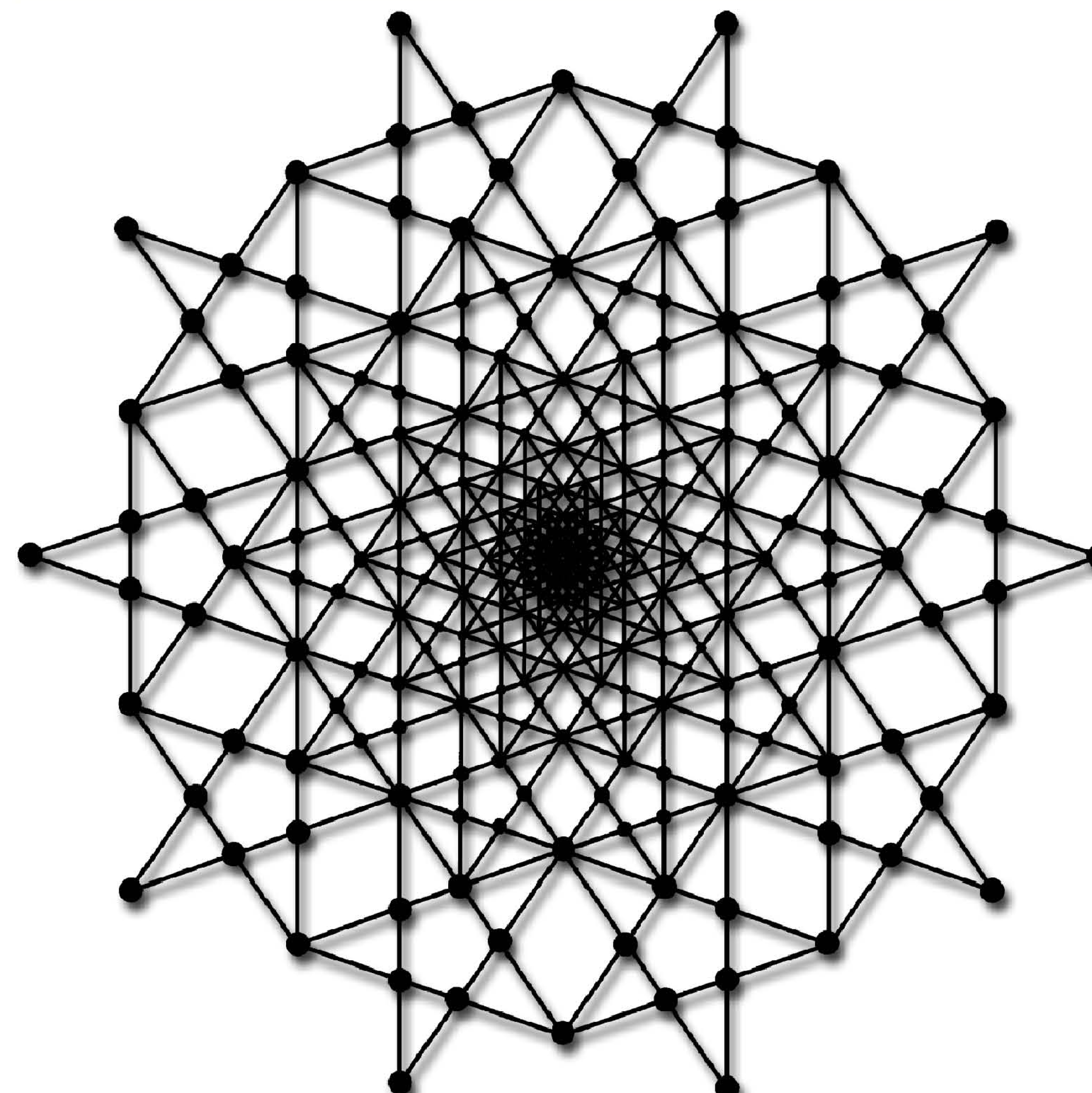
Symmetry: Culture and Science

The journal of the Symmetrion

Editor: Michel Petitjean
Volume 23, Number 1, 2012



Symmetry: Culture and Science · Vol. 23, No. 1, 2012

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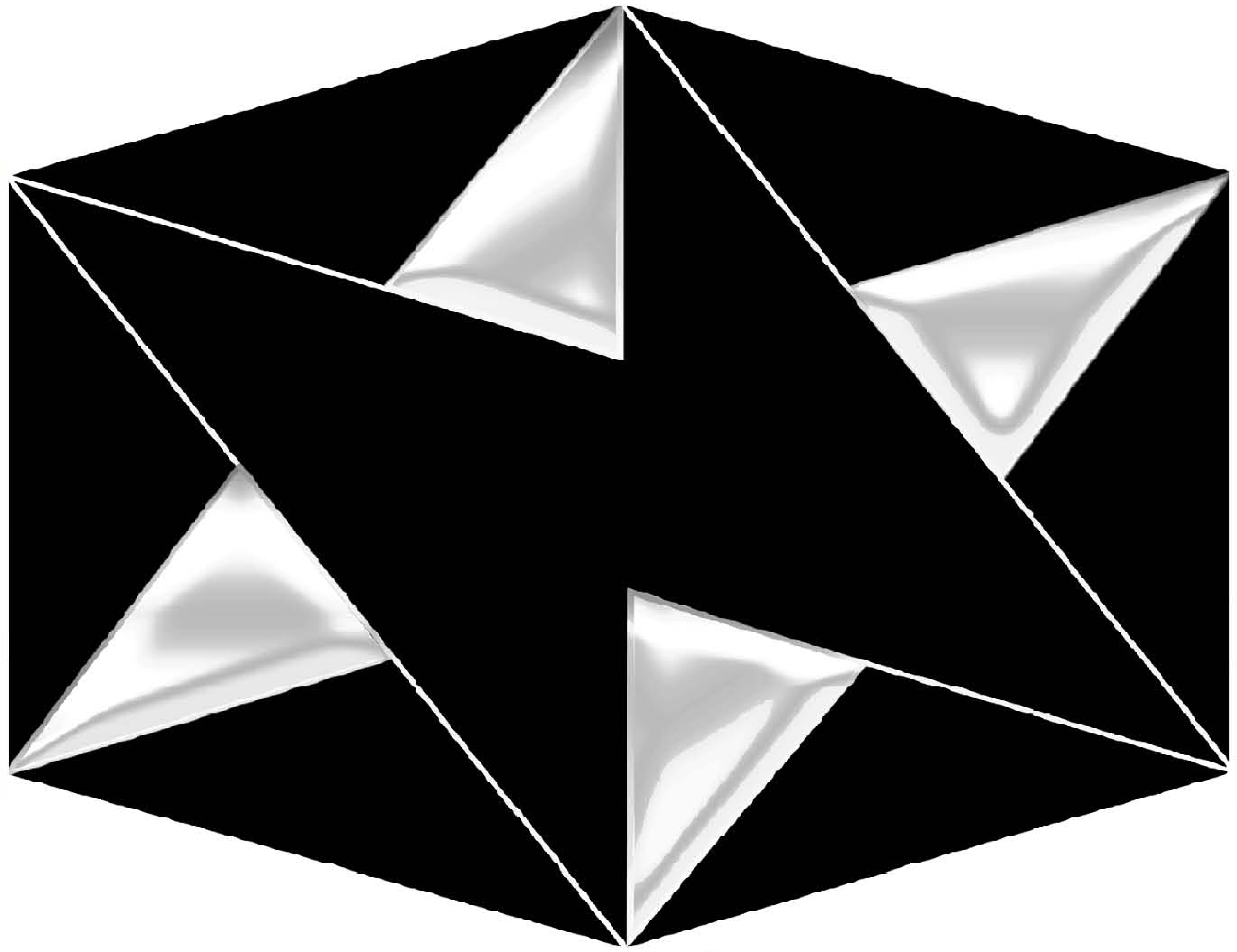

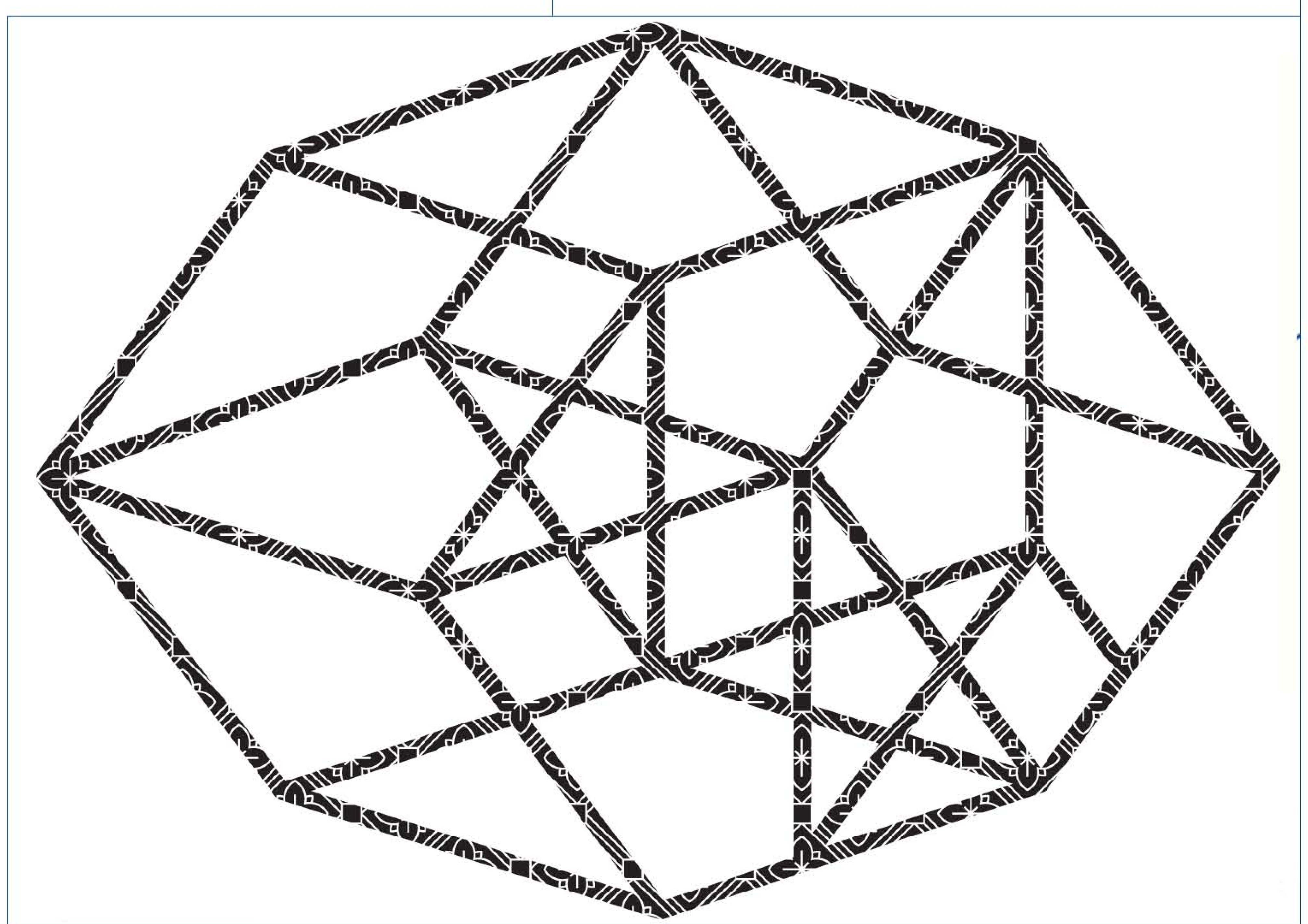

SYMMETRION
Budapest, Hungary
http://symmetry.hu

Symmetry: Culture and Science

Founding editors: G. Darvas and D. Nagy

The journal of the Symmetrion

Editor:
Michel Petitjean

Volume 23, Number 1, 1-96, 2012

SYMMETRY IN LITERATURE

CONTENTS

SYMMETRY: CULTURE AND SCIENCE is the journal of and is published by the Symmetrion, *http://symmetry.hu/*. Edition is backed by the Executive Board and the Advisory Board (*http://symmetry.hu/isa_leadership.html)* of the International Symmetry Association. The views expressed are those of individual authors, and not necessarily shared by the boards and the editor.

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Annual subscription:

Normal	€ 100.00,
Members of ISA	€ 75.00,
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ISSN 0865-4824 – print version

ISSN 2226-1877 – electronic version

Cover layout: Günter Schmitz;
Image on the front cover: Matjuska Teja Krasek: *Star(s) for Donald*, 2000, (tribute to H.S.M. Coxeter);
Images on the back cover: Matjuska Teja Krasek: *Twinstar* and *Octapent*;
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Symmetry: Culture and Science
Vol. 23, No.1, 3-4, 2012

EDITORIAL

This special issue of the Symmetry journal opens with Steven Weinberg's article on fundamental features of symmetry and its attitude towards universal structures. The Editorial board of Symmetry journal is delighted to express its sincere gratitude to Prof Weinberg for his kind permission to reproduce this inspiring article, where the fundamental approach to symmetry is proposed related to the symmetries of physical laws, leading to a deduction about strictly accidental nature of the mirror symmetry of the electromagnetic and strong nuclear forces, as well as the proton–neutron symmetry. The most intriguing are Steven Weinberg's meditations on the nature of the universe: still chaotic, except for some "patches" where life could arise, and in its own time start to reflect on the nature of universe. This can lead the reader to Greek myth on Titanomachy as the base of Greek culture, and accidentally, to the main topic of the presented issue of the Symmetry journal: symmetry in literature.

The known history of the symmetry in literature is traced back to the antiquity, when ancient Greek poets invented some strict forms of prosody. It descends from the ancient Greek art-*techne* that conformed to traditional and formal methods, and developed in multifarious forms, including elements of word play. Aristotle referred to art-*techne* understanding creative art as a special technique, similar to the techniques needed to create architectural objects, or even medical techniques (Aristotle, Metaphysics, book 1, chapter 1). Heidegger in *Question Concerning Technology* explains that the term *techne* was related not only to technical objects and processes in the modern sense of the word, but the methods of disclosure of the most important truth, raising to the highest level of understanding the mystery of the human being. Poetry, by Heidegger, was one of these arts: "the *poiesis* of the fine arts also was called *techne*".

The term *Ars* for the medieval arts and science was the scholastic loan translation of the Greek *techne*. Medieval poets invented and used restricted poetical structures such as *sonnet*, *rondeau*, *triolet*, *villanelle*, *terza rima* and *sestina* that later became the approved instruments of poetry or were forgotten for the preference of free verses. Less studied are formal restrictions on letters, words, or sounds and signs of the texts, resulting in such forms *acrostic* and *abecedary*, *palindromes* and *anagrams* that were also tools of the search for poetical harmony. In the mid-late twentieth century interest to formal literary techniques was reborn. The symmetrical (and dissymmetrical)

structures could be found in the texts of James Joyce, Vladimir Nabokov, Jorge Luis Borges, Julio Cortazár, Georges Perec, Raymond Queneau, Umberto Eco, and other writers. After many years of Romantic literature and *vers libre* poetry, new formalistic movements appear: in the 1960s, L'Ouvroir de Littérature Potentielle in France; in the 1980s, New Formalism in USA, focusing on rigid forms, refined rhymes and formalized stanza structures.

Still the literary works are ahead of critical and detailed textual analysis. This issue of the journal Symmetry is a step for this analysis, undertaken in order to create bridges between mathematics and literature, between cultures of different languages, and between the reader and the writer.

Tatiana Bonch-Osmolovskaya

Symmetry: Culture and Science
Vol. 23, No.1, 5-16, 2012

KEYNOTE LECTURE AT THE SYMMETRY FESTIVAL 2009

VARIETIES OF SYMMETRY[1]

Steven Weinberg

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When I first started doing research in the late 1950s, physics seemed to me to be in a dismal state. There had been a great success a decade earlier in quantum electrodynamics, the theory of electrons and light and their interactions. Physicists then had learned how to calculate things like the strength of the electron's magnetic field with a precision unprecedented in all of science. But now we were confronted with newly discovered esoteric particles, some existing nowhere in nature except in cosmic rays. And we had to deal with mysterious forces: strong nuclear forces that hold particles together inside atomic nuclei, and weak nuclear forces that can change the nature of these particles. We did not have a theory that would describe these particles and forces, and when we took a stab at a possible theory, we found that either we could not calculate its consequences, or when we could, we would come up with nonsensical results, like infinite energies or infinite probabilities. Nature, like an enemy, seemed intent on concealing from us its master plan.

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[1] This article is based in part on a keynote talk (entitled *Accidental Symmetry*) given at the *Symmetry Festival 2009*, (recorded at: *http://videotorium.hu/hu/recordings/details/571,Accidental_Symmetry*) organized by the International Symmetry Association at the Technical University of Budapest in August, 2009. A shortened version was published in *The New York Review of Books*, (Weinberg, 2011).

At the same time, we did have a valuable key to nature's secrets. The laws of nature evidently obeyed certain principles of symmetry, whose consequences we could work out and compare with observation, even without a detailed theory of particles and forces. It was like having a spy in the enemy's high command.

1

I had better pause to say something about what physicists mean by principles of symmetry (Darvas, 2007). In conversations with friends who are not physicists or mathematicians, I find that they often take symmetry to mean the identity of the two sides of something symmetrical, like the human face or a butterfly. That is indeed a kind of symmetry, but it is only one simple example of a huge variety of possible symmetries.

The Oxford English Dictionary tells us that a symmetry is "the quality of being made up of exactly similar parts". A cube gives a good example. Every face, every edge, and every corner is just the same as every other face, edge, or corner. This is why cubes make good dice; if a cubical die is honestly made, when it is cast it has an equal chance of landing on any of its six faces.

The cube is one example of a small group of regular polyhedra – solid bodies with flat polygons for faces, that satisfy the symmetry requirement that every face, every edge, and every corner should be precisely the same as every other face, edge, or corner.

These regular polyhedra fascinated Plato. He learned (probably from the mathematician Theaetetus) that regular polyhedra come in only five possible shapes, and he argued in *Timaeus* that these were the shapes of the bodies making up the elements: earth consists of little cubes, while fire, air, and water are made of polyhedra with four, eight, and twenty identical faces, respectively. The fifth regular polyhedron, with twelve identical faces, was supposed by Plato to symbolize the cosmos. Plato offered no evidence for all this – he wrote in *Timaeus* more as a poet than as a scientist, and the symmetries of these five bodies evidently had a powerful hold on his poetic imagination.

The regular polyhedra in fact have nothing to do with the atoms that make up the material world, but they provide useful examples of a way of looking at symmetries, a way that is particularly congenial to physicists. A symmetry is at the same time a

principle of *invariance.* That is, it tells us that something does not change its appearance when we make certain changes in our point of view. For instance, instead of describing a cube by saying that it has six identical square faces, we can say that its appearance does not change if we rotate our frame of reference in special ways, for instance by 90^o around directions parallel to the cube's edges.

The set of all the transformations of points of view that will leave something looking the same is called its invariance group. This may seem like an awfully fancy way of talking about things like cubes, but often in physics we make guesses about invariance groups, and test them experimentally, even when we know nothing else about the thing that is supposed to have the conjectured symmetry. There is a large and elegant branch of mathematics known as group theory, which catalogs and explores all possible invariance groups, and is described for general readers in two recently published books (du Sautoy, 2008; Stewart, 2007).

Each of Plato's five regular polyhedra has its own invariance group. Each group is finite, in the sense that there are only a finite number of changes in point of view that leave the polyhedron looking the same. All these different finite invariance groups are contained in an infinite group, the group of all rotations in three dimensions. This is the invariance group of the sphere, which of course looks the same from all directions.

For aesthetic and philosophical reasons, spheres also figured in early speculations about nature – as a model not of atoms, but of planetary orbits. The seven known planets (including the Sun and Moon) were supposed to be bright spots on spheres that revolve around the spherical Earth, carrying planets on perfect circular orbits. But it was hard to reconcile this with the observed motions of planets, which at times seem even to reverse their direction of motion against the background of stars. According to the neo-Platonist Simplicius, writing in the sixth century AD, Plato had put this problem to mathematicians at the Academy, almost as if assigning a bit of homework. "Plato lays down the principle," says Simplicius:

> "that the heavenly bodies' motion is circular, uniform, and constantly regular. Therefore he sets the mathematicians the following problem: What circular motions, uniform and perfectly regular, are to be admitted as hypotheses so that it might be possible to save the appearances presented by the planets?"

"Save the appearances" is the traditional translation, but what Plato meant by this is that a combination of circular motions must precisely account for the apparent motions of the planets across the sky.

This problem was addressed in Athens by Eudoxus, Calippus, and Aristotle, and then more successfully, with the introduction of epicycles, at Alexandria by Hipparchus and Ptolemy. The problem of planetary motions continued to vex astronomers and philosophers in the Islamic and Christian worlds, up to and beyond the time of Copernicus. Of course, much of the difficulty in solving Plato's problem arose from the fact that the Earth and what we now call the planets go around the Sun, not the Sun and planets around the Earth. The Earth's motion explained why planets seem sometimes to jog backward in their paths through the zodiac. But even when this had been understood by Copernicus, he still had trouble making his theory agree with observation, because he shared Plato's conviction that planetary orbits had to be composed of circles.

