigraph for centuries was its brevity. Now there are some literary epigraphs which do not adhere to this. For example, the literary epigraph in Vladimir Savchenko's (1998) novel *Opening yourself* reaches 9223 characters, not counting the spaces.

Usually literary epigraphs are put by the author of an epigraphic text in the process of its creation. But the history of literary epigraphs also knows exceptions, when texts after a long period of time without the knowledge of their author became epigraphic. In the early history of printing and publication, books were precious and rare and the choice of sources limited. The development of social thought stimulated a new view of existing books, and the development of printing allowed them to be reprinted. Many older books faded from public awareness, epigraphs brought them back into the present. The development of society and national identity is inseparable from the development of language, which explains the need to translate 22 books of the *Old Testament* into the Belarusian dialect, implemented by Francisk Skaryna in 1517. The literary epigraph he set for one of the books of the *Old Testament* emphasized the translator's attitude to his work, for whom and for what purpose the translation was carried out, emphasized the complexity, but at the same time the need to perform this task (Scott, 1831/2004).

The development of printing houses and the ability to publish a large print run for the XVI century in a short time, combined with one of the possibilities of a literary epigraph to direct the perception of readers in a certain direction, led, in all probability, supporters of the reformation to the idea of including in the new edition of Petrarca's (1610) treatise *De remediis utriusque fortunae* (p. 305, 342, 344) literary epigraphs, thus turning the original text in the appropriate direction which was effected by the distichs of Pinitian.

It can be assumed that the need to precede the text with a literary epigraph arose in connection with the change in the role and functions of this text in society and its adaptation to the changes that occurred was carried out thanks to the message conceyed by the literary epigraph.

The literary epigraph also created a special poetic form, the gloss, which modern poets rarely use despite the fact that it has existed for many centuries, first appearing in Spain in the XVI century. For most epigraphic texts and discourses the literary epigraph is by and large an optional element that brings additional meanings, but for glosses the literary epigraph is obligatory. As an independent literary work, the gloss relies on a poetic quotation, including its individual parts in its structure. A reference to the preceding poetic work as a conscious reminiscence is found in the last line of each stanza.

Some glosses deviate from these requirements. In traditional glosses, each line of a literary epigraph becomes the last line of each stanza. In variations, this strict sequence is not observed and the text unfolds as a comment of sorts on the epigraph.

One of these gloss variations is Gottwalt's (n. d.) *Variationen auf Dählings Bild: Der Wettgesang*. This variation has more stanzas than the literary epigraph provides. In some stanzas, two, three, or four lines of the literary epigraph that belong to another poet are repeated at once.

A literary epigraph may go beyond the generally accepted concept of a quotation, as a verbatim excerpt, but can result from transformations of a different nature. The transformation of quotations in literary epigraphs can be the result of both conscious and unconscious actions of the author to modify it. The deliberate alteration of a quote used as a literary epigraph is primarily due to creative intent. Such transformations in a quote can lead to its greater artistic expressiveness, greater compliance with the style, imagery of the prefaced text, and its functions. For example, A. S. Pushkin (1824/n.d.) in *The fountain of Bakhchisarai* freely stated the lines contained in a poem written in the XIII

century by the Persian poet Saadi as follows: "Many, like me, have visited this fountain; but others are no longer there, others are wandering far away. Sadi".

Sometimes authors want to preface their work with a literary epigraph that recalls words which left an emotional mark on their soul, but cannot be reproduced accurately. A literary epigraph as a special literary technique allows one not to make a reference to the source of citation, which sometimes makes one want to make changes to them, presenting the text in a light that is favorable to the author, or to put one's own thoughts as a literary epigraph. By employing them as a literary epigraph, even by attributing them to a fictional author, one's thoughts take on a special standing and assume a kind of authority from their alleged background.