No really satisfactory solution to Plato's problem could be found, because planetary orbits are actually ellipses. This was the discovery of Kepler, who incidentally as a young man had like Plato also been fascinated by the five regular polyhedra. Astronomers and philosophers for two millenia had been too much impressed with the beautiful symmetry of the circle and sphere.

2

The symmetries that offered the way out of the problems of elementary particle physics in the 1950s were not the symmetries or invariances of *things*, not even things as important as atoms or planetary orbits, but the symmetries, expressed as principles of invariance, of *laws*.

Laws of nature, in the modern sense of mathematical equations that tell us precisely what will happen in various circumstances, first appeared as the laws of motion and gravitation that Newton developed as a basis for understanding Kepler's description of the solar system. From the beginning, Newton's laws incorporated principles of invariance: The laws that we observe to govern motion and gravitation do not change

their form if we re-set our clocks, or if we change the point from which distances are measured, or if we rotate our laboratory.[2]

There is another less obvious symmetry, known today as Galilean invariance that had been anticipated in the fourteenth century by Jean Buridan and Nicole Oresme: The laws of nature that we discover do not change their form if we observe nature from a moving laboratory, travelling at constant velocity.

Newton and his successors took these invariance principles pretty much for granted, as an implicit basis for their theories, so it was quite a wrench when these principles themselves became a subject of serious physical investigation. The crux of Einstein's 1905 Special Theory of Relativity was a modification of Galilean invariance. This was motivated in part by the persistent failure of physicists to find any effect of the Earth's motion on the measured speed of light, analogous to the effect of a boat's motion on the observed speed of water waves. It is still true in Special Relativity that making observations from a moving laboratory does not change the form of the observed laws of nature, but the effect of this motion on measured distances and times is different in Special Relativity from what Newton had thought. Motion causes lengths to shrink and clocks to slow down in just such a way that the speed of light remains a constant, whatever the speed of the observer. This new symmetry, known as *Lorentz invariance*[3]*,* required profound departures from Newtonian physics, including the convertibility of energy and mass.

The advent and success of Special Relativity alerted physicists in the twentieth century to the importance of symmetry principles. But by themselves, the symmetries of space and time that are incorporated in the Special Theory of Relativity could not take us very far. One can imagine a great variety of theories of particles and forces that would be consistent with these spacetime symmetries. Fortunately it was already clear in the 1950s that the laws of nature, whatever they are, also respect symmetries of other kinds, having nothing directly to do with space and time.

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[2] For reasons that are difficult to explain without mathematics, these symmetries imply important conservation laws: the conservation of energy, momentum, and angular momentum (or spin). Some other symmetries imply the conservation of other quantities, such as electric charge.

[3] Lorentz had tried to explain the constancy of the observed speed of light by studying the effect of motion on particles of matter. Einstein was instead explaining the same observation by a change in one of nature's fundamental symmetries.

It had been known since the 1930s that the unknown laws that govern the strong nuclear force respect a symmetry between protons and neutrons, the two particles that make up atomic nuclei. It is not just that the equations governing the strong force do not change if everywhere in these equations we replace protons with neutrons and neutrons with protons. They also do not change if we replace protons and neutrons with particle states that are neither protons nor neutrons, but superpositions of the two; for instance, each proton might be replaced with a particle that has a 60% chance of being a proton and a 40% chance of being a neutron, and each neutron with a particle that has a 40% of being a proton and a 60% chance of being a neutron. As a consequence of this symmetry, the force between two protons is not only equal to the force between two neutrons; it is also equal to the force between a proton and a neutron. (This invariance group is mathematically the same as the invariance group of the sphere.)

Then as more and more types of particles were discovered, it was found in the 1960s that this proton-neutron symmetry was part of a larger symmetry group, which came to be called *the eightfold way*. Not only are the proton and neutron related by this larger symmetry to each other; they are also related to six other particles, known as hyperons. All the particles that feel the strong nuclear force fall into similar families, with eight, ten, or more members.

But there was something puzzling about these internal symmetries: Unlike the symmetries of space and time, these new symmetries were clearly not exact. Electromagnetic phenomena did not respect these symmetries; protons and some hyperons are electrically charged; neutrons and other hyperons are not. Also, the masses of protons and neutrons differ by about 0.14%, and their masses differ from those of the lightest hyperon by 19%. If symmetry principles are an expression of the simplicity of nature at the deepest level, what are we to make of a symmetry that only applies to some forces, and even there is only approximate?

An even more puzzling discovery about symmetry was made in 1956-7. The principle of mirror symmetry states that the laws we find do not change if we observe nature in a mirror, which reverses distances perpendicular to the mirror (that is, something far behind your head looks in the mirror as if it is far behind your image, and hence far in front of you). This is not a rotation – there is no way of rotating your point of view that has the effect of reversing directions in and out of a mirror, but not sideways or vertically. It had generally been taken for granted that mirror symmetry, like the other

symmetries of space and time, was exact and universal, but in 1957 experiments showed convincingly that, while the electromagnetic and strong nuclear forces do obey mirror symmetry, the weak nuclear force does not.

So we had a double mystery: What causes the observed violations of the eightfold way symmetry and of mirror symmetry? Theorists offered several possible answers, but as we will see, this was the wrong question.

The decades of the 1960s and 1970s witnessed a great expansion of our conception of the sort of symmetry that might be possible in physics. The proton-neutron symmetry was originally understood to be *global*, in the sense that the equations governing the strong nuclear forces were only supposed to be unchanged if we changed protons and neutrons into mixtures of each other in the same way everywhere in space and time. But what if the equations obeyed a more demanding symmetry, one that was *local*, in the sense that the equations would also be unchanged if we changed neutrons and protons into *different* mixtures of each other at different times and locations? This would not lead to any new particle families, like the neutron-proton doublet or the octets of the eightfold way. Instead, a local symmetry would require the existence of new particles similar to photons (the particles of light), new particles that could produce forces acting between protons and neutrons. It was hoped that this sort of theory might somehow explain the strong nuclear force that holds neutrons and protons together in atomic nuclei.

Conceptions of symmetry also expanded in a different direction. Theorists began in the 1960s to consider the possibility of symmetries that are *broken*.[4] That is, the underlying equations of physics might respect symmetries that are nevertheless not respected by the physical states represented by *solutions* of the equations.

Kepler's elliptical planetary orbits provide a good example. The equations governing the gravitational field of the Sun, and the motions of bodies in that field, respect rotational symmetry – there is nothing in these equations that distinguishes one direction in space from another. A circular planetary orbit of the sort imagined by Plato would also respect this symmetry, but the elliptical orbits actually encountered in the Solar System do not; the long axis of an ellipse points in a definite direction in space.

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[4] The term "broken symmetry" is somewhat misleading. In these cases the symmetry of the underlying equations may be exact; it is solutions of these equations that do not respect the symmetry.

At first it was widely thought that broken symmetry might have something to do with the small known violations of symmetries like mirror symmetry or the eightfold way. This was a false lead. A broken symmetry is nothing like an approximate symmetry; it can play no role in putting particles into families like those of the eightfold way.

But broken symmetries do have consequences that can be checked empirically. Because of the spherical symmetry of the equations governing the Sun's gravitational field, the long axis of an elliptical planetary orbit can point in any direction in space. This makes these orbits acutely sensitive to any small perturbation that violates the symmetry, like the gravitational field of other planets. For instance, these perturbations cause the long axis of Mercury's orbit to swing around through 360^o in the plane of the orbit every 2,573 centuries. In the 1960s theorists realized that the strong nuclear forces have a broken symmetry, known as chiral symmetry, which governs the properties of particles called π mesons.[5]

The path out of the dismal state of particle physics in the 1950s turned out to lead through local and broken symmetries. First, electromagnetic and weak nuclear forces were found to be governed by a broken local symmetry. (The experiments now under way at the new accelerator at CERN in Switzerland have as their first aim to pin down just what it is that breaks this symmetry.) Then the strong nuclear forces were found to be described by a different local symmetry. The resulting theory of strong, weak, and electromagnetic forces is now known as the *Standard Model*, and does a good job of accounting for virtually all phenomena observed in our laboratories.

3

It would take far more space than I have here to go into details about these symmetries and the Standard Model, or about other proposed symmetries that go beyond those of the Standard Model. Instead I want to take up one aspect of symmetry that as far as I know has not yet been described for general readers. When the Standard Model was put in its present form in the early 1970s, theorists to their delight encountered

[5] Chiral symmetry is like the proton-neutron symmetry mentioned above, except that the symmetry transformations can be different for particles spinning clockwise and counterclockwise around their direction of motion. The π meson is in a sense the analog of the slow precession of an elliptical planetary orbit; just as small perturbations can make large changes in an orbit's orientation, π mesons can be created in collisions of neutrons and protons with relatively low energy.

something quite unexpected. It turned out that the Standard Model obeys certain symmetries that are *accidental*, in the sense that, though they are not the exact local symmetries on which the Standard Model is based, they are automatic *consequences* of the Standard Model. These accidental symmetries accounted for a good deal of what had seemed so mysterious in earlier years, and raised interesting new possibilities.

The origin of accidental symmetries lies in the fact that acceptable theories of elementary particles tend to be of a particularly simple type. The reason has to do with the nonsensical infinities I mentioned earlier. In theories that are sufficiently simple these infinities can be canceled by a re-definition, or "renormalization", of physical constants, like masses and charges. In these simple theories, known as "renormalizable" theories, only a small number of particles can interact at any given location and time, and then the energy of interaction can depend in only a simple way on how the particles are moving and spinning.

For a long time many of us thought that to avoid intractable infinities, these renormalizable theories were the only ones physically possible. This posed a serious problem, because Einstein's successful theory of gravitation, the General Theory of Relativity, is not a renormalizable theory. In the 1970s it became clear that there are circumstances in which non-renormalizable theories are allowed, but the relatively complicated interactions that make these theories non-renormalizable are expected to be suppressed if they arise from some sort of unknown new physics at scales of distance much shorter than those probed in familiar physical processes. Gravitation is in fact highly suppressed – it is by far the weakest of all the known interactions among elementary particles. But even so, because non-renormalizable interactions are suppressed, physicists can usually ignore them and still get reliable approximate results.

This is a good thing. It means that there are only a few kinds of renormalizable theories that we need to consider as possible descriptions of nature.

Now, it just so happens that under the constraints imposed by Lorentz invariance and the exact local symmetries of the Standard Model, the most general renormalizable theory of strong and electromagnetic forces simply can't be complicated enough to violate mirror symmetry.[6] Thus, the mirror symmetry of the electromagnetic and strong nuclear forces is an accident, having nothing to do with any symmetry built into nature

[6] Honesty compels me to admit that here I am gliding over some technical complications.

at a fundamental level. The weak nuclear forces do not respect mirror symmetry because there was never any reason why they should. Instead of asking what breaks mirror symmetry, we should have been asking why there should be any mirror symmetry at all. And now we know.

The proton-neutron symmetry is explained in a similar way. The Standard Model does not actually refer to protons and neutrons, but to the particles of which they are composed, known as quarks and gluons.[7] The proton consists of two quarks of a type called "up" and one of a type called "down"; the neutron consists of two "down" quarks and an "up" quark. It just so happens that in the most general renormalizable theory of quarks and gluons satisfying the symmetries of the Standard Model, the only things that can violate the proton-neutron symmetry are the masses of the quarks. The "up" and "down" quark masses are not at all equal – the "down" quark is nearly twice as heavy as the "up" quark – because there is no reason why they should be equal. But these masses are both very small – most of the masses of the protons and neutrons come from the strong nuclear force, not from the quark masses. To the extent that quark masses can be neglected, then, we have an accidental approximate symmetry between protons and neutrons. Chiral symmetry and the eightfold way arise in the same accidental way.

So mirror symmetry and the proton-neutron symmetry and its generalizations are not fundamental at all, but just accidents, approximate consequences of deeper principles. To the extent that these symmetries were our spies in the high command of nature, we were exaggerating their importance, as happens often also with real spies.

The recognition of accidental symmetry not only resolved the old puzzle about approximate symmetries; it also opened up exciting new possibilities. It turned out that there are certain symmetries that could not be violated in any theory that has the same particles and exact local symmetries as the Standard Model and that is simple enough to be renormalizable.[8] If really valid, these symmetries, known as lepton and baryon conservation,[9] would dictate that neutrinos (particles that feel only the weak and

[7] These particles are not observed experimentally, not because they are too heavy to be produced (gluons are massless, and some quarks are quite light), but because the strong nuclear forces bind them together in composite states like protons and neutrons.

[8] Again, I admit to passing over some technical complications.

[9] Lepton number is defined as the number of electrons and similar heavier charged particles plus the number of neutrinos, minus the number of *their* antiparticles. (This conservation law requires the neutrino to be

gravitational forces) have no mass, and that protons and many atomic nuclei are absolutely stable. Now, on experimental grounds these symmetries had been known long before the advent of the Standard Model, and had generally been thought to be exactly valid. But if they are actually accidental symmetries of the Standard Model, like the accidental proton-neutron symmetry of the strong forces, then they too might be only approximate. As I mentioned earlier, we now understand that interactions that make the theory non-renormalizable are not impossible, though they are likely to be highly suppressed. Once one admits such more complicated non-renormalizable interactions, the neutrino no longer has to be strictly massless, and the proton no longer has to be absolutely stable.

There are in fact possible non-renormalizable interactions that would give the neutrino a tiny mass, of the order of one hundred millionth of the electron mass, and give protons a finite average lifetime, though one much longer than the age of the universe. Experiments in recent years have revealed that neutrinos do indeed have such masses. Experiments are under way to detect the tiny fraction of protons that decay in a year or so, and I would bet that these decays will eventually be observed. If protons do decay, the universe will eventually contain only electrons and lighter particles like neutrinos and photons. Matter as we know it will be gone.

I said that I would be concerned here with the symmetries of laws, not of things, but there is one thing that is so important that I need to say a bit about it. It is the universe. As far as we can see, when averaged over sufficiently large scales containing many galaxies, the universe seems to have no preferred positions, and no preferred directions. But this too may be an accident. There is an attractive theory, called chaotic inflation, according to which the universe began without any special spatial symmetries, in a completely chaotic state. Here and there by accident the fields pervading the universe were more-or-less uniform, and according to the gravitational field equations it is these patches of space that then underwent an exponentially rapid expansion, known as inflation, leading to something like our present universe, with all non-uniformities smoothed out by the expansion. In different patches of space the symmetries of the laws of nature would be broken in different ways. Much of the universe is still chaotic, and

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massless because neutrinos and antineutrinos respectively spin only counterclockwise and clockwise around their directions of motion. If neutrinos have any mass then they travel at less than the speed of light, so it is possible to reverse their apparent direction of motion by travelling faster past them, hence converting the spin from counterclockwise to clockwise, and neutrinos to antineutrinos, which changes the lepton number.) Baryon number is proportional to the number of quarks minus the number of antiquarks.

it is only in the patches that inflated sufficiently (and in which symmetries were broken in the right ways) that life could arise, so this is inevitably where any beings who study the universe will find themselves.

This is all quite speculative. There is observational evidence for an exponential early expansion, which has left its traces in the microwave radiation filling the universe, but as yet no evidence for an earlier period of chaos. If it turns out that chaotic inflation is correct, then much of what we observe in nature will be due to the accident of our particular location, an accident that can never be explained, except by the fact that it is only in such locations that anyone could live.

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Volume 23, Number 1, 17-96, 2012

SYMMETRY IN LITERATURE

A thematic issue

Guest editor:
Tatiana Bonch-Osmolovskaya

Symmetry: Culture and Science
Vol. 23, No.1, 19-28, 2012

SYMMETRY IN LITERATURE

1,143,839,622,748,050,000,000,000,000 SONNET ANAGRAMS

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Fields of interest: Constrained writing, software algorithms.

Abstract*: In this paper we present one hundred and forty lines of iambic pentameter and a simple combinational algorithm which together generate slightly more than one octillion different pairs of anagrammatically symmetric sonnets. The techniques used to create this highly-constrained text are also discussed.*

Keywords: combinational literature, anagrams

1. INTRODUCTION

Consider the following pair of poems:

When first the gods lie mounted on a tray
To play of idle art when summer's nigh.
The rules of his mind's order went astray
Because men rose at once with plans so high.

So on this earth the languid dream-pace flows:
A countryside, the blue romantic sea,
The god finance rebuilt, a prey that slows;
These hold the tired mountains earnestly.

To hasten faith, while printed authors leer,
Where farming thousands low resentment bore
Do paper hearts that win soon gladly sear?
The watchful starling toodles "Nevermore".

Tend to a torch as round-pitched tables hum
Let gather Fates; the icon moon sets dumb.

We find that soon the melodies turn gray
Our flesh an empty mold, a winter sigh.
She renders ransom first without delay
When each soon-passing truth becomes a lie.

What laid among the fields our parents chose:
A mist at noon, a cheesy cultured Brie,
The bending pile a faulty horse-cart tows;
These too shall run and meet their destiny.

With haunted hope, if lethal traitors sneer
While wrongs at men returned, as months before
Shall steady wind not propagate or shear?
The term's wrong value told the final score.

So spot that old authentic hardened crumb
The tombstone flat, the caged sensorium.

Each of these poems is a traditional English sonnet with fourteen lines of iambic pentameter and rhyme scheme *abab cdcd efef gg*. In addition, each sonnet of the pair is an anagram (or transposal) of the other, as it can be formed by rearranging all the letters in the other sonnet; in this sense the two sonnets are symmetric. Being anagrams, both sonnets have the same letter distribution shown in the Table 1.

Letter	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Count	38	6	10	20	61	9	9	33	24	0	0	22	14	33	36	8	0	33	37	51	15	1	11	0	7	0

Table 1: Letter distribution in the sonnet anagram.

In the remainder of this paper we will describe the construction of a base text and a simple procedure from which 1,143,839,622,748,050,000,000,000,000 different pairs of sonnet anagrams can be constructed. The pair above is just one chosen at random from the 1.143 octillion available.

2. STRUCTURE AND COMBINATORICS

The basis of the one octillion sonnet anagrams is a set 140 lines of iambic pentameter. There are fourteen sets of ten lines called Set 1, Set 2, … Set 14. To create a sonnet anagram, consisting of two sonnets called Sonnet A and Sonnet B, choose a line from Set 1 to be Line 1 of Sonnet A, then a different line from Set 1 to be Line 2 of Sonnet B. Continue this procedure, using Set N to provide the choices for Line N in both sonnets. The two sonnets that result from this procedure are guaranteed to be anagrams (in fact, they will always have the letter distribution shown in Table 1) because of a very special property of our text: all ten lines in each set are anagrams of each other.

Besides being anagrammatically symmetric, the fourteen sets of ten lines are also constrained by the rhyming necessities of the sonnet form. The *abab cdcd efef gg* rhyme scheme means that the 140 lines must also form seven groups of twenty lines (one group for each of *a* through *g* in the rhyme scheme), with all twenty lines in a group having the same rhyme sound (determined by the terminal vowel/consonant pair). For poetical reasons we also impose a strict requirement that the rhyming words in each pair of lines in a sonnet (each pair of *a*'s, each pair of *b*'s, etc.) be non-trivial. For example, if line 1 ends in *tea*, then line 3 must not end in *tea*, nor can it end in *tee* (different spelling but same sound), nor can it end in *fealty* (which has the same rhyme sound, -*tee*). A precise statement of this rule is that the vowel or consonant sound

which precedes the vowel-consonant rhyme sound must not be duplicated between any two sets with the same rhyme sound (Set 1 and 3, Set 2 and 4, etc.). For example if *-ā* is the rhyme sound and Set 1 has *stray* (consonant sound STR-) then Set 3 could have *stay* (ST-) or *today* (D-) but not *astray* (which duplicates STR- and so would lead to a trivial *stray/astray* rhyme in the resulting sonnets).

Table 2 contains a complete list of the penultimate vowel or consonant sounds for each line in the seven sets of twenty. In each row of the table the upper line represents the first set (e.g., Set 1) of a pair and the lower line the other set (e.g., Set 3). The sound symbols in each row of the table are in alphabetical order, and the fact that no sound appears in both an upper and lower part demonstrates that the requirement for non-trivial rhymes is satisfied. Note that it is permitted to use the same penultimate sound more than once in a set of 10 (as this does not lead to trivial rhymes in either sonnet of the pair), though for aesthetic reasons even this type of duplication is kept to a minimum.

Line #s	Rhyme	Consonant or vowel sound preceding rhyme
1, 3	ā	D2 Fr Gr R2 S Sl St Tr E H L M2 Sh Str Sw W2
2, 4	ī	D Fl F2 N2 Pl S Sp Wr B2 Ch H K L P2 T2
5, 7	ōs	Ch Cr Fl G Gl L P Pr Sh Sn Bl C H N R2 S Sl T W
6, 8	ē	B Br Cr M3 S2 Thr Tr D L4 N R T3
9, 11	ēr	D F H L Sn Sph St2 T2 G N2 P3 S Sh Sp Y
10, 12	ōr	• B D F2 H R S Sw W Dr Fl G L M N Sc Sh Sn St
13, 14	um	Ch Cr Dr E H Pl2 R S Sl Th B C D G Gl M N Str Thr

(C = hard C sound, as in *cape*; • = no preceding consonant, as in *oar*; digit N = used N times in set)

Table 2: The structure of the 7 sets of 20 rhymes.