Sometimes, in different editions of the same epigraphic text, the literary epigraph undergoes transformations that affect the perception of the entire text, illustrating the power of the epigraph to present the text like a skilled commander. Discrepancies caused by different transformations of the literary epigraph depending on the publication of the epigraphic text create a different pragmatic effect. In various editions of the musical play *April. Snowdrop* from Peter Ilich Tchaikovsky's series *The seasons* one finds the same literary epigraph with differences only of punctuation. In the pre-revolutionary edition of the notes, the literary epigraph had a neutral key and punctuation consisted only in a dash, three commas, a dot, an ellipsis. Of its two sentences the second one features an intonation of incompleteness (Tchaikovsky, 1876/n.d.). In a later reissue of the notes (Tchaikovsky, 1876/1964), an exclamation mark appears instead of a comma, which enhances emotionality. The first stanza acquires an intonation of incompleteness as an ellipsis replaces the dot. The sentence of the second stanza of the literary epigraph is not divided by a comma as in the earlier version, it is transferred from the second part of the sentence to the first. The literary epigraph increases the number of sentences to three thanks to the new punctuation division. Two of them feature an intonation of incompleteness, and one has an exclamation point.

Publishers often do not pay attention to the degree of isolation of the literary epigraph in the epigraphic text, which leads to different forms of typographic isolation. This typographic technique of shifting to the right is less common in glosses than in other epigraphic texts. Nevertheless, this technique is used in the modern edition of Friedrich Rückert's (n.d.) gloss "*Erhalte mir den offnen Sinn...*", although in the edition published in 1841, the literary epigraph is placed in the center (Rückert, 1984, p. 583). A literary epigraph is not a static quote, but often a quote that has undergone transformation both on the part of the author of the epigraphic text, which was influenced by his background knowledge and intent, as well as on the part of publishers, who most often exploit its aesthetic function and ability to influence the minds of readers. Among the transformations of literary epigraphs, we can currently distinguish paraphrasing, punctuation and typographic changes.

With the development of technological progress, there is a new need and opportunity to create a variety of texts in form and content. Over the centuries, literary epigraphs have varied in both form and content. If their form was primarily influenced by technological progress and a large variety of literary epigraphs appeared in typographic isolation, as written or audio epigraphs, or flash epigraphs, and if they thus became an integral part of texts, discourses, creolized texts, then their content changed depending on the needs of a society developing both technically and spiritually, which finds expression

in the genre variety of citation sources and the functions performed by them. The functionality of literary epigraphs in texts of the new format has become more diverse. Literary epigraphs decode nonverbal texts (Tchaikovsky, 1876/n.d), become provocateurs of discourses, and implement their goals and objectives.

Currently, the literary epigraph is going through difficult times. Some publishers try to remove literary epigraphs from epigraphic texts in order to avoid copyright issues which can lead to significant changes that interfere with the author's intent. A literary epigraph, having gone a long way from a simple text by way of varying degrees of creolization, discourse, and flash epigraphs, creating a new type of poetic text may disappear along with the gloss as a phenomenon, since according to modern copyright legislation it sometimes violates the rights of other authors.

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Essay

'A Few Words of Welcome'

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Abstract

This paper examines the contemporary absence of hospitality. Is today's absent hospitality to be understood as a moral disaster, and a failure of responsibility? Or should we think of the silence in place of yesterday (or tomorrow's) 'welcome' as the exemplary mode of hospitality? Through a polemical reading of Jacques Derrida's texts on hospitality, it is possible to argue that – far from representing a dereliction of the word 'welcome', the contemporary silence on the question of hospitality can be interpreted as the zenith of hospitality itself. Whether this silence stands for the final word on hospitality is, however, a question which remains unresolved.

Keywords: Hospitality; Derrida; Technology; Welcome; Host

Аннотация

В этой статье исследуется современное отсутствие гостеприимства. Следует ли понимать сегодняшнее отсутствие гостеприимства как моральную катастрофу и отказ от ответственности? Или нам следует рассматривать тишину вместо вчерашнего (или завтрашнего) "добро пожаловать" как образец гостеприимства. Путем полемического прочтения текстов Жака Дерриды о гостеприимстве можно утверждать, что игнорирование слова "добро пожаловать", молчание по вопросу гостеприимства означает зенит самого гостеприимства. Однако вопрос, является ли это молчание последним словом о гостеприимстве, остается нерешенным.

'A Few Words of Welcome'

I.

We are living in a time of inhospitality. Whether it's the refusal to welcome refugees – be they Eastern European, North African, Mexican or South Asian – the depersonalisation or anonymisation of traditional places of hospitality – in the form of the roadside hotel or the self check-in motel, or the illegalisation of hospitality during the Covid crisis: it's possible to say, today, that, in a number of places, hospitality is not taking place.

It would be possible, now, to raise the question of the time of hospitality, as a useful or dangerous fiction. Turning to the past, we may hear others say, or tell ourselves, that 'We have a great history of hospitality'; turning to the future, we might say 'We'll get around to hospitality in a just a moment, but I just need to get my house in order before I…'. Or perhaps, we remember that 'We used to be so good at hospitality, whatever went so wrong?'; or 'We'll do better in the future, starting now'. The time of hospitality, like all time, is filled with potential for good and bad.

But for the moment, here, I'm interested in the place of hospitality, or those sites at which hospitality takes place, or fails to take place. My text is provoked by the late work of Jacques Derrida, who – among other things – asks the reader to think about the dynamic, dangerous interplay of technology and hospitality (Derrida 1998, p. 61).

Responses to Derrida's request – to think about the technology of welcoming, and of hospitality – are not common. His thinking on hospitality has commonly been interpreted as a dialogue with Immanuel Kant on the possibility of retaining a place for particularist ethics within universal political theory (Bankovksy, 2005; Still, 2012); indeed, in a number of places, Derrida articulates his own position as a reformulation of Kant's (1795/1983), as it appears in 'On Perpetual Peace'. In similar terms, scholars have identified a confrontation with capitalism in the form of the 'gift economy' (Ahn, 2010; Norton, 2015; Heard, 2010): the question concerns the possibility of 'giving' hospitality without expecting – or demanding – that hospitality be given in return, thus instantiating a circulation of commodified 'gifts' of hospitality. But the question of hospitality today – of the modes, places and times of hospitality produced by contemporary technology – has remained comparatively marginal.

When I first imagined this text, I had the idea to follow the redefinition of technology, according to its Greek etymology – 'techne' and 'logos', meaning 'study of skills' – to a study of the skills of hospitality: skills which require practise, and cultivation. Hospitality is not something that can be achieved as a one-off, or a once and for all – it takes time. I know that these are skills that we are sorely, sorely lacking today.

But rather than follow the etymological route, through Greece and back to the present day, I'm interested in the meaning of 'technology' as we commonly use it: 'tech', computers, screens, Ipads, TVs etc. In particular, I'm interested to ask, in Derrida's words, when thinking about hospitality, "what it is that comes our way by e-mail or the Internet?" (Derrida, 1998, p. 47) What is the character of the reshaping of the place of hospitality which has occurred following the technological revolution of the last 20 or so

years? I aim to show that we have arrived, today, at a space of hospitality which is at the same time exemplary and empty. There is an exemplarily absent hospitality taking place today, when nobody is saying 'welcome'.

II.

In order to understand what is happening today, at the philosophical level, it will be necessary to think again about hospitality: how to give hospitality; to whom to give hospitality; where to give hospitality; what is given in hospitality, and so on. If the exemplary non-occurrence of hospitality is to be comprehensible, the exemplary occurrence will need to be clear.

Derrida's identifies three key qualities, or necessary conditions, in the act of hospitality: the generous welcome, the statement, and the reversal. These moments could be understood as unfolding one after the other, or perhaps in reverse order, or all at once.

First, a word, or a few words of welcome. When I say 'welcome' to you, I appear to be giving you something: water, bread, fish, wine, coffee, a meal, or even a place to sleep. At the abstract level, I give you the gift of hospitality; at the practical level, this gift entails giving you something of my own. There is a suggestion of generosity: it is generous to give something which used to be belong to me – my own things, things which belong to me, which matter to me, which are precious or treasured, which are personal, which carry personal significance or memories – away to somebody else. We are familiar with the virtue of generous hospitality: the guest is told, 'make yourself at home', 'what's mine is yours', 'be my guest'. This is a kind of unconditional or radical hospitality, in which I say, to you, welcome, whoever you are (Derrida, 1998, p. 27).