The number in the title of our paper results from counting the number of different sonnet anagrams which can be produced. First consider line 1. We can choose any line from Set 1 for line 1 of Sonnet A, so there are 10 possibilities. We must choose a different line for line 1 of Sonnet B, so there are 9 choices available. Taken together this means there are 10 x 9 = 90 possibilities for line 1 in the pair. This argument applies independently to all 14 lines, giving a total of 90^{14} possible choices. But if we

look at the resulting poems as a whole, a given pair of sonnets (say X and Y) will appear twice in the 90^{14} results (once as X,Y and once as Y,X, which should be considered the same anagram). Dividing by two to correct for this overcounting produces the final result, which is $90^{14} \div 2 = 1{,}143{,}839{,}622{,}748{,}050{,}000{,}000{,}000{,}000$. In general, if we have n sets of k mutual anagrams then $\frac{1}{2}(k(k\text{-}1))^n$ anagrammatically symmetric poems will be produced.

A 14x10 array of lines from which a sonnet is constructed by selection is the same structure used in *Cent Mille Milliards de Poèmes* (Queneau, 1961), from which ours differs because of its extra anagrammatic constraint. As Queneau's title indicates, this construction yields 10^{14} single sonnets. One might think that the number of sonnet pairs would be (10^{14} choose 2) = 4,999,999,999,999,950,000,000,000,000 but this is incorrect because it includes the prohibited pairs in which one or more lines in both sonnets are identical.

3. CONSTRUCTION OF THE LINE ANAGRAMS

Creating the fourteen sets of ten lines is a task in *constrained writing* of the kind practised by Oulipo (Mathews et al., 1998). In this case we have multiple constraints: iambic pentameter rhythm, a certain rhyme structure and, most difficult of all, the requirement that all ten lines in a set be mutual anagrams. So complex is the anagram constraint that some custom computer software was written to help with some of the mechanical chores involved in anagramming, while still leaving the human writer the task for which he/she is best suited, that of moulding the anagrammatic possibilities into lines that make grammatical sense and, ideally, have some poetic qualities.

First we mention an approach that initially seems reasonable but is not very successful. Assume that one line in a given group has already been written. To create one of the nine anagrammed lines in that group, we could first choose a terminal word that fits with the rhyme scheme, have a computer generate all the possible anagrams of the remaining letters and then manually select one. Unfortunately, even with short lines such as we have here, the number of possible anagrams is unmanageable. For instance, consider the set with the shortest lines (Set 6, 30 letters), and suppose we are starting to create a line that we have decided will end in *tree*. This leaves 26 letters to be anagrammed. Using an unrealistically small dictionary containing just the most common 2000 English words, and restricting anagrams to have no more than eight words, we find that approximately 5,000,000 anagrams are possible. Many of these

will be ungrammatical combinations of words, of course, and many others can be rejected as not fitting into the iambic pentameter rhythm, but even if these unwanted anagrams are weeded out automatically there will still be too many to deal with efficiently. To solve this problem we implemented two separate software modules - one to assist in choosing words during the initial phase of writing a line, and one to help complete the last half or so of the anagram. We now describe some details of these processes.

3.1. Early Word Finder

The key idea behind the Early Word Finder (EWF) is to show the writer those words which, if used early in the creation of a line, will maximize the anagramming options later on, especially when it comes time to insert the last few words, when finding a good anagram is the most difficult. Assume that part of an anagram line has been written and we are attempting to select the next word to be used. The basic strategy is to compute a score for each of those words that can be formed from the remaining pool of letters and then present to the writer the words with the best score. The score for a word (lower is better) is computed by the following formula:

$$score = \sum_{l} w(l) \cdot \left| if(l) - f'(l) \right|$$

where: the sum is taken over each letter *l* in the word
$w(l)$ = value of the "weighting function" (see below) for letter *l* of the alphabet
$if(l)$ = ideal frequency in English of the letter *l*
$f'(l)$ = frequency of letter *l* in the pool of remaining letters *after* removing the trial word

The absolute-value expression measures how closely the remaining pool of letters, after removing the trial word, matches the ideal letter distribution for English – a metric which we have found correlates well with how easy it will be to form good anagrams from the remaining letters. This measurement is shaped by an empirically-determined weighting function *w* whose purpose is to more clearly separate the best trial words from the inferior ones. The weighting function is defined as:

$$w(l) = r(l) \cdot \left(1 + \left| 1 - \frac{f(l)}{if(l)} \right| \right)^{a}$$

$f(l)$ = frequency of letter *l* in the pool of remaining letters *before* removing the trial word
$r(l)$ = rarity function (see below)
a = empirically-determined constant

and serves two purposes. The first factor in the formula, the rarity function *r*, increases the importance of the rare letters in the alphabet (such as P, V, or Z) over the common letters (E, T, A, etc.), to reduce the probability that when we get near the end of the anagram the harder-to-use letters will be a problem. The rarity function *r* has a simple shape, ranging linearly from $r = 1$ to $r = \beta$ over the letters arranged in frequency order (ETAONIRSHDLUCMFPGWBYVKXJQZ). The second factor in the *w* formula makes the weighting value larger for those letters that have a skewed frequency of use *already* (prior to choosing a trial word) compared to the ideal frequency distribution in English, and therefore more aggressively corrects the distribution of such letters. For the empirical constants *a* and β in these formulas we use the values $a = 2.0$ and $\beta = 2.5$.

To make the EWF even more powerful we also implemented a set of "filters" which can be used to specify certain criteria that every returned word must satisfy, including:

- Part of speech (noun, verb, adjective, or adverb).
- Number of syllables and stressed/unstressed nature of each syllable.
- Minimum and maximum number of letters in the word.
- Terminal sound with which the word must rhyme.

These filters were implemented by using the information in the Moby Part-of-Speech List (Ward, 1996) and the CMU Pronunciation Dictionary (Weide, 1998). As an example, suppose that only the last word (*rows*) has been chosen for a line in Set 7. We could try making the previous word a two-syllable adjective with a stressed syllable (S) followed by an unstressed one (s), and we might ask for Ss words with seven or more letters. Table 3 shows the 39 best-scoring words that are returned by the EWF.

1.908 *stately*	2.106 naughty	2.174 cutting
1.924 *healthy*	2.113 *peaceful*	2.175 *scarlet*
1.953 patient	2.120 fragile	2.179 boiling
1.989 healing	2.122 pleasant	2.182 careful
2.046 painful	2.123 feeling	2.183 ancient
2.050 plastic	2.137 grateful	2.189 crystal
2.052 central	2.137 telling	2.189 fitting
2.061 neutral	2.142 painted	2.201 helpful
2.070 *partial*	2.147 bleeding	2.206 tearing
2.073 *tasteful*	2.152 *playful*	2.229 hostile
2.082 lasting	2.158 pleasing	2.232 splitting
2.102 leading	2.163 hopeful	2.260 *graceful*
2.103 special	2.169 floating	2.264 sleeping

Table 3: The best-scoring Ss words with ≥7 letters contained in the letters *aaabcdeeeefghhiillnnoprsttttuy*.

We identified the words in italics as ones that might lead to a pleasing finished line. Suppose we choose "peaceful". Prepending the word "in" gives a tentative ending for the line as "...in peaceful rows". But what can the first part of this line be? This is where the second bit of software comes into play.

3.2. Directed Anagram Finder

The purpose of the Directed Anagram Finder (DAF) is to construct valid anagrams that can be formed from the pool of letters allocated to a given set. As we discussed at the beginning of Section 3, doing this in an unrestricted fashion is not useful due to the large number of possible anagrams. To reduce the number of possibilities, the user is required to input a grammatical template consisting of words already chosen and place-holders for words to be filled in. The DAF then returns a list of all possible anagrams that fit this template, sorted by a score which tends to favour those most likely to be useful.

To continue the example from 3.1, suppose we are working in Set 7 and are exploring lines that end with "…in peaceful rows". There are many possible ways the first part of this line could be constructed grammatically; one of these is:

The (*plural noun*) *that* (*adverb*) (*verb*) *in peaceful rows*

To fit the demands of iambic pentameter we can ask for the noun to have one syllable, the adverb two syllables (accented on the first) and the verb one syllable. In addition, the verb must have a form that agrees with a plural noun. This is specified to the DAF using the code like this:

The -N2 that -Bb -V2 in peaceful rows

In a template the letters N, V, A, and B denote a part of speech (Noun, Verb, Adjective, and adverB, respectively), a number (1 or 2) specifies whether a noun is singular or plural (or what type of noun a verb must agree with), and capital and small letters specify the number of syllables and how they are stressed (e.g., Bb means two syllables: first stressed, second unstressed).

Results from the DAF are presented to the user sorted by a score (higher is better) that is calculated as follows: each word in the dictionary is tagged with its frequency of use in English, and the score of an anagram is the product of the frequency values for all the

words in the empty slots of the template. This favours anagrams using primarily common words, which we have found to be a simple but effective way of weeding out the less useful anagrams.

Table 4 shows some of the best anagrams generated by different templates for the line ending in *-rows*, culled by inspection from the many hundreds produced by the DAF. Although any of these lines would have served, for our final text we chose the first one, as a result of its numerous suggestive allusions (from Poe to Hitchcock to Wallace Stevens' *Thirteen Ways of Looking at a Blackbird* to Leonard Cohen's *Bird On A Wire*). The existence of numerous acceptable lines simultaneously satisfying several highly-restrictive constraints (meter, terminal word, and anagram) is a clear illustration of the remarkable versatility of language.

The -N2 that -Bb -V2 in peaceful rows	The birds that neatly go in peaceful rows
One -Aa -N1 behind the -Aa rows	One tragic play behind the tasteful rows
The -Aa -N2 in -Aa -Aa rows	The clean brigades in tatty hopeful rows
The -N2 -aA in -A and -Aa rows	The boys alert in tight and peaceful rows
The -Aa -N2 that -V2 in -Aa rows	The Latin boys that peed in graceful rows
The -N1 beside that -N1 in -Aa rows	The corn beside that gate in playful rows
The -Bb -Aa -N2 in -Aa rows	The partly heated cubes in floating rows

Table 4: Some anagrams that result from various templates ending in *-rows*.

The fourteen sets of ten lines are displayed on the following two pages. An interactive version of the text which automatically displays a random sonnet anagram on request can be found online at http://cadaeic.net/octosonnets.htm.

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Quadrilliard† *De Poèmes Anagrammatiques*

†et un peu plus

Michael Keith

Set 1

How fortunes land to meet the rising day
With motion under feet the dragons slay
The demon saw our strength in life today
We find that soon the melodies turn gray
The hint of dormant energies would stay
When first the gods lie mounted on a tray
To lowered faith the turning demons say
Dream on while students go into the fray
The weather-tingèd moon unfolds its ray
For many would attend the night's soirée

Set 2

Our flesh an empty mold, a winter sigh.
To play of idle art when summer's nigh.
In grammar fully shown the poets die.
Who fuel hate immortal springs deny.
Around the smiling metaphors we fly.
Life's word among the humanist reply.
The shallow pen our immigrants defy.
In reds the human film plot goes awry.
In this long dream the formula we spy.
This normal male the grownups edify.

Set 3

Now try and read this short life's resume
To rise or rest undress the mind halfway
The rules of his mind's order went astray
This order ends the fruitless Roman way
And stirs the world the nurseries of May
Swift moralists surrendered on the hay
Hot murderers of thirteen islands sway
With Monday rules transfer the dossier
She renders ransom first without delay
The new-found milder terrorists sashay

Set 4

Because men rose at once with plans so high.
When each soon-passing truth becomes a lie.
See towns through peace, man's chosen alibi.
Ban laws, choose change, the promises untie.
Whose reason-catching son eats humble pie.
As beach-whales sense the mourning octopi.
The chaste men groan, woo shapeless incubi.
Sense each blouse open thrown at Sigma Chi.
To now abuse one charming, speechless Thai.
So businesswomen phone, charge latte chai.

Set 5

So on this earth the languid dream-pace flows:
With random life the author's landscape goes:
On frail death comes the lurid pageant-shows:
Reach out, read hope amidst the falling snows:
The spread outlines a team of highland crows:
Afraid, these contemplate our highs and lows:
What laid among the fields our parents chose:
There men could fashion paradise that glows:
The fat world laughed one Christmas in a pose:
The farmland showed this catalogue in prose:

Set 6

The countryside, a blue romantic sea,
His secret cloud, a mountain by a tree,
A land secure that you inscribe to me,
North County aims, a suitable decree,
A mist at noon, a cheesy cultured Brie,
Today's lie, accusation number three,
Some trail cut and a rustic honeybee,
Some acrid truth, a buoyant licensee,
State boundaries, neurotic alchemy,
This balance-tried secure autonomy,

Set 7

The ocean ripe, a friendly gust that blows;
The bending pile a faulty horse-cart tows;
Abundant light, receipts of earthly woes;
A wasteful con, the brightly painted rose;
That fiercely hated blow, a spurting nose;
The god finance rebuilt, a prey that slows;
A finely captured boon, the girl that sews;
Truth-leaning ways, the fabled porticoes;
The pleasing county dwarf, a brittle hose;
The birds that neatly go in peaceful rows;

Set 8

These too shall run and meet their destiny.
There saints should not entail the remedy.
Then heroes sat 'round death time silently.
No matter, these should die here instantly.
Then meet instead one earth's dull history.
These hold the tired mountains earnestly.
So time and tune shield art there honestly.
These hostile thrones demand neutrality.
The one that learned should miss eternity.
Thus lean hearts mentioned lost heredity.

Set 9

On this outlandish earth, replete with fear
To read, to learn, within this hateful sphere
Our faith in this low planet shattered here
With haunted hope, if lethal traitors sneer
Till then if earth, with nature's hope so dear
To halt in faith where unheard pilots steer
Of health and roles within the trip austere
To hasten faith, while printed authors leer,
That then was hailed The Perilous Frontier
With hope, sir, in the soul and heartfelt tear

Set 10

When men in arms the battlegrounds foreswore
While wrongs at men returned, as months before
When mortal news-bound nightmares fester o'er
While urban men soft shortened garments wore
Where farming thousands low resentment bore
When fearsome men the brown stunt girls adore
Where rows of streamlined tungsten men abhor
When we bound migrants feel the monster's roar
While modest strangers name the newborn four
When from the trees great sun-blind women soar

Set 11

Will hopes on that regard today pass near?
Shall any good in these tart words appear?
Do troops end all the pagan wars this year?
Then shall two years go rot and disappear?
Do roadway portals splash that engineer?
Shall steady wind not propagate or shear?
Ahead do pawnshop trolleys start in gear?
Shall standard weapon rays go to the pier?
Do paper hearts that win soon gladly sear?
Will ghost parades donate a thorny spear?

Set 12

The watchful starling toodles "Nevermore."
What lost such flavor lettered men ignore.
We all meet trusted thighs on craven floor.
The term's wrong value told the final score.
The turtle-wrestling falcon moved ashore.
From cloth and nuts the village we restore.
Felled converts want the humorist Al Gore.
Tell much as love's forgotten in the drawer.
With freedom last consult the graven lore.
Mold closet laughter with a fervent snore.

Set 13

Hold hope abstract and count the tired sum
To catch the pints around the boarded slum
So strut not, death placed acid on her thumb
The lot stood up then snatched Bacardi rum
I touch clasped hands to batter on the drum
And then those trod to catch a bruisèd plum
Tend to a torch as round-pitched tables hum
Transport the blood and educate this chum
So spot that old authentic hardened crumb
To stretch as dead and touch the iron plumb

Set 14

Each one the forest tomb attends is glum.
Tied fast on those the celebrants go mum.
Let gather Fates; the icon moon sets dumb.
The best of things must to a real end come.
O face his sad tomb, note the gentle strum.
On stage to this the Democrat feels numb.
To match in sense the bolder taste of gum.
To face instead the bosom's gentle thrum.
The motions granted to the faceless bum.
The tombstone flat, the caged sensorium.

Instructions:

Create two fourteen-line sonnets (Sonnet A and Sonnet B) like this:

- For each number N (1 through 14), choose two different lines from Set N.

- Assign one of the chosen lines to line N of Sonnet A, the other to line N in Sonnet B.

Congratulations! You've created two sonnets that are anagrams of each other.

Symmetry: Culture and Science
Vol. 23 , No. 1, 29-40, 2012

MANIFESTATIONS OF SYMMETRY AND DISSYMMETRY IN LITERATURE

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Abstract: *In this paper, in addition to well-studied kinds of symmetry in literature (in existing research, usually it is symmetry in the external form, formal structure, order of words, characters etc. in a work of literature) we will focus on more complicated kinds of symmetry in literature. These kinds include cases of incomplete and inexact symmetry: chirality, Moebius's tape, devices of "Mise en abyme", "Story within a story", "Theatre within a theatre", paradoxical perspective effects, the infinite loop motif. Furthermore, symmetry can be seen in such phenomena as interlacing and interosculation of parallel worlds ("The Devil's Elixir" by E.Hoffmann, stories by E.A.Poe; stories by Argentine writers J.L.Borges, A.B.Casares, J.Cortazar, plays by A.Strindberg, L.Pirandello); doppelganger (double), mirrors, shadows and portrait motifs at many authors, including F.Dostoevsky and N.Gogol; contradictions between different plans of a story (Fabula and Plot, by L.Vygotsky) as a source of artistic effect etc. We conclude that future research of these kinds of incomplete and inexact symmetry in literature should be carried out using methods of not only mathematics but also of structural poetics*

Keywords: symmetry, dissymmetry, literature

1. INTRODUCTION

In this paper we consider the role of symmetry and dissymmetry in literature (fiction). Certainly symmetry in various forms and extents is always present in art. However, it is dominant only in decorative arts. In more advanced forms of art – painting and graphics, theatre, cinema, even in architecture, - the violation of symmetry is important, too (Eisenstein, 1966, Darvas, 2003). Some researchers wrote that dissymmetry of organisms and brains was essential in the development of mankind (Geodakyan, 2005). Moreover, the development of the Universe also was accompanied by breaking of symmetry (Rosen, 2008).

Therefore, it is natural to conjecture that dialectic synthesis of symmetry and dissymmetry is important for any artistic composition and for literary works in particular. Here we will consider mainly the effect of incomplete (or inexact) symmetry in literature because the effect of precise symmetry in art has been studied in greater extent (see, e.g., Darvas, 2007, Bonch-Osmolovskaya, 2009_1, Bonch-Osmolovskaya, 2009_2, Shubnikov & Koptsik, 1974). Furthermore, while the existing research deals mainly with formal relations on the level of characters (letters), sounds, words or formal structural elements of literary pieces, we suggest to study literary works on deeper levels consisting of images, compositional parts and other devices of artistic effect.

It is not surprising that the traditional concept of exact (mathematically strict and precise) symmetry is insufficient for considerations on such deeper levels. Shubnikov and Koptsik (1972, p. 297-298) wrote that "the extension of the symmetry concept also significantly extends areas of its applications in art… Transformations (variations) and their invariants are most important concepts both in art and in science! …The use of ideas and representations of "ordinary" symmetry in literary studies, poetics, music theory etc. often carries the character of judgement by analogy or metaphor. The transition to representations and ideas of generalized symmetry allows to give to these ideas more definite and exact meaning also in structural art studies". These authors introduced such generalizations of "ordinary" symmetry as *antisymmetry*, *color symmetry*, *symmetry of similitude* and, more generally, *affine symmetry* (ibid., p.200, 222, 237 and 256-259), and even *projective symmetry* (p.297). They indicated the a possibility of further generalizations by substituting equality by equivalence (p. 259) etc.

Darvas (2003, p. 12-13, 15, 17) considered as manifestations of symmetry – among others – *affine projection, aerial perspective* and *topological symmetry*. He described generalized symmetry as any transformation of an object that preserves at least one property of the object.

In recent decades, various generalizations of symmetry have been developed. For example, J. Rosen (1975) considered *analogy* and *approximate symmetry*. In particular, "a system is said to possess approximate symmetry with respect to a transformation, if it is almost invariant under that transformation" (Ibid., p. 79). More generally, "approximate symmetry is approximate immunity to a possible change… Approximate symmetry is a softening of the hard dichotomy between symmetry and asymmetry" (Rosen, 2008, pp. 6,7). J.Rosen (2008, p. 251-253) also introduced the mathematical notion of approximate symmetry transformation using metric.

H. Zabrodsky, S. Peleg and D. Avnir (1992) introduced *symmetry measures* for approximate symmetries. They also considered the symmetry of *fuzzy* sets (Zabrodsky et al., 1994, Avnir et al., 1998).

Thus, there exist well-developed theory of symmetry and its generalizations (approximate, topological, fuzzy etc.). However, these generalizations have been applied mostly in natural sciences and in some extent in visual arts. For studying manifestations of generalized symmetry in literature, we still have to use metaphors and reasoning by analogy.