Following, or prior to, or at the same time, there is a statement. When the host says 'welcome' to the guest, they say 'this is mine to give to you'. In order to be able to give something, from me to you, it must be mine in the first place. Thus, 'this is my bread, my wine, my house, my spare bed', even 'this is my own bed, and I give it to you'. In order for the exchange to occur, it must be begun with a statement from the host to the effect that 'all this – this place I call 'home' – is mine': Derrida (1999) writes, "to say welcome is perhaps to insinuate that one is at home here, that one knows what it means to be at home, and that at home one receives, invites, or offers hospitality, thus appropriating for oneself a place to welcome the other, or worse, welcoming in order to appropriate for oneself a place" (p. 15-16). In order to say 'welcome', in order to give hospitality, it is necessary to state that I belong here, that this is my place, that I know how to give hospitality, and that I know how to make you feel at home.

Already, then, the dynamic power of hospitality is laid out: when I welcome you, I commit myself – my time and my place – to you, and yet, in doing so, I lay claim to everything. In this way, it is possible for Derrida (1999) to claim that "hospitality thus precedes property" (p. 45). Hospitality, as the statement 'this is mine', is constructive, insofar as it empowers the host to lay claim to something, or somewhere. The hospitable host builds their own home in the act of hospitality. Being hospitable, thus makes property possible, and creates the home space.

Finally, or first of all, there is a reversal. I have claimed that the act of welcoming simultaneously gives and takes: in order to give hospitality, I must have hospitality to give. Derrida argues, on the basis of this, that it is really the guest who gives hospitality, not the host. The very possibility of saying 'this is mine and I give it to you, welcome',

the "capacity to receive ('to be in the position to receive')" (Derrida, 1999, p. 27) depends on having someone – a guest, a friend, a stranger, a migrant – to give to. Thus, it is the guest who 'gives' that possibility to the host. Hospitality cannot be achieved alone: it depends on the guest.

These moments can be confusing. Which comes first? Who gives last? Where does hospitality begin and end? Are they stages in time, or can they all be bundled up together? Do they unfold in different spaces? I suggest that all of these questions, and many more beside, are different ways of asking the most fundamental question: what is the best form of hospitality?

Derrida's (1998) answer is 'unconditional' or 'absolute hospitality' (p. 25). What is called for, in unconditional hospitality, is hospitality with quotas, without time limit, without points systems, without VISA, or sans-papieres. If any limit is placed on hospitality, "if I welcome only what I welcome, what I am ready to welcome … there is no hospitality" (Derrida, 2001, p. 362). Hospitality must not be given selectively, or based on any preconditions. As soon as the host says 'you are welcomed, just as long as you don't…' or 'you are completely welcome, on the condition that…', this is not really hospitality.

Hospitality, according to Derrida, consists in welcoming unconditionally: extending the welcome to whoever passes your door, whoever they may be, wherever they may be from, wherever they may be going, whatever their name or nation (Derrida 1998, p. 25). This welcome, this hospitable gesture, is not something which can be controlled, located, determined, measured, or planned for. It happens all at once, and over and over again. It's out of control: it can't be controlled. Hospitality doesn't obey any category or law, except its own Law: the Law of absolutely unconditional hospitality.

It is clear, of course, that unconditional hospitality is not taking place today. I suggest that this 'non-occurrence' is can be understood most clearly in the figure of the 'absent host' – a host who, surprisingly, can be said to figure exemplary hospitality. That is to say, unconditional hospitality entails giving everything: one's food, drink, one's time and space, even one's own bed. How can this be done? I suggest: by not being there.

III.

There are a number of places, today, in which you – the guest – can stay which do not require ever meeting the host. You can arrive, and check in, at your fixed time: this can be achieved with a code sent to your phone, or via inputting your details into a machine at the 'arrival desk'. You may be given a key, or a keycard, which gains access to the room, in which you may find a bed, sheets, perhaps even a towel. You are informed of the check out time, by which point you must vacate the premises, in order that the cleaner – perhaps the only person you may during your stay, if only by accident, having not checked out at the proper time – can do their job.

All of the traditional signs and objects of hospitality are present: you have full and unlimited access to the contents and space of your allocated room. The room will be exactly as you expected it to be: clean and fully equipped with all the necessary implements.

And yet. Where is the host? Who is the host? Who says 'welcome'? You may communicate with the host online, via email or virtual message. They may even have left you a 'welcome package' in which the rules are laid out, the insurance policy, and your

rights in the case of emergency are described. In some cases, it may not even be that the host is 'absent': they may never have lived there. They may have bought the property with the sole intention of putting it up to rent. In their absence, then, stands their employee: the cleaner. The cleaner who may themselves not be 'in-house', but from an outsourced company which employs a predominantly female, immigrant population. There is an absent host, and no permanent replacement.

And yet. Isn't this ideal? All of the tensions, complications, awkwardnesses and trade-offs described above – Who gives to who? How much to give? When to give, and for how long? – all of these disappear. The host provides exemplary hospitality by simply being out of the picture. They give everything, even their own place. They are not there. Nothing is held back, retained, or off-limits: there is nobody, nothing, nowhere which says 'this is the host: not for you'. Those words of welcome – so difficult to enunciate – are no longer required. Nobody, and nothing, says 'welcome, make yourself at home', and thus there is no anxiety about the right way to respond to those words. At no point, are the guests commanded or obligated to 'be' somebody's guest. There is no question of asking for more food, or where the toilet is, because there is nobody to hear those words. There is no word of welcome, because there is no 'welcomer'. The host does not take their place: they do not take place. Exemplary hospitality is, then, achieved in the absent host.

And perhaps this is the situation. Perhaps, today, what is occurring is an absent, yet exemplary hospitality. Perhaps the absent host of these new modes of hospitality is not the sign of the apocalypse, or abyss of inhospitality; perhaps, rather, this is exemplary of the current situation. Hospitality is not being performed badly; it is not being performed at all. Those who might otherwise be in the position to give hospitality are simply not there. The posts of hospitality are unmanned, absent, out of place. The word 'welcome' is no longer spoken.

Thus, all of the difficult questions about how to give and receive hospitality disappear. The space of hospitality – the rented apartment – is completely open for the guest to inhabit. There is no awkward greeting, no uncertain exchange of gifts, no moment of measured generosity. The host does not impinge upon the guest's space, or right to space. All of the trappings of traditional hospitality are not there, and thus the guest is able to fully make themselves at home.

This, therefore, is the high point of hospitality. The hospitality of the absent host should not be considered a failure, or a wrong turn in the history of cultures. Rather, this cultivated absence has produced an exceptional mode of hospitality.

But, of course, something has gone awry. Surely, it doesn't make sense to say that exemplary hospitality is achieved when there is no host? Is it really possible that hospitality is best done by abdication? Does it even make sense to say this non-occurrence, the non-gift of the absent host, is what should be considered 'exemplary hospitality'? To say such a thing would mean to say that, today, when hospitality is not occurring, what is occurring is exemplary hospitality.

Today, what is occurring is the end – the most, the ideal, the best – of hospitality. Today, we can answer the question and close the door, close the book on hospitality: hospitality has been an open and shut case. The last word on the question of hospitality has been spoken. We have no more need for words of welcome. We can move on now.

IV.

But, there are attempts. There are attempts, although they are failing. Small attempts at kindness, minor moments of goodness and little gestures remain; glancing eye contact in the one-off encounter. Nothing systematic, or planned; no calculated activity, or deliberation. Nothing which can be incorporated into a plan, a policy, or a quota, or a script which can be learnt and recited. Almost nothing.

In whichever spaces – yours or mine or theirs – at whatever time, it remains possible to meet the glance of another, or to give someone else a bit of space, or to pass a moment's conversation. Whether it is my space or time which I give to someone, or I give someone some time and space to themselves, fractional occasions of hospitality occur. This hospitality is not something which can be foreseen or curated: it may be barely perceptible – barely recognisable as such. The terms, the words, the gestures are not calculable; the moment of their exchange unforeseeable, and their nature undefinable. Perhaps it could even be accidental, a slip of the tongue, or done with more skill than intended. These little moments remain possible, and perhaps more necessary than ever.

We are, presently, falling short of the demands of hospitality. Where and when hospitality is called for, we are not responding. We are providing and being given limited time, limited space, and limited hospitality. It can feel, sometimes, as if we are trying for nothing. This isn't an exclusively modern, unprecedented diagnosis, however – this case has a history, and perhaps a future, too. This is not the last word of hospitality. The door is not entirely closed, even if it is only ajar.

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