In this paper, we will briefly survey some manifestations and applications of inexact symmetry in literature in several aspects: a) approximate symmetry (the term of J.Rosen, 1975 and Rosen, 2008; however, we do not use any metric to measure the breaking of symmetry); b) paradoxical symmetry; c) fuzzy symmetry; d) role of dissymmetry in literature.

Here we list only some of existing examples of structures corresponding to these aspects, and give *our* interpretation to the texts as organized in given structures – of course the reader can find her/his own examples, and make her/his own interpretations. The texts are selected from the wide variety of world (including Russian) classical literature consisting mostly of prose and drama – from ancient and medieval to contemporary authors. However, priority was given to works of romantic and innovative authors such as E.T.A.Hoffmann, E.A.Poe, N.Gogol, J.L.Borges, V.Nabokov etc.

2. APPROXIMATE SYMMETRY

By the approximate symmetry we will mean very wide variety of manifestations of phenomena in some significant extent close to the strict symmetry: *mirror* motifs, *Doppelganger (double)*, *shadows* and *portraits* motifs, *parallel worlds*, symmetry in the plot of a story etc.

Mirror motifs express approximate symmetry close to mirror reflection (Rosen, 1975, p.2).

The most famous book using the mirror motif is Lewis Carrol's *Through the Looking-Glass* (see Carroll, 1982). However, the mirror motif is extremely popular in world literature. This motif has been widely explored (see, e.g., Mints, 1988, Lotman, 2000). It was used in such known literary works as Alexandr Pushkin's fairy tales (for example, the mirror the stepmother of the princess looks at plays the important role in *The Tale of the Dead Princess and the Seven Knight*), Nikolay Gogol's stories and plays (the hero of *The Nose* does not see his nose in the mirror, the entire play *The Inspector-General* is interpreted in its epigraph as a mirror of the everyday life), in works of Fyodor Dostoevsky (for example, the mirror served as a necessary attribute of the disguise for the central character of *Netochka Nezvanova*), Mikhail Bulgakov (Woland and his band appear in human residences through mirrors in the novel *Master and Margarita*; so a mirror is a gateway between the common and supernatural worlds), Konstantin Vaginov (a mirror is a passage to the weird world for the hero of *The Works and Days of Svistonov*) etc.

Note that in cases of using the mirror motif the phenomenon of chirality (Petitjean, 2003), or enantiomorphism (Shubnikov & Koptsik, 1972, p. 18), is important that causes the impossibility of the identity between the object and its image (Lotman, 2000).

The portrait motif also expresses approximate symmetry and in literature it is close to the mirror motif. However, mathematically it does not correspond to the reflection symmetry but rather to the composition of translations and rotations and sometimes of similitude (Darvas, 2003, p. 16). Moreover, the time and space dimensions are forgotten in a portrait, it is only a two-dimensional projection. Therefore, it corresponds to the affine symmetry (Shubnikov & Koptsik, 1972, p. 200). Most explicit examples are Nikolay Gogol's story *The Portrait* (about the picture that had the mystical evil force) and Oscar Wilde's novel *The Picture of Dorian Gray* (the portrait of the hero grows old

instead of him). This motif is also important in Charles Maturin's *Melmoth the Wanderer* (the portrait of Melmoth also has a mystical force, and Melmoth himself becomes immortal), Ernst Theodor Amadeus Hoffmann's *The Devil's Elixir* (the central hero Medard identifies young Aurelia with her portrait and even with the image of Saint Rosalia), Edgar Allan Poe's *The Oval Portrait* (when the painter finishes the picture of his bride, she dies and her spirit is transferred into the lifelike painting), Fyodor Dostoevsky's *The Idiot* (the magic force of the photographic picture of Nastasya Filippovna) and many other works by different writers.

Even more popular in world literature was the motif of Doppelganger (double) that occurred in many works of different writers. Doppelganger motif expresses approximate symmetry close to the classical composition of translations and rotations. This motif was used by such famous authors as Edgar Allan Poe (*William Wilson* is a short story about the double of the central character), Fyodor Dostoevsky (*The Double: A Petersburg Poem* also tells about the double of the hero), Vladimir Nabokov (*Despair* where the hero plans to stage his own death by killing his doppelganger so he can get his insurance money) and Jose Saramago (*The Double* where the protagonist competes with his physical double).

Quite often the pairs of similar or almost identical "duo" persons occur in literary pieces: for example, in Nikolay Gogol's works: Bobchinsky and Dobchinsky in *The Inspector-General (Revizor)*, Uncle Mityay and Uncle Minyay in *Dead Souls*, Ivan Ivanovich and Ivan Nikiforovich in one of stories etc. We see "duo" characters in Lewis Carroll's *Through the Looking-Glass, and What Alice Found There* (Tweedledum and Tweedledee), William Shakespeare's *Hamlet* (Rosencrantz and Guildenstern), Franz Kafka's *The Castle* (Artur and Jeremias are assistants of Mr. K., the land surveyor).

Close to the phenomenon of Doppelganger is more complicated case of the *split personality* reflected in such novels and stories as Mary Shelley's *Frankenstein* (some researchers wrote that Dr. Frankenstein and the monster are two sides of the same split personality), Robert Louis Stevenson's *Strange Case of Dr Jekyll and Mr. Hyde* (a well-known depiction of a split personality: within the same person there are two distinct personalities – a kind one and an evil one), Edgar Allan Poe's *The Fall of the House of Usher* (the hero, Roderick, has a split personality with his twin sister), Vladimir Nabokov's *Invitation to a Beheading* (Rodrig and Rodion are two facets of one personality).

Being more complicated and less distinct, this case sometimes may also be qualified as expression of *fuzzy symmetry* that will be discussed further.

Close to the Doppelganger motif is the Shadow motif. It expresses approximate symmetry close to rather complex composition of translations, rotations and sometimes projections with color symmetry. For example, in Adelbert von Chamisso's *Peter Schlemihl* where the hero sells his shadow to the Devil, and Hans Christian Andersen's *The Shadow* (the hero is displaced by an evil impostor, his double). This motif is also important in Vladimir Nabokov's novel *Mashen'ka* (where the shadow symbolizing the life in emigration is the main metaphor).

As approximate symmetry we regard also parallel worlds motif. It expresses approximate symmetry close to the (spatial) translation. This motif often occurs in stories of Argentine writers: e.g., Adolfo Bioy Casares' short stories *The Celestial Plot* (a test pilot travels to an alternate universe and back) and *The Shady Side* (the hero experiences two alternate copies of his life), Jorge Luis Borges' *The Garden of Forking Paths* (a story about multiple worlds, with a metaphorical labyrinth) and Julio Cortazar's *Yellow flower* (the protagonist finds himself reincarnated as a boy in other circumstances and in other place).

Symmetry in the composition or in the plot of a literary work usually is not precise and, therefore, we also qualify it as approximate. One can see symmetrical compositions in such books as Dante's *Divine Comedy* (oppositions Paradise – Hell etc.), Jonathan Swift's *Gulliver's Travels* (oppositions Lilliput – Brobdingnag etc.), Alexandr Pushkin's *Eugene Onegin* (Onegin and Tatiana exchange their roles in final chapters), Frank Wedekind's *Earth Spirit* and *Pandora's Box* (the rise and fall of the main character, Lulu, proceed symmetrically, here one can see the manifestation of approximate temporal reflection symmetry like in Rosen, 1975), Dino Buzzati's short stories *Seven floors* (seven floors of a hospital methodically and inevitably lead the hero to death) and *Seven Messengers* (the area conquered by a king increases in a regular manner) and many, many other classic and contemporary works.

3. PARADOXICAL SYMMETRY

Here we consider such phenomena as paradoxical perspective effects, the *mise en abyme* motif, the *strange loop* motif, *Moebius's tape* motif and other phenomena connected with metafiction. These types of paradoxical symmetry are close to

topological symmetry (Darvas, 2003, p. 12) and also to the iterated composition of mirror symmetry with a similitude.

One can see the paradoxical perspective effects (when things actually far away become close and vice versa) in some novels and stories of Franz Kafka (for example, in *The Trial* are mixed up the attic of an apartment house with the court, a room in a bank with a room for punishment of guards etc.), in the *Invitation to a Beheading* by Vladimir Nabokov (the hero leaves a jail and suddenly, at the other side of the city, comes to be again in his prison) and *On the form of the world* by Adolfo Bioy Casares (the distance of 150 km unexteptedly shortens to 5 km).

Similar to the paradoxical perspective effect is the *mise en abyme* motif. It means an infinite reproduction of the image of a person standing between two mirrors (sometimes it is called the *Droste effect*). Thus, here one can also see the expression of the composition of iterated mirror symmetry with a similitude. In literature it is usually displayed as *story within a story* or *play within a play* where the part in some extent reproduces the whole. Known examples are *Hamlet* by William Shakespeare (the Mousetrap – "play within a play"), and *If On a Winter's Night a Traveler* by Italo Calvino (stories within stories). Also, the device "play within a play" is used in *The Seagull* by Anton Chekhov, *The Servants* by Jean Jenet, Tom Stoppard's *Rosencrantz and Guildenstern Are Dead*.

More complicated than the "mise en abyme" motif is the *strange loop* motif connected with self-reference when an author refers to his work within the work itself. Also, the strange loop takes place if we encounter a *predestination paradox* when persons are caught in a loop of events that "predestines" or "predates" them to travel back in time or when the sequence of person's efforts directed to avoiding the predicted destiny leads precisely to the forecasted finish as, e.g., in the *Oedipus Rex* by Sophocles or in the *Appointment in Samarra* by William Somerset Maugham where persons trying to escape from predicted destinies, on the contrary, by their actions only facilitate the fulfillment of predictions. Well-known examples of the strange loop can be found in such works as Miguel de Cervantes's *Don Quixote* (heroes are reading the first part of the novel about themselves) and Luigi Pirandello's *Six Characters in Search of an Author* (characters of the play are begging the author to write this play).

Close to the "strange loop" motif is the *Moebius tape* motif when two sides of the world – the real world and the fictitious one – turn out to be the same side. One can mention Vladimir Nabokov's novel *The Gift* where the central character is going to write the

novel named *The Gift*. The similar situation takes place in *The Counterfeiters* by Andre Gide and in *One Hundred Years of Solitude* by Gabriel Garcia Marquez. Furthermore, one can see the structure resembling Moebius tape in Eugene Ionesco's play *The bald soprano* where the whole play repeats permanently with Smiths couple replaced by Martins couple and vice versa. The straight use of the Moebius tape concept takes place in *A Subway Named Moebius* by A.J. Deutsch.

Connected with metafiction are also some reflections of the infinity concept in fiction, especially in Jorge Luis Borges' short stories: *The Aleph* (the Aleph is a point that like a Leibnitz's *monad* mirrors all other points in the universe), *The Library of Babel* ("the library is illimited and periodic").

4. FUZZY SYMMETRY

In the scientific literature, symmetry of fuzzy data, or symmetry of fuzzy sets, has been understood as the approximate symmetry of fuzzy shapes i.e. shapes with uncertain point localization. By *fuzzy symmetry* we will mean very roughly approximate symmetry of a complex literary work where various approximate symmetries of parts of that work are combined. Here we consider such effects as reflection of reality in dreams and, vice versa, reflection of the dreams in the reality, reflection of fiction in the story, reflections of some elements of a story in other elements etc.

One can mention such works as plays by William Shakespeare (*A Midsummer Night's Dream*), Pedro Calderon (*Life is a Dream*) and August Strindberg (*The Dream Play* and *The Ghost Sonata*) where dreams are integral parts of story lines, and J. L. Borges' short story *The Circular Ruins* where the protagonist wanted to dream a man and to impose him on reality

Fiction is creatively reflected in such stories as *Usher II* by Ray Bradbury which cites Edgar Allan Poe's *The Fall of the House of Usher* which, in turn, cites the fictitious ancient story named *The Mad Trist*. Mention also *Ulysses* by James Joyce alluding to Homer's *Odyssey*, short stories *At the Tolstoy Museum* and *Eugenie Grandet* by Donald Barthelme reflecting works of Lev Tolstoy and Honoré de Balzac, Peter Handke's novel *Short Letter, Long Farewell* where movies of John Ford and books by Gottfried Keller are permanently cited parallel to the development of the main plot.

Many stories using parallel plots reflecting each other can also be regarded as manifestations of fuzzy symmetry; for example, novels *Point Counter Point* by Aldous Huxley, *The Counterfeiters* by Andre Gide, *Master and Margarita* by Mikhail Bulgakov, *October Light* by John Gardner. In each of these novels protagonists are writing (or reading in J.Gardner's work) books with plots parallel to the main plot.

Still more often one may observe cases of multiple reflections and repetitions of a story or some of its parts in other, sometimes smaller, parts. These cases can be named also cases of *fractality* by analogy with fractals in mathematics (see Mandelbrot, 1983, Bonch-Osmolovskaya, 2009_2). For example, an epigraph frequently placed at the beginning of a text usually reflects the content or the main idea of a story. Above-mentioned "stories within stories" and "plays within plays" also frequently repeat some contents of the framing stories and plays. Multiple reflections of parts of a story in other parts take place, e.g., in Lev Tolstoy's novel *Anna Karenina* (the suicide of Anna is anticipated by the death of a railway worker and by her nightmares, and also by the death of a horse during the racing, etc.), Hugo von Hofmannsthal's story *The Tale of the 672nd Night* (here the death of the protagonist is anticipated by the behavior of his servants, and images of their faces pursue him and lead to the disaster).

Furthermore, we can also regard as fuzzy symmetry the motifs of *cyclicity* and *recurrence* in literature, e.g., in James Joyce's novel *Finnegans Wake* (the composition of the book is cyclic) and Jorge Luis Borges' short stories *The Doctrine of Cycles* (the title speaks for itself), *The Aleph* (recurrent reflections of infinite many points in a single point) and *The Library of Babel* (a periodic library).

5. DISSYMMETRY

As explicit manifestations of dissymmetry one may consider contradictions between different structural frames of a story (fabula and sujet, i.e. plot, by L.S.Vygotsky, 1986, p. 235) as a source of artistic effect, violation of inertia of perception etc. Famous film director and art theorist Sergei Eisenstein (1988, pp. 234-278) wrote that dissymmetry is important for the artistic effect and referred to the Yin Yang opposition in Chinese culture. Lev Vygotsky in his "The Psychology of Art" (1986, pp.183-244) revealed the contradiction as the vital characteristic of art perception in the process of "counterfeeling". It is caused in all literary works, from elementary fable to extremely complicated "Hamlet", by the struggle between plot and fabula.

Furthermore, the infringements of inertia of perception (for example, breaking the symmetry in the composition of a literary work) also can strengthen the artistic effect.

6. PROBLEMS AND EXAMPLES OF STUDY

Thus, we discussed here the manifestations of some kinds of dissymmetry and imperfect symmetry in literature. Of course, problems of symmetry in literature have been studied in the theory of literature.

Shubnikov and Koptsik (1972, p. 297-298) drew attention to works of prominent critic V.Vinogradov (1934, 1941) on the style of A.Pushkin where "the principle of symmetric arrangement, reflection and variation of images and themes in the structure of a literary work" was revealed as a "rule of Pushkin's artistic system" (Vinogradov, 1941, p. 479).

V.Vinogradov (1934, p. 171) wrote: "In Pushkin's lyrical piece, drama or story often occur uniform types of verbal composition based on leitmotifs and symbolic variations: groups of words , images and themes supporting and tying a plot construction and ruling its development, act symmetrically, with almost algebraic exactness of proportions". V.Vinogradov indicated the symmetry of images and themes in such works as *Baryshnya-krestyanka* (The Squire's Daughter), *Grobovschik* (Undertaker) and *Skupoy rytsar* (Covetous knight). He noticed, however, that "symmetry of verbal images is veiled by the dense network of literary-polemic connotations…" (ibid., p. 175-176) .

Indeed, such manifestations of symmetry in literature as, say, mirror and shadow motifs, have not only formal or structure-making meaning. The use of these motifs has a long history and has been enriched by philosophical, mythological and even mystical interpretations and meanings (see, e.g., Lotman, 2000, Chulkov, 2000).

Evidently the use of phenomena close to symmetry is aimed at the strengthening of the artistic effect of literary works, and this effect is mostly connected with compositional structure of these works and also with *devices of expressiveness*. Yu.Shcheglov and A.Zholkovsky (1987) wrote that they introduced the concept of *expressiveness devices* under the influence of S.Eisenstein and V.Propp (1968). They considered the following devices: combination of functions, contrast, variation, shading, augmentation, increase, repetition, concretization, reduction, presage (anticipation) etc. One can easily

see that almost each of these devices of expressiveness can be constructed with the help of symmetry: for example, it is obvious for the repetition, and for augmentation, reduction and presage it may be the transformation of similitude.

In order to illustrate the complexity of the study of manifestations of symmetry in a literary work, consider the story *The Fall of the House of Usher* by Edgar Allan Poe. In this story, the symmetry can be observed at many layers. First, we see the motifs of double and split personality (Roderick and his twin sister Madeline). Second, we see the reflection of the fate of the remaining family members in the fate of the crumbling mansion (not by a chance, in the story the appellation "House of Usher" includes both "the family and the family mansion"). Third, the events and sounds mentioned in the book "Mad trist" that the protagonist reads to Roderick are simultaneously doubled in the reality. Fourth, Roderick himself guesses that the mansion is as sensitive as himself and so the house is similar to himself. Fifth, there is a physical "mirror" in the story – the mansion is reflected in the "dark tarn". Finally, the physical fall of the House of Usher coincides with the death of the remained members of the family. So the fall of the house of Usher in literal sense is repeated in the fall of the house of Usher in metaphorical understanding.

Thus, the system of approximate symmetries in the story constitutes very complex and partly hierarchical structure. In this case, these symmetries not only express such devices of expressiveness as repetition, variation and anticipation but also illustrate Poe's literary theory: every detail, with respect to both style and content, directly contributes to the creation of the total effect of the piece, and the unity of tone creates the unity of effect. This story is rather short, and it seems that in the analysis of symmetries of larger works using tools of not only mathematics but also of structural poetics much knowledge about literary craft can be discovered.

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Symmetry: Culture and Science
Vol. 23, No. 1, 41-66, 2012

CREATION IDEAS EXPRESSED THROUGH COMBINATORIAL LITERARY FORMS IN ELENA KATSYUBA'S POETRY

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Abstract*: The analysis of combinatorial techniques used by contemporary Russian poet Elena Katsyuba is presented to identify and examine the topics of her poems, often obscure and virtually incomprehensible to the uninitiated reader. It is demonstrated that the overall idea of Katsyuba's poetic is the similarity of the primary Creation of objects and phenomena by pronouncing the Word to a secondary poetic creation, so that by using combinatory literary techniques the essence of the objects can be restored. Katsyuba as the author possesses all information about the objects, so they can be easily changed into either ordered or disordered state. Though it is a state of 'junkyard' as an irregular collection of discarded words, all known, used and stained, which in Katsyuba's opinion corresponds to the contemporary paradigm. Nevertheless Katsyuba considers this collection favourably in accordance with the medieval concept of seeing the world, despite its complexness and grieves, full of light and love.*

Keywords*:* combinatorial poetry, literary restrictions, order and disorder, anagram, palindrome.

1. OVERALL OBSERVATIONS ON CHARACTERISTIC FEATURES OF KATSYUBA'S POETRY

Elena Katsyuba, an established Russian poet, often uses formal literary restrictions in her works. Katsyuba herself defines her method as *linguistic realism* [Katsyuba 2001] emphasizing the representation of the reality through the linguistic units – words. The question Katsyuba permanently raises in her work is: "if in the beginning there was a word, and everything was made of this word, then how was it done?" [если вначале было слово и все создано из него, то каким образом? Katsyuba 2001]. In the further analysis I will demonstrate that in Katsyuba's poems new meanings appear through the transformations of letters' order, in a process similar to the creation of new beings by the transformation of primary substances. I have worked on the analysis of Katsyuba's poems in connection with the poet, so I interviewed her and asked questions on the origins of her works, thus achieving confirmation for my analytical findings. I will present here analysis of some Katsyuba's poems from the poem collection *Игр Рай* [Katsyuba 2003] where her poetic techniques are presented most distinctly. I will reproduce the original poems in Russian and their word-by-word translations into English, and refer to the Russian originals in the analysis of the texts when needed for understanding the meaning and poetic technique.

Katsyuba considers her poetry as a whole with the titles of the poems connected together so that some poems refer to and explain the others, and the structure of a detached poem echoes the structure of the whole book full of literary games and joy. Already in the title of the book *Игр Рай*, Katsyuba involves the reader in literary game. The conjunction of identical consonants on the edges of two words makes the reading of the title ambiguous: as the extended substantive 'игр рай' (heaven of games) and as the imperative for the verb 'играй' (play). Here Katsyuba presents these games as a means for perfection (heaven of games) and direct the reader to participate in these activities – to play together with the author.

In the collection of poems *Игр Рай*, poems are presented in alphabetic order: 'Азбука' (Alphabet), 'Алхимик' (Alchemist), 'Антология мёда' (Anthology of honey), 'Aurum', 'Бабочка' (Butterfly), 'Близнецы' (Twins), 'Блюз' (Blues), 'В баре' (In a bar), 'Вальс цветов' (Waltz of flowers), 'Вересковый ветер' (Heath wind) and so on. Here Katsyuba follows the tradition of baroque poetry, where a similar alphabetic method of organizing the structure of poetic collection was accepted, for example, in *Вертоград многоцветный* (*Multi-coloured orchard*) by Simeon Polotsky (1678). The alphabetic structure of the whole collection is echoed in the first poem, *Alphabet*

[Katsyuba 2001, 13], where the words are presented in the alphabetic order of their first letters:

1	Алая и Белая розы – это А и Б любви,
2	далее – Война Глаз, Дар Евы, Желание, Забвение,
3	Искренности Йод, Кошка Ласки, Мёд Неведения,
4	Опиум Поцелуя, Разорение Сада, Тьма Упрека,
5	Фарфор Хрупкости, Церемония Чайная, Шепот и Щека.
6	Ы – знак умножения: розЫ – буквЫ.
7	Значит, переход на ты
8	не сделает тебя одиноким
9	в розарии азбуки,
10	где Эхо Ютится
11	и в конце всегда Я.

1	Red and White roses are the A and B of love,
2	then – war of eyes, Eve's gift, desire, oblivion,
3	iodine of sincerity, pussy cat of kindness, honey of ignorance,
4	opium of a kiss, destruction of a garden, darkness of reproach,
5	porcelain of fragility, tea ceremony, whisper and cheek.
6	UI is a multiplication sign: roses – letters.
7	Then, changing addressing to 'thou'
8	won't make you lonely
9	in the rosary of alphabet,
10	where echo takes shelter
11	and in the end it is always I (letter YA).

The lines of the poem are grouped in pairs by rhymes: 'забвение' – 'неведение' (oblivion – ignorance), 'упрёка' – 'щека' (reproach – cheek), 'буквы' – 'ты' (letters – you), 'одиноким' – 'азбуки' (lonely – alphabet), 'ютится' – 'я' (takes shelter – I). These pairs would not be considered exact rhymes in contemporary prosody, though they are in the course of the early twentieth century's poetic experiments by Velimir Khlebnikov [Khlebnokov 1987] and Vladimir Mayakovsky [Mayakovsky 1955–1961] who began to use imperfect rhymes in their poetry. Moreover, rhymes on different stressed syllables were a characteristic feature for the era of Russian syllabic poetry of the seventeenth–eighteenth century, for example, by Simeon Polotsky in 1678 [Polotsky 1990] where the rhymes were often seen as visual not audial poetic tools. Therefore, Katsyuba reproduces and modifies to contemporary topics the poetic techniques widely practised in the era of baroque poetry and revitalised in Russian avant-garde of the early twentieth century. The alphabetic restriction together with the relict syllabic rhyme becomes a method of organizing the text by a combinatorial structure different from conventional rhyme–rhythm poetic structure.

The book *Иgр Рай* includes a collection of poems *Свалка* (*Junkyard*) which is the focus of my research. In contrast to the baroque poems of the past where a garden is chosen for the model of the world as in *Multi-coloured orchard* by Polotsky, in Katsyuba's poems the world is presented as a post-modern collection of junk, where the author finds the beauties or creates them with a recombination of already used words. In this sense, the role of the poet is changed from naming the beautiful objects in the garden created in order and with purpose by the Gardener, to creating an order and beauty from the seeming chaos of a 'junkyard'.

The characteristic features of Katsyuba's *Junkyard* are contradictoriness, infinity and eternity. The contradictoriness appears already as a statement belonging to *Junkyard* and prohibiting it: "Prohibited / (on every junkyard there is a sign: 'Littering prohibited' " [запрещенная / (на каждой свалке есть табличка: 'Свалка запрещена!' Katsyuba 2003, 213]. The statement is placed at the entrance to 'junkyard', both in reality as a described prohibition sign in front of the gate and in the poem as the epigraph to *Junkyard*. That is, the existence of 'junkyard' as a system is prohibited by its own rules, leading to inner contradiction. As a junkyard is constantly replenished by used and thrown away objects, similarly the poetic collection *Junkyard* is growing eternally and infinitely: "there is no / beginning, end, clear boundaries in time and space" [не имеет / начала, конца, четких границ во времени и пространстве, / а также / одного постоянного состояния Katsyuba 2003, 213]. Stochastics becomes apparent through the random combination of unique objects presented in a 'junkyard'. Katsyuba declares this by an allusion to a known Leo Tolstoy maxim on the uniqueness of unhappy families: "every standard object becomes individual in a junkyard. / All new shoes are new equally – / Each broken shoe is broken in its own way" [Любой стандартный предмет на свалке приобретает индивидуальность. / Все новые башмаки новы одинаково – / каждый рваный башмак рван по-своему! Katsyuba 2003, 221]. That is, even objects created by mass production become unique after personal usage. Katsyuba includes some social aspect to her poem proclaiming, "There are no replaceable objects in a junkyard!" [На свалке заменимых нет! Katsyuba 2003, 221], thus making an allusion to the famous Stalin declaration about the functionality and replaceability of people. In Katsyuba's 'junkyard', every object is unique and cannot be replaced by another, in contrast to Stalin's personnel policy.

I will present Katsyuba's poems based on anagrammatic transformations, on palindrome techniques, and on other combinatorial techniques to demonstrate how the author achieves her poetic goal: to find new language for the contemporary world.

2. ANAGRAM AS A TECHNIQUE OF CREATION SUBSTANCES OUT OF THE EXISTING SUBSTANCES

The anagram technique is considered by Katsyuba as a poetic method applied arbitrarily for certain poetic purposes rather than a formal constraint which should be obeyed strictly through the whole poem. In this sense, Katsyuba writes poems consisting of anagrammatic nonsensical sets of letters in the style of *zaum* (futuristic trans-sense writing), or includes some anagrammatic words into her poems written in a conventional manner and in combination with other techniques.

The concept of 'junkyard' where all objects are broken and deformed is significant for the interpretation of Katsyuba's anagrammatic poems. For Katsyuba, words are objects to be transformed, so she applies an anagram transformation to the existing poem, presenting seemingly nonsensical combinations of letters [Katsyuba 2003, 216]: "Женбла кот сепотил йес рим / в оге нитумы коворые. / Еог рпивзали бласвегие / Как бессоедника ан рип. (Дорфе Тетвюч)"

In some editions, Katsyuba presents this poem with the remark, (http://www.rvb.ru/np/publication/01text/40/02katsyuba.htm#superpoem), "translation from the language of junkyard" (перевод с языка свалки) and the quotation from the poem by Fyodor Tyutchev, "Блажен, кто посетил сей мир / В его минуты роковые! / Его призвали всеблагие / Как собеседника на пир" (Blessed is he who visited this world / In moments of its fateful deeds: / The highest Gods invited him to come, / A guest, with them to sit at feast / And be a witness of their mighty spectacle), as a letter anagram of the presented lines: 'блажен' – 'женбла' (blessed – zhenbla), 'посетил' – 'сепотил' (visited – sepotil), and so on. If the reverse transformation is known, Katsyuba's poem can be read in the same rhythm of iambic tetrameter as the original Tyutchev's poem, thus it is perceived as a regular rhythm poem written in an unknown language with Cyrillic alphabet and seemingly Russian grammar. Similar to other examples of poetical transformations, such as cento poetry or Lewis Carroll's parody on Victorian moral verses, the original and transformed lines are linked, providing a comical poetic impression.

One of the literary methods practised by Katsyuba is the search for meaningful words from the letters of a given word. This is a known method among other word-game techniques [Fedin at al 2001, 12–25], though Katsyuba only partly relates to word-game poetry; more exactly, she is restoring techniques that could be associated with cabbalistic practice in the search for the inner essence of the object represented by a

word. Graphic elements are used in some poems by placing the inner words in certain positions, as in the following poem [Katsyuba 2003, 215] where Katsyuba's poetic manifesto is presented:

(Manifesto. Mine, myth, stork, no, nets, forfeit, fiesta, topic, trick, wall.
Transliteration: Manifesto. Mina, mif, aist, net, seti, fant, fiesta, tema, fint, stena)

The word 'manifesto' is chosen for the application of this technique for its association with the multiple poetic manifestos of the twentieth century created by artists and writers to present their styles, goals and methods. Contemporary Russian poet and schoolar Biryukov finds this poem effective in expressing a poetic message: "I don't know a more precise expression of the very notion of 'manifesto' than this one. <...> Placed in this way as in Manifesto, connected by a system of lines, the words provide a total picture of Katsyuba's poetic world" [Я не знаю более точного выражения самого понятия «манифест», чем это. <…> Поставленные таким образом, как в «Манифесте», связанные системой линий, те же слова задают целостную картину поэтического мира Кацюбы Biryukov 2003, 269]. The words found in the word 'manifesto' could be interpreted as the sides of artistic creativity and program. Altogether, the poem is created by these components with logical links provided for the overall meaning. Katsyuba does not decipher her combinatorial poem, leaving this task to her reader, as she sees the text as a dialogue, both in the process of creation, with the language, and in the process of reading, with the reader devoted to the same word-game activity.

The following poem *Анкета манекена* (*Mannequin's questionnaire*) [Katsyuba 2003, 220–221], made by the same technique, is considered to be one of Katsyuba's most representative poems and is reproduced in a number of her publications:

Анкета манекена	Mannequin's questionnaire
Наименование_____МАНЕКЕН	Appellation _____ Mannequin
Пол_____МАН	Gender _____ man
Национальность____НЕМКА	Nationality _____ German (woman)
Родной язык _____НЕМ	Mother tongue _____ dumb
Образование _____НЕМА	Education _____ none

Историческая родина НАМЕК (?)	Native land _____ a hint (?)
Место проживания __НА КАМНЕ	Place of residence _____ on a stone
Вероисповедание____АМЕН	Denomination _____ amen
Основное занятие___ЕМ	Occupation _____ eat
Любимое блюдо ____МАНКА	Favourite dish _____ semolina
Жизненное кредо ___МНЕ!	Credo _____ for me!
Какой сутре следуете? _КАМЕ	What is your sutra? ____ Kama
Любимый цветок_____МАК	Favourite flower _____ poppy
Любимый писатель___МАНН	Favourite writer _____ Mann
Любимый художник__МАНЕ	Favourite artist _____ Manet
Поэтический символ__АКМЕ	Poetic symbol _____acme
Какой поэтессе отдаете предпочтение _АННЕ	Who is your favourite poetess? _Anna
Кем можно заменить в случае отсутствия? _НЕКЕМ	Whom can you be replaced by in case of absence? _ No one

In this poem Katsyuba presents creator–creature relations in the alchemist or cabbalistic sense as the object is considered to be created out of the letters of its name. The poem is an example of both profound and playful combinatorial poetry with an aspect of irony included into the text. 'Mannequin' here is a mechanical creature simulating a human being, in this sense it can be correlated to other artificial creatures. The list includes the most famous Golem made of clay by a Prague rabbi [Ripellino, 1994] and Mary Shelley's Frankenstein's monster [Shelley 1831], together with Hoffmann's dancing doll [Hoffmann1885], L'Isle-Adam's Thomas Edison's perfect female creature [L'Isle-Adam 1886], Olesha's court doll [Olesha 1928] and many others. It is worth to note that Katsyuba creates her 'mannequin' in a pure linguistic act, not following scientific, mechanical or biological, concepts as the listed writers did, or philosophical theories, as for example, Saussure's 'mannequin' [Starobinski 1971] or Le Lionnais comparison of combinatory literature to the synthesis of living matter in laboratory [Le Lionnais 1973, 26]. As well as Golem, who becomes animated when a magic word is put into its head, her 'mannequin' is animated by a simple manipulation of the letters of his naming in accordance with Katsyuba's understanding of secondary Creation of the poetry compareing to the primordial Creation of the universe. By this procedure, as artificial as it is, Katsyuba's 'mannequin' becomes vivid enough to imitate developed human psychology.

The association of inner combinatorial words with the nature of the person is a procedure similar to the anagrammatic interpretation of the fate of a person by their name [Bombaugh 1961, 49–57]. Katsyuba provides 'mannequin' with a list of passwords to answer any possible formal question which could be asked by officials when applying for a passport, a job, or a study: name, gender, nationality, education,

religion and so on. By these answers ‘mannequin’ is indistinguishable from a member of society. In addition, there are a number of personal questions such as favourite food, favourite writer and poetic symbol that ‘mannequin’ can be asked on social occasions. Katsyuba is partly proud, demonstrating almost human capacities of a mannequin, and partly critical, demonstrating the limits of the creature: “Occupation – eat” (Основное занятие – ЕМ), “Credo – for me!” (Жизненное кредо – МНЕ!). By these answers, a spiritually deprived person is displayed, who only imitates cultural activity by memorizing certain formulae: “Favourite writer – Mann” (Любимый писатель – МАНН), “Favourite artist – Manet” (Favourite artist – Manet), “Who is your favourite poetess? – Anna (Akhmatova)” (Какой поэтессе отдаете предпочтение – АННЕ). This interpretation is only one of other possible interpretations of the poem, as Katsyuba does not provide the reader with her own interpretive remarks on these contradicting descriptions of the mannequin. Consequently, it is problematic to consider whether Katsyuba presents her creature as another Frankenstein’s monster, or supposes it to be an equal member of human society. The unique individuality of the mannequin is expressed by the answer to the last question: “Whom can you be replaced by in case of absence? – No one” (Кем можно заменить в случае отсутствия? – НЕКЕМ), by which Katsyuba presents a concept of irreplaceability already manifested in the epigraph to the collection of poems *Junkyard*: “There is no replaceable object in the junkyard!” (На свалке заменимых нет!).

To conclude, the poetic message of the poem is ambiguous: it develops from a pseudo-creationistic act in the beginning, into a social critique in the middle and to the declaration of uniqueness of each creature by the end of the poem. The technique of combining the letters of words can be considered as a simple word-game technique, and by allusion to the Golem, as an act of secondary creativity.

In the following poem [Katsyuba 2003, 215], created on the basis of anagrammatic transpositions of the single word ‘junkyard’, Katsyuba presents a microcosm of persons and their emotions:

Не выходя за пределы слова СВАЛКА, в нем найдут друг друга:	Not transgressing the boundaries of the word ‘junkyard’ they will find each other:
АС и СЛАВА	ace and glory
СКАЛА и ЛАВА	rock and lava
КВАС и ЛАВКА	kvass and bench
ЛАВ и ЛАСКА	‘luv’ (love) and caress
ВЛАС и КЛАВА	Vlas and Klava

Here Katsyuba studies the word 'свалка' (junkyard), finding surprisingly numerous inner words in this six-letter word. The words are grouped by associative pairs: 'ас' (airman, pilot, ace) is associated with 'слава' (glory) as a reward for his bravery; 'скала' (rock) is associated with 'лава' (lava) as a product of volcanic eruption, and by the associations to the further lines could also represent a sexual act; 'квас' (kvass) and 'лавка' (bench) are connected as attributes of traditional rural life; 'лав' ('luv') as a loanword for 'love' is connoted to the slang of sexual revolution, thus leading to 'ласка' (caress) as a physical manifestation of love. Finally, 'Влас' (Vlas) and 'Клава' (Klava) are presented as a rural couple in which all these subjects of simple life, behaviour and love are united. By the expression "not transgressing the boundaries of" (не выходя за пределы), she emphasizes the metaphorical meaning of the poem, so that the characters and their actions are placed on the outskirts of the world, though everything, including happy love, can be found there. Hence, 'junkyard' is presented as a microcosm for its in-habitants. This universe seems to be scanty, thus raising the question on the sufficiency of any personal universe. Also the relation of the creator and the characters are shown in the poem: She regards her characters with attention and understanding. There are no derogatory words in combinatorial or interpretive sections of the poem, instead only positive feelings are presented: love, pride and simple joys. As such, it is the relation of the creator to minor creatures, whose weakness and narrow-mindedness are excusable.

Summing up, Katsyuba uses the method of re-combination of letters in a word for writing poems of ambiguous meanings, both relating to the concept of creativity and playful word-game activities. The presented poems are minimalistic by the provided information on associated objects, thus the interpretive role is entrusted to the reader. Katsyuba does not intend to obey the anagram restriction throughout her poems. For her, the formal method is a tool considered to be more adequate to the overall metaphysical concept of the world and more expressive than conventional poetic methods. The cabbalistic concept of specification of persons and ideas by their naming, as well as the concept of the Creation of the world by pronouncing the Word, is demonstrated by this simple technique.

3. *SPONTANEOUS MUTATION* AS A MODIFICATION OF ANAGRAM TECHNIQUE AND A MEANS TO LINK SEQUENCES OF PHENOMENA

Spontaneous mutation (the Russian term proposed by Katsyuba: *спонтанная мутация*) is a method of consecutive replacement of certain letters of a word with

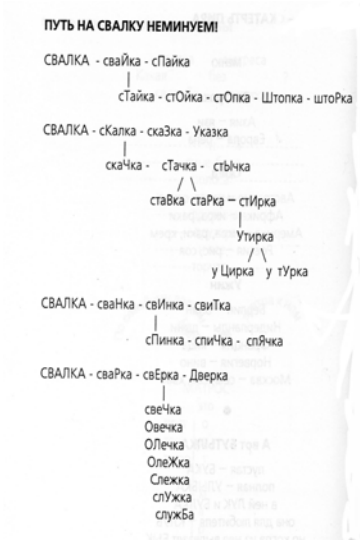
some other letters in order to make another word. As a result, two words of opposite or related meanings become connected; for example, ‘day’ and ‘night’, ‘elephant’ and ‘fly’ and other pairs. This technique is popular as a word-game in English [Gardner 1996, 83–101] and Russian languages [Fedin at al 2001, 32–38]. Katsyuba uses this technique as another combinatorial basis for her poetry, creating a poem by finding a set of transforming words and adding interpretive remarks to it.

The following poem on the subject of ‘junkyard’ is presented in multiple media: as a hardcopy [Katsyuba 2003, 218–219] and as a web publication (http://www.liveinternet.ru/users/1951050/post68718642), slightly differing by spellings and meanings. In this poem, Katsyuba demonstrates the potentiality for the total variability of the words:

ПУТЬ НА СВАЛКУ НЕМИНУЕМ!	The path to junkyard is inevitable!
СТОПКА приводит прямо на свалку: стопка – стойка – стайка – свайка – – СВАЛКА.	A SHOT leads straight to junkyard: shot – counter – flock – pile – – JUNKYARD.
УТАЙКА еще ближе: утайка – стайка – свайка – СВАЛКА.	CONCEALMENT is even closer: concealment – flock – pile – JUNKYARD.
СТЫЧКА идет тем же путем: стычка – стачка – скачка – скалка – – СВАЛКА.	SKIRMISH goes the same way: skirmish – strike – gallop – rolling pin – – JUNKYARD.
СЛУЖБА проходит более длинный путь: служба – служка – слежка – Олежка – Олечка – овечка – свечка – сверка – сварка – СВАЛКА.	SERVICE takes a longer route: duty – lay brother – spying – Olezhka – Olechka – lamb – candle – verification – welding – JUNKYARD.
СПЯЧКА неминуемо выведет туда же: спячка – спичка – спинка – свинка – сванка – – СВАЛКА.	HIBERNATION inevitably leads there: hibernation – match – back – pig – swan – – JUNKYARD.
ПРАВДА на свалку не приводит! У нее свой путь. ПУТЬ ПРАВДЫ	TRUTH does not lead to junkyard! It has its own way. THE WAY OF TRUTH
1) ПРАВДА – правка – плавка – плавки – – ПЛЕВКИ 2) ПРАВДА – правка – травка – ТРАВМА 3) ПРАВДА – правка – плавка – планка – – пленка – плетка – КЛЕТКА	1) TRUTH – correcting – melting – – bathing suit – SPITS 2) TRUTH – correcting – grass – INJURY 3) TRUTH – correcting – melting – level – – film – lash – CAGE

The poem is divided into two parts: in the first part, the common finale for all sets of words is the word 'junkyard', and the message is "The path to junkyard is inevitable" (путь на свалку неминуем), whereas in the second part it is the word 'truth', and the message is contradictory to the first message: "Truth does not lead to junkyard" (ПРАВДА на свалку не приводит). The interpretive remarks are similar, "A shot leads straight to junkyard" (СТОПКА приводит прямо на свалку), "Skirmish goes the same way" (СТЫЧКА идет тем же путем), establishing the concept of total entropic degradation of objects. These statements are close to a known proverb "All roads lead to Rome", though in Katsyuba's poem the paths are temporal rather than spatial, and the centre of attraction is the 'junkyard' rather than the capital of the empire. In a metaphorical sense, Katsyuba presents not only the way of material things, but of all beings as well. That is, Katsyuba shows a wide range of human activities, asserting them all to be meaningless and leading inevitably to total decay: instead of the attraction to the power and luxury represented by Rome, this is the statement equivalent to the Biblical 'vanity of vanities'.

In the book *Игр Рай* [Katsyuba 2003, 218–219], the first part of the poem is presented in a way different from the Internet version (dated 1985) quoted above:



PATH TO JUNKYARD IS INEVITABLE!
JUNKYARD – fid – joint
flock – pile – shot – darn – blind
JUNKYARD – rolling pin – tale – pointer
galloping – strike – skirmish
stake – Starka [vodka] – laundering
wiping
near a circus at the Turk's
JUNKYARD – Swan-woman – pig – shirt
back – match –hibernation
JUNKYARD – welding – check – door
candle
lamb
Olechka
Olezhka
shadowing
lay brother
service

The main difference is the placement of the word 'junkyard' at the beginning rather than at the end of the sets of words. In this case, 'junkyard' becomes a starting point for creation, and the objects are developed through recombination from available details. This transformation is restoring order from chaos, which is impossible for real systems

following the entropy principle, but realizable for mechanical systems of the simple re-combination of elements. In Katsyuba's model, the system can be easily changed in both directions of entropic growth due to the presence of the creator possessing information on all states of the system, ordered and disordered. Similar transformation can be performed in a game by a child creating and destroying objects from a construction set blocks. In her poems, Katsyuba is such a creator, omnipotent in a sense of the Creator and playful in the sense of a child. Nevertheless, it is a state of deformed and corrupted words which in Katsyuba's opinion corresponds to the contemporary paradigm.

The poem is presented in a graphical way with bifurcations of the divergent sets of words. As the words are transformed from the word 'junkyard', the presented objects and categories are supposed to be transformed from broken and spoilt objects found on the junkyard. In this sense, time reversal is possible in this model, presented in two versions of the poem as forward and backward transformation in time. Consequently, in this short poem consisting of basic combinatorial words with little interpretive remarks, Katsyuba presents multiple philosophical ideas: of total degradation with time, of absolute truth and of the reversing of time.

In the next poem based on the *spontaneous mutation* technique, multiple sets of connected words and interpretive remarks are presented in a description of the posthumous transformation of the object departing from the same word 'junkyard' [Katsyuba 2003, 227–228]:

НА СВАЛКЕ ЕСТЬ ВИДЕОСАЛОН	THERE IS A VIDEO-SALON IN THE JUNKYARD
Он показывает мистико-экологический триллер сериал "СЛОН"	It screens a mystical–ecological thriller series "ELEPHANT"
(По заказу окружающей Среды и других дней недели)	(Ordered by the environment Wednesday and other days of the week)
Серия 1.	Episode 1
Белый СЛОН	White ELEPHANT
СТОН издал	uttered a GROAN
в грязный СТОК упал	fell into a dirty DRAIN
в нем как УТОК сновал	where the shuttle cocked as a WEFT
но жизни УРОК кончен	but the LESSON of life is over
счастья УРЮК съеден	dried APRICOTS of happiness are eaten
готовит КРЮК	he prepares a HOOK
с криком КАЮК	with a cry 'the END'
смерть – одноглазый КАЮР	death is one-eyed reindeer-team DRIVER

Следующий КАДР –
черный КАФР
сидит в КАФЕ
перед ним КАРЕ карт
выпала КАРА
жизнь – КОРА гнилая
Лопнула КОЖА слона
раскрылась ЛОЖА нутра
и там где ЛУЖА
дрожит как ЛУЗА
МУЗА свалки
МУХА

The next SHOT –
a black KAFFIR
is sitting in a CAFÉ
there is a SQUARE of cards in front of him
PUNISHMENT is open
life is a rotten BARK
the SKIN of the elephant has burst
inside LODGE was opened
and there on the PUDDLE
trembling as a billiard POCKET
the MUSE of the junkyard
a FLY

Серия 202
Слон, упавший в сток, превращается в шлак:
сток – стык – шлык – шлак

Episode 202
The Elephant who fell into the drain becomes waste:
drain – joint – cap – waste

Серия 303
Слон, начиная с кожи, превращается в торф:
кожа – кора – Тора – торф

Episode 303
The Elephant, beginning with skin, becomes peat:
skin – crust – Torah – peat

Серия 404
Слон, получив жестокий урок, впадает в мистику переселения душ, становится графом, слушает Грига, пьет грог и попадает в гроб:
урок – урон – уран – кран – край – грай – граф – гриф – Григ – грог – гроб

Episode 404
The Elephant, having learned a cruel lesson, falls into mysticism of transmigration of souls, becomes an earl, listens to Grieg, drinks grog and falls into a coffin:
lesson – losses – uranium – tap – edge – cry – earl – fingerboard – Grieg – grog – coffin

Серия 505
Слон, достигший края, становится кротом, а потом клопом:
край – крой – крот;

край – кран – клан – клин – блин – блик – блок – клок – клоп.

Episode 505
The Elephant, having reached the edge, becomes a mole, and then a bedbug:
edge – style – mole;

edge – tap – clan – wedge – pancake – speck – block – flock – bedbug.

The multiplicity of versions begins with the title of the poem: in the Internet publication (http://www.liveinternet.ru/users/1951050/post68718642), the title is *There is a television set in the junkyard*, whereas in the book publication, Katsyuba names a poem *Video-salon*. In the latter, the traits of everyday life of the 1980s–1990s are marked, when video-salons where audiences could watch movies were so extremely popular, that it was natural to imagine a video-salon open in a junkyard.

At first sight, the topic of the poem seems deliberately humorous, and it is the word-game transformation of distinguished objects, though by the analysis a deeper meaning can be disclosed. The topic of the poem is the transformation of 'elephant' as a word and a creature represented by this word in conjunction with the cabbalistic concept. The word 'elephant' is the most common subject for this type of letter transformation: the most popular word game based on this technique is to make a fly out of an elephant", which is known to be solved in seventeen transformations: 'слон' – 'стон' – 'сток' – 'срок' – 'урок' – 'крок' – 'крюк' – 'каюк' – 'каюр' – 'кафр' – 'кафе' – 'каре' – 'кара' – 'тара' – 'тура' – 'мура' – 'муха' (elephant – groan – drain – term – lesson – rough sketch – hook – end – reindeer driver – trunk – café – square – punishment – package – rook – nonsense – fly; transliteration: slon – ston – stok – srok – urok – krok – kryuk – kayuk – kayur – kafr – kafe – kare – kara – tara – tura – mura - mukha). As can be seen, Katsyuba uses some of these words in her sequence.

In Katsyuba's poem 'elephant' (слон; transliteration: slon) becomes 'fly' (муха; transliteration: mukha) through death and decomposition, followed by posthumous transformations. Katsyuba creates a story of an elephant, who has fallen into a drain and died, so that its body is decomposed and filled with flies. By this sequence, Katsyuba demonstrates the extent of post-mortem transformations as in the second (202) series 'elephant' (слон; slon) is simply transformed into 'waste' (шлак; shlak), then in the third (303), it is transformed into 'peat' (торф; torf) becoming a part of the eternal cycle of nature. This transformation starts not with 'elephant' (слон; slon) itself, but more naturally, with its skin (кожа; kozha). The transformation goes through the sacral book of Torah so that, the concept of cabbala appears in which an object and its name are strongly associated. By the fourth transformation (404), another embodiment becomes possible for the 'elephant' (слон; slon) appointed by multiple attributes: it becomes 'earl' (граф; graf) with 'grog' (грог; grog) and string music by Grieg (Григ; Grig), dies again and follows into 'coffin' (гроб; grob). By the last episode (505), the 'elephant' (слон; slon) that has already lost its initial essence, starts on 'edge' (край; kray) and develops as part of nature in two directions, either to 'mole' (крот; krot) or to 'bedbug' (клоп; klop). Consequently, the final transformation is made from a large object into a small, though now it is seen not as humiliation of the 'elephant', but as his metempsychosis, a happy restoration of life through the natural cycle.

Concluding, by using *spontaneous mutation* technique, Katsyuba proclaims the concept of overall transformation to disorder and then to a different order. In her understanding, objects are bound with their names, so similarly to the decomposition and re-

composition of names made by letter re-combinations, objects are easily changed through the post-mortem transformation. This combinatorial technique is mutual for word-game poetry and ancient cabbalistic writing, providing a profound foundation for the understanding of the world.

4. LETTER PALINDROME IN KATSYUBA'S POETRY: SYMMETRICAL TRANSFORMATION OF THE WORDS

Letter palindromes are texts read the same forward and backwards. It is one of the oldest literary restrictions, which has been widely known in Europe since antiquity. Transformation of the way of reading can be seen as a strict symmetrical transformation of the text. According to Lotman [Lotman 1992, 19–24], the dual reading of a palindrome is associated with a contraposition of apparent to secret, of ignoramus to sacral and aesoteric. This understanding is close to Katsyuba's concept of palindrome, as exploring this technique she searches for the inner meaning of the words that carry a dialogue with the poet. Lotman contends that the author of a palindrome considers the world through a non-linear, holistic perception that turns the flow of time [Lotman 2000, 218], which is also the idea typical for Katsyuba's poetry.

Katsyuba often works with palindromes, creating palindrome poems consisting of several lines, with each of the lines being letter palindromes themselves. Katsyuba strictly follows the spelling of words without changing letters to close letters such as 'ш' (sh) to 'щ' (stch), 'ь' (the soft sign) to 'ъ' (the hard sign) and other pairs of letters. On the other hand, she includes nonsensical sets of letters in her poetry instead of meaningful words, as for Katsyuba a meaningful word is only one of permissible combinations of all possible versions. In palindromes, as well as in other forms, Katsyuba understands *zaum* as pure language in which meaning is possibly lost or damaged throughout everyday usage, though this meaning can be restored by combinatorial techniques. This concept is close to understanding of *zaum* by Khlebnikov, one of the founders of Russian futurism [Markov 1994, 180].

In palindrome writing, Katsyuba discovers multiple palindrome phrases for the same word elaborating her poetic ideas and demonstrating her linguistic virtuosity. The following palindromes are presented here to demonstrate Katsyuba's poetic ideas that differ from the post-apocalyptic 'junkyard' concept demonstrated in the poems analyzed above. Among these palindromes [Katsyuba 2003, 252] there are many short one- and two-lines with non-palindrome titles providing a clue to the understanding of

the lines: “Две русалки. Обе на деле – танец НЛО, солнце на теле да небо” (Two mermaids. Both indeed are a dance of UFO, sun on body and sky); “Мечтатель. ‘Ох, эти волны снова, мама!’ – вон сын ловит эхо” (Dreamer. “Oh, these waves again, mother!” – son catches the echo there); “Мудрец. Ум его – бином, он и бог ему” (Sage. His brain is binomial, he is the god of it); “Астролог. Ада кора – Зодиак, а там атака и доза рока? – Да!” (Astrologer. Zodiac is a cortex of hell, and is there an attack and dose of fate? – Yes!); “Цыганка. Им Аза лгала глазами” (Gypsy girl. Aza lied to them with her eyes). The topics of these line palindromes are mostly instant observations, so they can be understood as sketches in the writing pad of an artist practicing the technique at any opportunity: on a beach (Солнце на теле да небо; sun on body and sky; Ох, эти волны снова, мама; oh, these waves again, mother), in seeing a passer-by (Gypsy girl), and in reading a newspaper with astrological prediction (Astrologer). Supplied by titles and united in a collection of line palindromes, these sketches form facets of the everyday life depicted by Katsyuba.

The topic of the following multiple-line palindrome *Eve’s mirror*, [Katsyuba 2003, 241] is the Adam–Eve theme, popular among palindrome writers, referring to the beginning of Creation:

Зеркало Евы	Mirror of Eve
Аве, Ева!	Ave, Eve!
Ума дай Адаму.	Give reason/intellect to Adam.
“Рад я, ем змея дар”.	“I am glad, I am eating a serpent’s gift”.
Но мед – демон,	But honey is a demon,
небу – бубен,	a tambourine to the sky,
ночи бич он.	it is a lash of the night
“Я луна нуля,	“I am a moon of naught,
ада к раю аркада!”	an arcade of hell to heaven!”
Узор ангела лег на розу,	An angel’s pattern lay on a rose,
нежен	it was tender,
летел,	it flew,
лад Евы ведал.	it knew a concord of Eve.
В аду зло полз удав.	In hell a boa groveled maliciously

The Adam–Eve theme can be found in palindromes created by various poets; for example, by French author Paul Fournel [Fournel 1972, 132–134]. In this topic the images of the first people, in accordance with Judaic and Christian religions, are linked to the concept of reflection, as Adam was created in God’s image and likeness, and Eve was created from Adam as his partial and inexact copy. In Katsyuba’s understanding the Creation was a process of symmetrical transformation of the primary substance into

the world: "Then God created a mirror and reflected in it / thus Adam was created" [Тогда сотворил Бог зеркало и отразился в нем – / так Адам создан был Katsyuba 2003, 25]). The word 'mirror' as a tool of reflection appears in the title of Katsyuba's poem with a connection to the name of Eve, thus palindromic doubling of images is attributed to women's creativity. Similar to the above-analyzed poem *Alphabet* [Katsyuba 2003, 13] where Eve was mentioned in regard to 'Eve's gift' (Дар Евы), the interpretation of Eve's role is favourable.

The poem begins with the greeting of Eve, "Ave, Eve!" (Аве, Ева; transliteration: Ave, Eva), followed by an appeal to bring Adam to reason, "Give reason/intellect to Adam" (Ума дай Адаму; transliteration: Uma day Adamu). In the next lines, Katsyuba manifests Eve as a junction from hell to heaven: "I am a moon of naught, / an arcade of hell to heaven!" (Я луна нуля, / ада к раю аркада; transliteration: Ya luna nulya, / ada k rayu arkada). The female essence is emphasized by mentioning the moon, which is traditionally associated in astrology with womankind. At the end of the poem Eve is associated with a rose and an angel, whereas the demonic serpent presented metonymically by 'boa' (удав; udav) takes its place in hell: "An angel's pattern lay on a rose, / it was tender, / it flew, / it knew a concord of Eve. / In hell a boa grovelled maliciously" (Узор ангела лег на розу, / нежен / летел, / лад Евы ведал. / В аду зло полз удав; uzor angela leg na rozu, / nezhen / letel, / lad Evii vedal. / V adu zlo polz udav).

It is worth noting the line "Рад я, ем змея дар" (I am glad, I am eating a serpent's gift; Rad ya, em zmaya dar) as an expansion of one of the simplest and most known Russian palindromes "я ем змея" (I eat a serpent; ya em zmeya). Similarly, in the line "Узор ангела лег на розу" (An angel's pattern lay on a rose; uzor angela leg na rozu), Katsyuba makes allusions to two well-known palindromes: "А роза упала на лапу Азора" (And a rose fell down on a paw of Azor; a roza upala na lapu Azora) attributed to the nineteenth century poet Afanasy Fet, and "Но невидим архангел, мороз узором лег на храм, и дивен он" (But an archangel is invisible, and frost lay down on a temple, and it is wonderful; no nevidim arkhangel, moroz uzorom leg na khram, i diven on) by the well-known contemporary poet Dmitry Avaliani. In the poem *Cathedral* [Katsyuba 2003, 245], Katsyuba reproduces the latter palindrome almost strictly: "Лег на храмы дым. Архангел / невидим и дивен" (Smoke lay down on the temples. The Archangel / is invisible and wonderful; Leg na khramii diim. Arkhangel / nevidim i diven), following her belief in the pre-existence of short palindromes in the language, so they are discovered by multiple authors rather than created uniquely. Again the

priority of the whole text over its parts, including the re-composition of existing combinatorial texts, is demonstrated. In this sense, Katsyuba's understanding of authorship is close to that in the prepress and early press era. For example, combinatorial authors such as the 18th century Ukrainian poet Ioann Dovgalevsky cited and translated Latin examples without indicating the names of the original writers [Dovgalevsky 1973].

Another topic explored by Katsyuba [Katsyuba 2003, 239] is the meditations on the 'я и ты' (I and you) theme presented as a proclamation of love as the essence of the universe:

Я и ты –	I and you –
Я и ты – бог, эго бытия.	I and you are god, the ego of being.
Я и ты – Бах эха бытия.	I and you are the Bach of the echo of being.
Я и ты – бутон нот у бытия.	I and you are a bud of notes of being.
Я и ты – балет тела бытия.	I and you are a ballet of the body of being.
Я и ты – бури миру бытия,	I and you are storms to the world of being,
я и ты – бич у тучи бытия,	I and you are a lash near a cloud of being,
я и ты – беда в аде бытия,	I and you are misfortune in the hell of being,
я и ты – бензин из небытия.	I and you are petrol from non-being.
Я и ты были силы бытия.	I and you were forces of being.
Я и ты были жилы бытия.	I and you were the sinews of being.
Я и ты – база, фаза бытия.	I and you are a base, a phase of being.
Я и ты будем мед у бытия.	I and you will be honey to being

In this poem, Katsyuba celebrates a love union by enumerating the values of a loving couple in the universal existence. The poem is a mono-rhyme as all the endings are the same: 'бытия' (being), defined by the identical beginnings of lines: "я и ты б<…>" (I and you 'b<…>'). That is, the combinatorial structure of the poem dictates the rhetorical figures of speech, anaphora and epiphora presented in each line, as means to emphasize the poetic message. The structure of the poem is formed by the three sections of thesis, antithesis and synthesis. Katsyuba starts with proclaiming a couple to be "God, ego of being" (бог, эго бытия), referring to the absolute self-sufficiency of lovers. By the next lines of the first stanza, the themes of music and harmony appear through mentioning Bach and ballet: "Bach of echo of being" (Бах эха бытия), "bud of notes" (бутон нот), "ballet of a body" (балет тела). By the second stanza, a disturbance of being is brought into consideration: "storms to the world" (бури миру), "lash near a cloud" (бич у тучи), "misfortune in the hell" (беда в аде) finishing in the total negation of the being and the appearance of the non-being: "petrol from the non-

being" (бензин из небытия). The poem concludes with a catharsis after the disturbance as a couple is proclaimed to be "honey to being" (мед у бытия). That is, the poetic message of the poem is metaphysical as a proclamation of love as a kernel of the universe.

Concluding, in the letter palindrome poems Katsyuba presents her positive understanding of the world filled with harmony and love as multiple symmetrical transformations of the absolute substance. Numerous palindromes are united producing the total picture of a combinatorial universe, where a poet is a secondary creator. For Katsyuba, the concept of authorship is related mostly to the integral work rather to separate lines of the poems, and the interconnection of the parts of the poem is more important than these parts themselves. For palindrome poems, writing in variations of the same palindrome rhyme is similar to the known rhetorical methods of anaphora and epiphora, in which sense combinatorial writing is drawn closer to conventional poetry.

5. OTHER PALINDROME TECHNIQUES IN KATSYUBA'S POETRY: DISSYMMETRICAL TRANSFORMATIONS OF THE WORDS

Katsyuba uses a wide range of palindrome techniques: the above analyzed poems are letter palindromes – that is, they are read letter by letter the same forward and backwards, whereas the poems analyzed below are different: one is read letter by letter forward and backwards with a different meaning, and another is read word by word the same forward and backwards.

A palindrome of non-identical forwards and backwards reading (*turn-over* in Russian combinatorial terminology, [Fedin at al 2001, 168–172]) is used by Katsyuba through the search for expressive combinatorial poetic methods. This kind of palindrome, where each line can be read backwards, but the meaning of the phrase is not identical to the meaning of the initial phrase, can be considered a type of dissymmetry. In her poem *Sunrise in a mirror of sunset* Katsyuba presents forward and backwards reading as the poems with corresponding meanings [Katsyuba 2003, 268]:

ВОСХОД В ЗЕРКАЛЕ ЗАКАТА (Артур и Атон)
(Sunrise in the mirror of sunset (Arthur and Aten))

ЗАКАТ	ВОСХОД (обратный текст)
Я – ига мира замок. Ах, это имя не там, осени куб – закон, Евы тон алоэ, цена тени он, ход в ворох адониса. От Артура шла темнота, короля нем меч и туп – лев луны в чаду у дурмана. Я сличу ладов зов: себе ни разу, ему – воля и сад. Я – ром боли, а не полет. А муза разума – мрака кот, сова.	Кома зари – магия. Но ты – венок азбуки, несома тенями от эха, но и не танец Эола, а синода хоров вдох. То Атон метал шар утра, чем менял, о рок, пути, а нам руду удач вынул. Вел воз вод, а лучился у зари небес. «Да» сияло в уме и лоб моря, тело – пена. А Востока карма – муза разума!
SUNSET	SUNRISE (reverse text)
I am a lock of the yore of the world. Ah, this name is not there, a cube of autumn is a law, a tone of Eve aloe, it is the price of a shadow, a path to a pile of Adonis, From Arthur, darkness went, the king's sword is dumb and blunt – a lion of the moon in fumes of a haze. I will compare a call of concords: not once to myself, to him – a will and a garden. I am a rum of a pain, not a flight. And the muse of reason is a cat of shadow, an owl.	Magic is a coma of a dawn. But you are a wreath of an alphabet, carried by shadows of echoes, not either the dance of Aeolus, but a breath of choruses of the synod. That Aten threw the morning's ball, by which he used to change, oh fate, the ways, and for us he extracted the ore of luck. He lead a cart of waters, and shone by the dawn of the skies. "Yes" shone in mind and the forehead of a sea, body is foam. And the karma of the East is a muse of reason!

The poem *Sunset* is read from left to right, as in the European tradition of reading, and concerns the decline of the West, whereas the reversal poem *Sunrise* is read from right to left, as in some Eastern traditions of script/reading, and concerns the ascent of the East. Again, the transformation of symmetry is presented here as if by reflection in a mirror where sunset is transformed into sunrise: "Sunrise in the mirror of sunset" (Восток в зеркале заката), though in this case it is a distorted transformation of non-identical objects.

In this pair poem Katsyuba contrasts the East to the West, as cardinal point of sunrise and sunset and as the realms of human civilization. The West is personified by a legendary King Arthur, who is believed to be sleeping inside a cave, and the East is presented by an Egyptian name for the only god, Aten, proclaimed by the pharaoh Akhenaten in his reform of a system of faith in Egypt from polytheism to monotheism. Arthur appears as a mythical person, who is partly real and partly imaginary. In his realm everything is foggy and vague. On the other hand, Aten is seen as a real figure appeared in Egypt and still remaining there in the matter of monuments and temples. His realm is sunny and clear. The title of Katsyuba's poem literary alludes to the concept of the 'decline of the West' proclaimed by Spengler, who stated that the present era is a decline of the Faustian (Western) culture [Spengler 1926]. Many spiritual searchers for the wisdom, for example, Nikolay Rerikh, or 'gurus' of Western culture of the 1960s also proclaimed their preference for the East. Nevertheless, Katsyuba, as in her other poems, develops her own ideas, not following any of these philosophical or literary and art concepts.

In Katsyuba's poem, the West is associated with darkness: "From / Arthur, darkness went" (От / Артура шла темнота), whereas the East is associated with light: "shone / by a dawn of the skies" (лучился / у зари небес). Katsyuba expresses this concept in the form of a palindrome where a formal transformation of letter order corresponds to the reverse of civilization: what is a sunrise for one culture is a sunset for another; when the first culture is "in a haze fumes" (в чаду у дурмана) as Arthur is charmed by Merlin in a cave in accordance with the legend, the other culture is prospering, "the ore of luck is extracted" (руду удач вынул), as a consequence of monotheist reform. This contradiction is mostly arbitrary, as Akhenaten's reforms were unsuccessful and had no significant influence for Egyptian civilization, and happened long before the legendary Arthurian kingdom, so they doubtfully can be contrasted to each other. Nevertheless, Katsyuba presents her opinion on the development of the cultures, supporting it by the formal structure of the poem.

Another modification of the palindrome-based formal structure used by Katsyuba is a word palindrome, in which words instead of letters are read forward and backwards. This type of combinatorial restriction is a well-known form of European combinatorial poetry existing for centuries [Bombaugh 1961, 59–63] and revived in recent works [Braffort 1981, 221], [Grangaud 1998], though it is still rare in Russian combinatorial poetry. In the poem *Moon and darkness*, Katsyuba presents a word palindrome as a dissymmetrical transformation of substances [Katsyuba 2003, 110]:

Луна и мрак

ЗАКАТ ЗАХВАТИЛ лес – ЛЕС ЗАХВАТИЛ закат
СТВОЛЫ ЗАСЛОНИЛИ омуты тьмы – ТЬМЫ ОМУТЫ заслонили стволы
Олово стало ЗОЛОТО – золото стало ОЛОВО
Валун был ФИЛОСОФСКИЙ КАМЕНЬ – камень философский был ВАЛУН
ТОРЖЕСТВО АЛХИМИИ победило неверие – НЕВЕРИЕ победило алхимии торжество
Пелась не СВАДЬБА – свадьба НЕ пелась:
ВЕЧНОЕ не единение молчащего и светящей – светящей и молчащего единенье НЕ ВЕЧНОЕ
Ей ПЛЫТЬ не острой звездой – планетой – планетой, звездой острой НЕ ПЛЫТЬ ей
Ему БЫТЬ не видимым – ощутимым – ощутимым, видимым НЕ БЫТЬ ему
ЛЕТЯТ, не теряя друг друга – друг друга теряя, НЕ ЛЕТЯТ
ЛУНА И МРАК

Moon and darkness

Sunset captured the wood – a wood captured the sunset
trunks shielded the sloughs of darkness – sloughs of darkness shielded the trunks
tin became gold – gold became tin
A boulder was the philosopher's stone – the philosopher's stone was a boulder
the triumph of alchemy defeated disbelief – unbelief defeated the triumph of alchemy
it was not a wedding singing – a wedding did not sing:
the eternal is not unification of the silent and the shining – unification of the shining and the silent is not eternal
for her, to float not as a sharp star, but a planet – neither as a planet, nor as a sharp star for her to float
for him, to be not visible, but perceptible – neither perceptible, nor visible for him to be
they fly not losing each other – losing each other they do not fly
moon and darkness.

The interaction of the moonlight and darkness is described as a unity of opposites: reflection and absorption, light and shadow, decline and rise. The text could be read in multiple directions: from left to right as well as from right to left and from top to bottom as well as from bottom to top. That is, multiple symmetries and dissymmetries as non-identical resemblance are presented here, including the double reverse of the time arrow. The meaning of the lines is modified by the reflection in the central vertical mirror: "Sunset captured the wood" (ЗАКАТ ЗАХВАТИЛ лес) is transformed to "A wood captured the sunset" (ЛЕС ЗАХВАТИЛ закат) and vice versa. In the left part of the poem describing moonlight, positive transformations are presented as the light appears: "Tin became gold" (Tin became gold), "A boulder was the philosopher's stone" (A boulder was the philosopher's stone); whereas for the right side of the poem representing darkness, the transformations are negative as the degradation spreads: "Gold became tin" (Gold became tin), "The philosopher's stone was a boulder" (The philosopher's stone was a boulder). In other lines, the mirror transformation is equally unproductive: "The eternal is not unification" (ВЕЧНОЕ не единение), or "Unification

<…> is not eternal" (единенье НЕ ВЕЧНОЕ). In the final lines, the moon and the darkness are described through mutual negations in the adjacent lines: "For her, to float not as a sharp star, but a planet – neither as a planet, nor as a sharp star for her to float" (Ей ПЛЫТЬ не острой звездой-планетой – планетой, звездой острой НЕ ПЛЫТЬ ей), and "For him, to be not visible, but perceptible – neither perceptible, nor visible for him to be" (Ему БЫТЬ не видимым-ощутимым – ощутимым, видимым НЕ БЫТЬ ем); concluding with unification in the last line of the poem: "They fly not losing each other, losing each other they do not fly / moon and darkness" (ЛЕТЯТ, не теряя друг друга – друг друга теряя, НЕ ЛЕТЯТ). Altogether, complex interactions of darkness and light are presented by word-palindrome phrases of reverse meanings.

Concluding, Katsyuba writes palindromes of different types using these techniques as a means to express her poetic ideas, where traditional palindromes are representation for strict symmetry, and non-identical *turn-over* palindromes are for dissymmetry.

6. CONCLUSION

The analysis of poetic techniques allowed me to identify and examine the topics of Katsyuba's poems, often obscure and virtually incomprehensible to the uninitiated reader. These topics include a number of philosophical and spiritual themes of the highest poetry, such as meditations on spiritual subjects and the essence of poetry; on the spiritual life and inevitability of death; the essence of human self and the world. On the other hand, in some poems the social, personal and playful topics appear as the author' reaction to everyday life.

It is demonstrated that formal restrictions play a central role in Katsyuba's works. Katsyuba explores the simplest letter restrictions such as variations of anagram and palindrome searching for the inner meaning and extensions of the words. In many cases, these restrictions replaced or helped accomplish traditional poetic techniques, allowing the author's ideas to be clearly expressed, or even new ideas appear through exploration of the formal technique. This concept is in accordance with the language potentiality concept proposed by Oulipo, which Katsyuba is not directly familiar with, but independently discovers and develops.

Katsyuba applies formal restrictions freely, not attempting to create virtuoso combinatorial poetry as such, but using them as illustrations of and arguments for metaphysical concepts. Her overall idea is the similarity of the primary Creation of

objects and phenomena to a secondary poetic creation. The objects and phenomena are understood as strictly correlated, even identical to the words that signify them, so that their essence can be restored by the study of their names using combinatory literary techniques. Katsyuba's concept is partly playful in a word-game manner and partly serious in a cabbalistic sense: a transformation of letters of a word results in modification of the subject itself and clarification of its nature. Another distinguishing concept of Katsyuba's poetry is the understanding of love as the essence of the universe, which is close to the concepts of metaphysical poetry.

By the formal combinatorial methods, Katsyuba develops baroque literary methods such as ordering poems in alphabetic order and syllabic rhymes, as well as futuristic literary methods such as the *zaum* language in a search for new expressiveness for the new era. Katsyuba's understanding of *zaum* as a pure language of lost meaning is close to original concept presented by Khlebnikov and, together with her understanding of the correspondence between the object and its name, can be seen as an exercise in the search for the inner meanings of the words.

Despite the similarity to the baroque authors in her desire to create an encyclopaedia of poetic phenomena, Katsyuba's model of the world differs from the world described by those authors: if the preceding authors saw the universe as a harmonic and perfect miracle, for Katsyuba the world is all known, used and stained. Here the metaphor of 'junkyard' appears as an irregular collection of discarded objects. Nevertheless Katsyuba considers this collection favourably, as a set for further re-combinations.

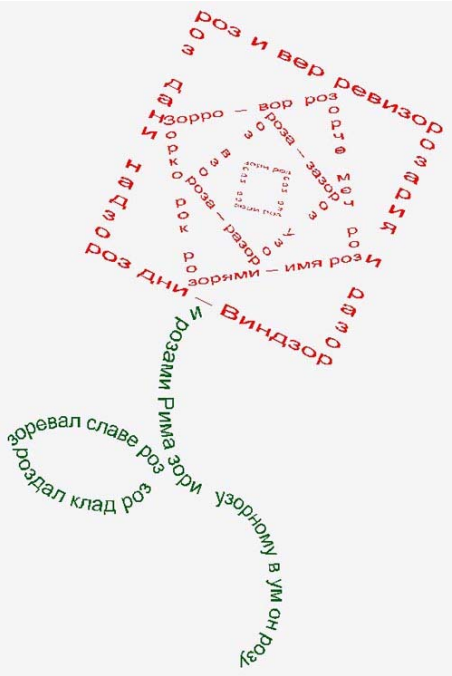
On the whole, Katsyuba's poetic program is a demonstration of the possibility of the secondary creativity out of the words of the existing creation. A restoration of the primary meaning, as well as transformation to the other objects, are possible in Katsyuba's poems thus confirming her optimism for the world. According to Zumthor [Zumthor 1972, 32] the medieval texts are "filled with deep optimism, truth in sufficient man and word, nature that is filled with God's support... The world considered the united comprehensive truth". In correction for the belief in God's support, Katsyuba's understanding of the world as full of light and love, despite its complexness and grieves, is similar to the medieval concept.

Presented here is the first detailed approach to the structural analysis of Elena Katsyuba's poetry. Through the present analysis, characteristic features of this poetry were identified otherwise obscure and virtually incomprehensible to the uninitiated reader. The comparative analysis of Elena Katsyuba's poems together with the poems

of the other Russian authors who works in the same experimental combinatorial style, for example, Anna Alchuk, Rui Nukonova, Boris Grinberg, Dmitry Avaliani and some others, could be the goal for the future researches as the next approach for a systematic analysis of contemporary Russian experimental poetry.

APPENDIX
ELENA KATSYUBA : QUADRATURE OF A ROSE

Katsyuba's poem is devoted to a rose and is represented in the graphics as a rose. In addition, the word 'роза' (rose) is included into each line of the poem. The lines of the poem are visualized as four sides of squares representing an artificial flower created by the combinatorial technique, and in a forking curve representing a stalk and a leaf. Each line on the sides of the squares and each curve of 'stalk' is a palindrome. The letters on the corners of the sides of the squares belong to the words of both sides, alternating by the consonants of the word 'роза' (rose): 'р' (r) and 'з' (z). The poem does not have a defined order of reading, so the reader can start from multiple points and read the poem in several directions: from 'stalk' to 'head' or vice versa, from inner 'petals' to outer or backwards, from any of the four corners of each 'petal', as well as from left to right and from right to left in accordance with the palindrome structure of the poem. From the centre, the figure of the rose develops with variations as the number of letters in a line increases. In the inner square, all four sides of the square are identical: "зори роз" (dawns of roses). In the next square, "роза – зазор / роз узор / роза – разор / роз взор" (to a rose – a gap / pattern of roses / a rose – a ravage / look of roses), the variations are minimal: 'зазор' – 'разор' (gap – ravage), 'узор' – 'взор' (pattern – look). The next lines are more variable, though some words are repeated ('dawns', 'ravage'), and some lines differ by one or two letters only: "роз дни – Виндзор / роза дани надзор" (days of roses – Windsor / oversight on the contributions of roses). In this way, the described object is developing, potentially, to infinity. In contrast, the lines of the 'stalk' are all limited, and all different, even though they are not strict palindromes: "роздал клад роз" (dispensed a buried treasure of roses). In this line, a combination of a palindrome ("дал клад" (gave a buried treasure)) and alliteration repetitions ('роз' – 'роз' (rose – rose)) is used. In *Quadrature of a rose*, the allusion is made to a known mathematical problem of a quadrature of the circle, which cannot be solved by elementary geometrical tools. Katsyuba states the possibility of solving an impossible task by creating a living object, 'rose', using a combination of the letters in an alchemy style.



(Quadrature of a rose // inspector of roses and faiths / a rosary and a ravage / days of roses – Windsor / oversight on the contributions of roses // Zorro – a thief of roses / make an alert eye, sword of roses / by dawn – the name of roses / fate of roses is sharp-sighted // to a rose – a gap / pattern of roses / a rose – a ravage / look of roses // dawns of roses / dawns of roses / dawns of roses / dawns of roses // and by roses of dawn of Rome // he placed a rose in the patterned mind // spent a dawn to the glory of roses / dispensed a buried treasure of roses, in Russian)

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Symmetry: Culture and Science
Vol. 23, No.1, 67-96, 2012

FIGURE-GROUND SYMMETRY ANALYSIS OF CHARACTERS IN LITERATURE

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Abstract*: Character impression in literature is captured through a bipolar symmetry of figure and ground. According to gestalt psychology, when the target of attention is on a figure, the rest of what we perceive is the ground. In literary texts, we assume that the character which the reader pays attention to is a figure while the rest of the characters are the ground. The potential for such figure-ground contrast is illustrated by the notion of complements in lattice theory. The double approximation method of rough set theory allows us to consider subject-attribute relations of characters. The resulting fixed point elements of subject sets construct Boolean as well as non-Boolean lattices. By doing so, we get a model for a figure-ground symmetry derived from textual information. Additionally, this allows us to categorize scenes into clear or unclear figure-ground symmetry, depending on the attribute relationships of characters. It is an insight of symmetry not achieved by existing probabilistic or intuitive character interpretive methods. The story from the popular folktale Cinderella is used to demonstrate how attributes and roles assigned to characters establish figure-ground profiles in the lattices, thus in the story.*

Keywords: figure-ground symmetry, gestalt psychology, character dynamics, literary analysis, complements, lattice theory, rough set theory.

1. INTRODUCTION

In this paper we analyze the figure-ground status of characters in literary text based on the concept of gestalt psychology and subject-attribute information supplied in the text. Bipolar concepts such as assumptions-conclusions, finite-infinite, discreteness-continuity, etc. are treated as symmetry by Marcus (Marcus, 2009). The foundational concept of gestalt psychology (Koffka, 1935) is the contrast in perception between an object which is the target of attention, known as the figure, and the rest of the perception field known as the ground, forming a figure-ground contrast or symmetry. When the figure-ground status of an object changes, the event is called a figure-ground reversal. Figure-ground reversal is often the trick in illusionary images (Figure 1).

Figure 1: An example of clear figure-ground symmetry, Rubin's vase. In this example, the image is recognized even when the figure-ground status is reversed (figure-ground reversal between a white vase and black profile of two faces).

The concept of figure-ground symmetry continues to find applications inside and outside of gestalt psychology: optical illusion (Figure 1) (Rubin, 1915; Hoffman, 1983), perception (Palmer et al., 2008; Huang et al., 2009; Christman et al., 2009), symmetry patterns in natural sciences (Gershoni, 2008), human or computer vision (Huang, 2008; Loss et al., 2009), focus of attention and consciousness (Forti, 2008; Werner et al., 1941; Siegenthaler et al., 1967), biological matter vs. abiotic matter in the environment (Rajaniemi et al., 2009; Granek et al., 2008), music (Meyer, 1956; Cooper et al., 1960), literature or poetry (Herrnstein-Smith, 1968; Tsur 2009).

There have been several attempts to investigate figure-ground symmetry relationships in literature: to consider the written text as a figure and the reader's imagination or impressions as a ground (Awagaki, 2008); to treat assumed information as figure and the unconsidered information as the ground (Tsur, 2009; Veale, 2009); to regard subjects of active verbs as figure and state-describing nominal sentences as ground (Labov, 1972); to associate dialogue text as a figure and the narrative text as a ground (Hamada, 2001). In contrast, we have assumed that gestalt psychology, originally

intended for understanding consciousness and perception of the environment, can also be applied to the virtual world created by a text to analyze the figure-ground symmetry of characters and events in a story.

In our investigation, the subject-attribute information of a text is the source. Our analysis picks up attributes associated with each subject. The attributes can be nouns, verbs, or adjectives. When there is a clear contrast in the attributes among the characters, an observer can shift her/his attention from one character to another. The character receiving the attention would be the figure and the rest of the characters would be the ground. When the attributes of characters overlap each other, the figure-ground symmetry can become unclear.

Complements in lattice theory are convenient for analyzing figure-ground symmetry in a given scene. A lattice is a partially ordered set closed with respect to two kinds of binary operations, join ($\vee$) and meet ($\wedge$). By using join and meet, complement is defined as a unary operation or as an element indicated by such an operation. In our framework, a lattice is constructed as a collection of subsets of a given set. In set theory, complement A^c for any subset A is uniquely defined by $A^c=U-A$ when U is a universal set. This case allows us to compare a pair of A and A^c to a pair of figure and ground. If one lattice element is a figure, its pairing element is a ground. A figure-ground reversal occurs when an observer switches the naming of figure and ground of the complement elements in the lattice.

Whether the characters in a scene have a clear figure-ground symmetry can be analyzed with the rough set derived lattices. When we obtain a lattice element with a single complement pair, we can consider that element to have a clear figure-ground symmetry in that scene. If a lattice element has multiple complements we can consider that element to have an unclear figure-ground symmetry with respect to the other characters. An algebraic structure analysis of plays and character prioritization developed by Marcus (1970; Brainerd, 1974) and character impression analysis based on attribution theory have been researched by Culpeper (1996). These investigations attempt to capture characters in stories by using mathematical tools or psychological methods. However, these novel approaches for extracting character information are not proper for modeling a dual symmetry of figure and ground. The rough set derived lattice offers an additional insight which is not provided by other methods.

We examine the figure-ground symmetry in scenes of a story from the resulting rough set derived lattice structures. Although the methodology for the application of the tool is

open to investigation as discussed in the Methods and Procedures, and Discussion sections, we provide the principles and demonstrate the results. We have used a story from popular folklore, Cinderella; or, The Little Glass Slipper (Perrault, 1697), for our examples.

2. METHODS AND PROCEDURES

The attribute commonalities and differences of character subjects are preliminarily processed through a double approximation method called rough set theory. Fixed points result from the subject and its attribute information of a scene in the text. The combination of lattice theory and rough set theory provides diverse lattice structures. The lattice structures are adaptive to various scene settings.

2.1 Rough set theory

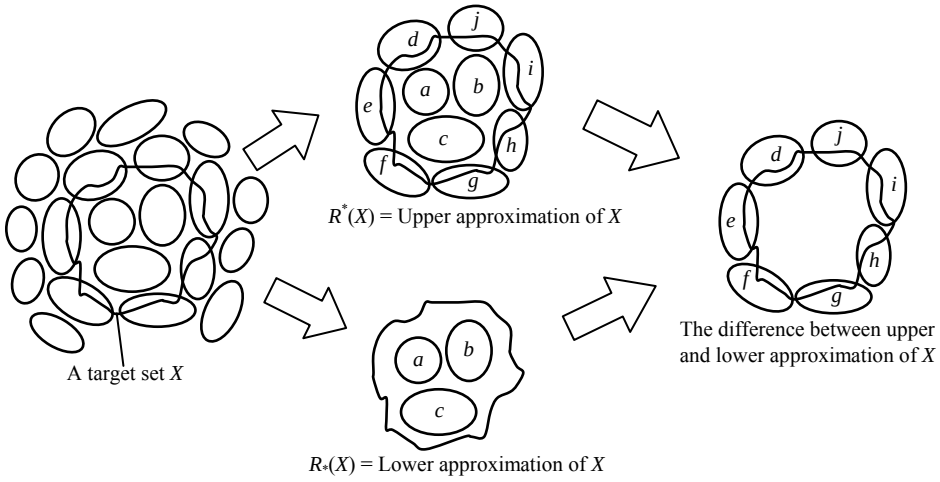


Figure 2: A diagram of the upper and lower approximation method of rough set theory.

Rough set is an approximation method (Figure 2). If there is a target of interest X, it can be approximated as a collection of elements that certainly belong to the target and those that partly belong to the target. The set of elements certainly related is called the lower approximation, denoted as $R_*(X)$, and the set of elements partially related is called an upper approximation, denoted as $R^*(X)$ (Pawlak, 1981; Pawlak, 1982). If there is no

difference between the lower and upper approximations, the set is called a crisp set. This means there is no ambiguity about the target.

2.2 Equivalence relation and indiscernibility

Rough set theory is founded on the idea that the elements in a set are indistinguishable (because if they were distinguishable and each element could be evaluated, a "rough set" approximation would not be necessary). The indistinguishable elements are said to have an equivalence relation with each other and belong to the same equivalence class. Let x, $y \in U$ be elements of a universal set U and f be a transformation function. If $f(x)=f(y)$, then x and y are said to have an equivalence relation. Express the equivalence relation as R. Then equivalence class is expressed as $[x]_R=\{y \in U | xRy\}$ (Figure 3 (a)). Thus the lower approximation of X is formally defined as $R_*(X)=\{x \in U | [x]_R \subseteq X\}$ and the upper approximation as $R^*(X)=\{x \in U | [x]_R \cap X \neq \phi\}$, where ϕ represents an empty set (Figure 3 (b)).

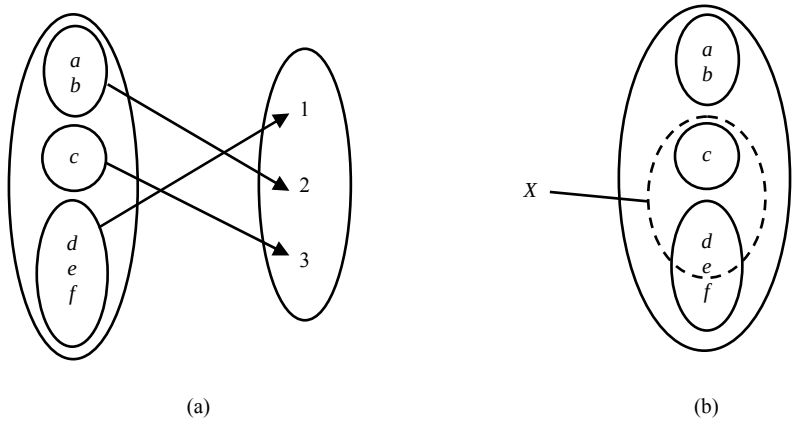


Figure 3: (a) Diagram of an equivalence class. $[a]_R=\{a, b\}$, $[c]_R=\{c\}$, $[d]_R=\{d, e, f\}$. (b) Diagram of a rough set approximation of X. The lower approximation is $R_*(X)=[c]_R=\{c\}$ and the upper approximation is $R^*(X)=[c]_R \cup [d]_R=\{c, d, e, f\}$.

2.3 Galois connection and lattice

In a theory of partially ordered set, Galois connection leads to a complete lattice. Given two partially ordered sets P and Q, a pair of maps (F, G) with $F:P \rightarrow Q$ and $G:Q \rightarrow P$ is called a Galois connection, if $F(x) \leqq y \Leftrightarrow x \leqq G(y)$ for any $x \in P$ and $y \in Q$. A closure operator $C:=FG:P \rightarrow P$ can be constructed from a Galois connection such that, for any x,

$y \in P$, (i) $x \leqq C(x)$; (ii) $x \leqq y \Rightarrow C(x) \leqq C(y)$; (iii) $CC(x)=C(x)$. This means that the closure operator is a good and natural operator to take a stable structure in a partially ordered set with respect to F and G. Overall it results in a (complete) lattice $L_T=\{x \in P | C(x)=x\}$. In the context of a rough set, given a universal set U, the R^* and R_* transition of the power set of U ($R^*:\mathcal{P}(U) \rightarrow \mathcal{P}(U)$ and $R_*:\mathcal{P}(U) \rightarrow \mathcal{P}(U)$) constitutes a Galois connection. Actually, for any X, $Y \subseteq U$, $R^*(X) \leqq Y \Leftrightarrow X \leqq R_*(Y)$. Thus $C=R_*R^*$ is defined as a closure operator and $L_C=\{X \in U | C(X)=X\}$ is a complete lattice. This lattice, however, is too trivial to observe the structure, since it is destined to be a set lattice. Thus for any $A \in L_C$, complement of A is defined as $A^c=U-A$.

If there are two kinds of binary relations R and S on a universal set U and two kinds of operations R^* and S_* (or R_* and S^*), a pair of operations do not constitute a Galois connection. Indeed, if an operator $T=R_*S^*$ is introduced, T is not a closure operator since it satisfies only (ii) $X \subseteq Y \Rightarrow T(X) \subseteq T(Y)$ and (iii) $TT(X)=T(X)$ for X, $Y \subseteq U$. We call this operator pseudo-closure. If fixed points with respect to pseudo-closure are collected by $L_T=\{X \in U | T(X)=X\}$, L_T is a lattice but not a set lattice. Inversely, it can be verified that any lattice is expressed in the form of L_T by determining adequate equivalence relations S and R. It gives fruitful results to analyze literature text.

2.4 Constructing a lattice

Lattice is an algebraic structure where any two elements of a partially ordered set have a unique least upper bound (join or $\vee$) and a greatest lower bound (meet or $\wedge$) (Birkhoff, 1967; Davey et al., 2002). As mentioned before, given two kinds of equivalence relation R and S on a universal set U, we can construct a lattice by $<L_T; \subseteq>$ with $L_T=\{X \subseteq U | T(X)=X\}$ where $T=R_*S^*$. Actually, an element of L_T is a subset of the universal set, and order is defined by inclusion $\subseteq$. If all subsets of U are collected, L_T is a power set, and is a set lattice in which join and meet are defined by union $\cup$ and intersection $\cap$, respectively. In general, $L_T \neq \mathcal{P}(U)$, thus join and meet are defined by the following: for any X, $Y \in L_T$, $X \wedge Y=T(X \cap Y)$, $X \vee Y=T(X \cup Y)$. It can be verified that L_T, is closed with respect to $\vee$ and $\wedge$, and that L_T is a lattice.

When we construct a lattice of fixed points from one equivalence relation, $R_*(R^*(X))=X$, we get a set lattice only. A set lattice has two important properties in lattice theory such as distributivity $A \wedge (B \vee C)=(A \wedge B) \vee (A \wedge C)$ for A, B, $C \subseteq U$, and complementarity of which for any $X \subseteq U$ there exists $Y \subseteq U$ such that $X \vee Y=U$ and $X \wedge Y=\phi$. Note that U and ϕ are the greatest and least elements in the lattice L_T. A distributive complemented

lattice is called a Boolean lattice. However, when we construct a lattice of fixed points from two equivalence relations, $R_*(S^*(X))=X$, the resulting lattice can be either a Boolean lattice or a non-Boolean lattice. This is a result of two equivalence classes fully or partially overlapping each other. The differences between Boolean and non-Boolean lattices are mentioned in the next section (Section 2.5).

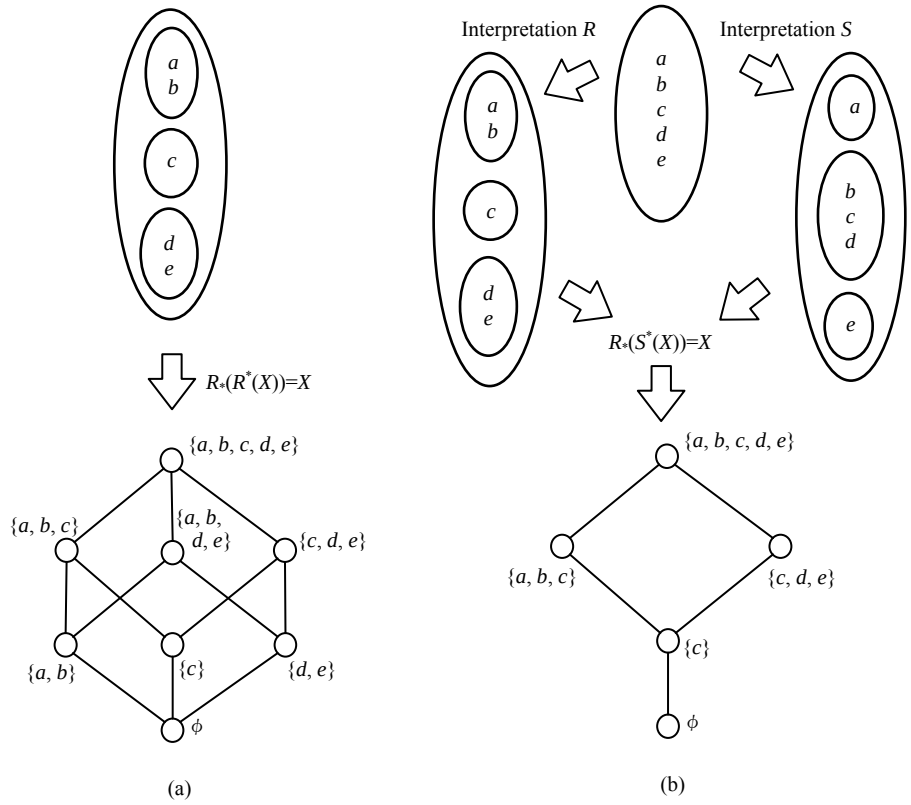


Figure 4: (a) The lattice shown here is a Boolean lattice. Only Boolean lattices result when using fixed points from a single equivalence relation. (b) The lattice shown here is a non-Boolean lattice. Elements $\{a, b\}$, $\{d, e\}$, and $\{a, b, d, e\}$ from (a) are missing in (b). Boolean as well as non-Boolean lattices result when using fixed points from double equivalence relation.

The difference between a lattice of $L_C=\{X\subseteq U|C(X)=X\}$ and $L_T=\{X\subseteq U|T(X)=X\}$ with $C=R_*R^*$ and $T=R_*S^*$ is illustrated in Figure 4. In the case of L_C, when we denote $W=\{[a]_R, [c]_R, [d]_R\}=\{\{a, b\}, \{c\}, \{d, e\}\}$, we get $L_C=\wp(W)$ where all possible combinations of equivalence class of R are obtained (Figure 4 (a)). By contrast, in L_T, although elements of L_T are possible unions of equivalence class R, some elements are

missing (Figure 4 (b)). Actually, $R_*S^*(\{a, b, c\})=R_*([a]_S \cup [b]_S)=R_*(\{a, b, c, d\})=[a]_R \cup [c]_R= \{a, b, c\}$. Thus $\{a, b, c\}$ is a fixed point and an element of L_T on one hand. On the other hand, $R_*S^*(\{a, b, d, e\})=R_*([a]_S \cup [b]_S \cup [e]_S)=R_*(U)=U \neq \{a, b, d, e\}$. Thus $\{a, b, d, e\}$ is not a fixed point element and is missing in L_T. Due to the loss of information, an obtained lattice can be constructed as a non-Boolean lattice (Gunji et al., 2010).

2.5 Characteristics of a lattice

There are several ways to characterize a lattice structure. One of the notable features of a lattice is an atom. An atom is the element immediately above (directly connected to) the empty set element. For example, in Figure 5 (a), the atom is U, and in Figure (b), the atoms are A and A'. Another characteristic of a lattice is a complement. Complement of an element, $A \in L_T$, is defined as A^c such that $A \vee A^c = U$ and $A \wedge A^c = \phi$. Note that $A \vee A^c \neq A \cup A^c$ and $A \wedge A^c \neq A \cap A^c$. For example, in Figure 5 (a), a pair of complements are ϕ and U, and in Figure 5 (c), ϕ - U, A-A', B-B', C-C' are complement pairs. For a set lattice as in Figure 4 (a), elements $\{a, b\}$ and $\{c, d, e\}$ are complements, since $\{a, b\} \vee \{c, d, e\}=U$ and $\{a, b\} \wedge \{c, d, e\}= \phi$. Complement pairs are a key to describing a figure-ground symmetry, which together constitute the whole (U).

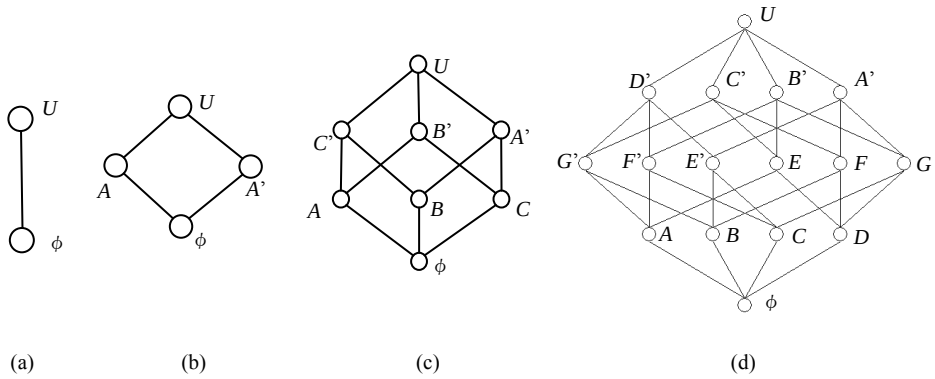
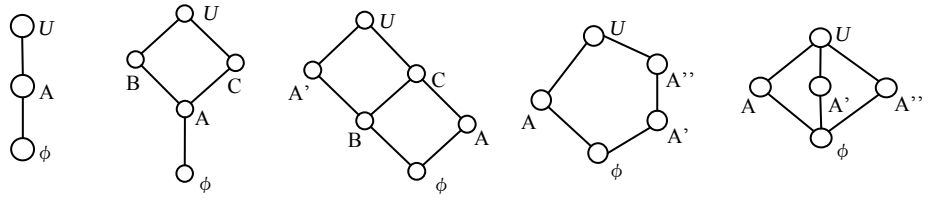


Figure 5: Examples of Boolean lattices. Complement pairs are elements with letters and their corresponding dashed letters.

A Boolean lattice is a lattice structure that is distributive, where every element in the lattice has a unique complement, and is closed under the binary operations $\vee$ and $\wedge$ (Figure 5 (a)-(d)). Non-Boolean distributive lattices have some elements with no complements (element A in Figure 6 (a), elements A, B, and C in Figure 6 (b), and element B and C in Figure 6 (c)). Non-Boolean lattices that do not hold the distributive

law are N_5 and M_3 lattices (Figure 6 (d) and (e) respectively). These lattices have elements with non-unique complements (*A*, *A*', and *A*'').



(a) (b) (c) (d) (e)

Figure 6: Examples of non-Boolean lattices. Complements are elements with letters and their corresponding dashed letters.

2.6 Procedure

To construct a rough set derived lattice from some universal set *U*, we need two interpretation criteria *R* and *S* applied to *U*. For analysis of figure-ground symmetry impressions of characters, we have used subjects and their attributes for the two criteria. Each *X* considered for finding the fixed points is each equivalence class, for example $\{a, b\}$ or $\{c\}$ or $\{d, e\}$ for the interpretation *R* in Figure 4 (b). Treating each equivalence class as a unit, we consider its power set (all possible combinations of the unit until we get a universal set): ϕ, $\{a, b\}$, $\{c\}$, $\{d, e\}$, $\{a, b, c\}$, $\{c, d, e\}$, $\{a, b, d, e\}$, and $U=\{a, b, c, d, e\}$. Each equivalence class and its power set composition are used as *X*, and operators S^* and R_* are applied in this order. When applying S^* to *X* of interpretation *R*, one must take the upper approximation of *X* in terms of interpretation *S* since we are applying S^*. For example, take $\{c\}$ of interpretation *R* and apply S^*. We get $S^*(X)=\{b, c, d\}$ since $\{c\}$ in interpretation *R* is lying within $\{b, c, d\}$ of interpretation *S*. Next, to apply R_* to $S^*(X)$, find the lower approximation of $S^*(X)$ in terms of interpretation *R*, that is, find the equivalence class units in interpretation *R* that "fit" strictly within $S^*(X)=\{b, c, d\}$. In our example, $R_*(\{b, c, d\})$ is $\{c\}$ in interpretation *R*, since only the equivalence class $\{c\}$ is included completely within the elements $\{b, c, d\}$. We started with $X=\{c\}$ and we get $R_*S^*(X)=\{c\}$. Therefore, the equivalence class $\{c\}$ is considered a fixed point. Here is another example. Take $\{a, b\}$ in terms of interpretation *R* and apply S^*. We get $S^*(X)=\{a, b, c, d\}$ since $\{a, b\}$ in interpretation *R* is lying across $\{a\}$ and $\{b, c, d\}$ in interpretation *S*. Next, to apply R_* to $S^*(X)$, find the lower approximation of $S^*(X)$ in terms of interpretation *R*, the equivalence class units that belong strictly within interpretation *R*. $R_*(\{a, b, c, d\})$ is $\{a, b, c\}$ in terms of interpretation *R*, since only the equivalence classes $\{a, b\}$ and $\{c\}$ are included

completely within the elements $\{a, b, c, d\}$ of interpretation S. We started with $X=\{a, b\}$ and we get $R_*S^*(X)=\{a, b, c\}$. Therefore, the equivalence class $\{a, b\}$ is not a fixed point. Repeat this process for all element sets in the power set. Note that the empty set ϕ and the universal set U will always be a fixed point. Then collect the fixed points and use them as elements to build a lattice based on its inclusion relationships, with the universal set at the top and the empty set ϕ at the bottom.

2.7 Relation Table

The relationship between the equivalence classes grouped by two interpretations R and S are organized by using a relation table shown in Table 1. The example here uses the two equivalence relations R and S in Figure 4 (b). Table 1 (a) shows the relationship between the elements of the equivalence relations R and S. 1's denote the presence of a relationship and 0's denote the absence of a relationship. Repetitious rows or columns may be united as in Table 1 (b), since Table 1 (a) and (b) result in the same lattice structure. In this example, Table 1 (b) is simplified to the relationship between the equivalence classes, although this is not always the case. In subsequent sections, we will refer to such relation tables. We use such tables to organize the information and to find fixed points to construct rough set derived lattices as explained in the previous Procedure section (2.6).

Table 1: (a) A relation table showing the relations between R and S according to the elements. (b) A simplified version of (a). Unifying repetitive rows or columns gives the same results.

(a)

		S				
		a	*b*	*c*	*d*	*e*
R	*a*	1	1	1	1	0
	b	1	1	1	1	0
	c	0	1	1	1	0
	d	0	1	1	1	1
	e	0	1	1	1	1

(b)

		S		
		{*a*}	{*b*, *c*, *d*}	{*e*}
R	{*a*, *b*}	1	1	0
	{*c*}	0	1	0
	{*d*, *e*}	0	1	1

2.8 Application

This method is applied to any character-attribute relationship in a story. Subjects are the source of the equivalence relation R. Subject pronouns are replaced by actual character names. Predicates are the source of attributes used for the equivalence relation S. An attribute can be a noun, verb, or adjective. The attribute examples are "… is happy." or

"… loses her shoe," or simply "loses" if focused only on the verb. Quotes by characters were replaced by simple narration describing their comment. Since we are constructing a lattice with subjects as elements, X of $R_* S^*(X)$ must be taken from the "subject interpretation" or the equivalence relation R.

When analyzing subject-attribute relationship, a sentence or a compound of sentences will be considered as a "scene." In the simplest case, a sentence forms a scene (a single subject-attribute relation). An analyst has the discretion to initiate or terminate a scene at any sentence. Some convenient choices for a transition in a scene may be: a new paragraph, an appearance or disappearance of characters, a change of stage settings, a change in conversation topic, an interval in the story timeline (passing of time), the beginning or the end of an event, etc.

The folklore story used for examples is based on Cinderella; or, The Little Glass Slipper. The text is "based" on the story, since some modifications are made for demonstration. One can apply this method to either the interpretive content implied by the text or only the explicitly written text. If one applies this method to the interpretive meaning of the text, the analysis would be of the content of the story, reflecting the richness of imagination of the reader and the writer. However, in spite of it being more "natural" to incorporate implied information, the inclusion of inexplicitly written information can sometimes lead to subjective and convenient results for the analyst. If one considers the strict writing of the text, the obtained result would be less dependent on the investigator. Such objective results would possibly allow us to compare texts written by different authors or to compare various genres of texts with less dependency to the interpretation of the story. On the other hand, results obtained from rigid treatment of the text may misguide the original intentions of the writer, failing to provide potential insights for the reader. These arguments suggest a tradeoff between "naturalistic" and "literalistic" methods when analyzing text. To demonstrate our method in the following examples, we have selected, as much as possible, sections of the story that withstand a literal treatment of the text without deviating much from the contextual meaning of the story.

3. RESULTS

3.1 Clear figure-ground symmetry

A clear figure-ground symmetry is represented by elements which possess only one complement pair in a lattice. The lattices may be a Boolean lattice or a non-Boolean lattice that obeys the distributive law.
The first example has two characters with distinct attributes.

> [The stepmother] was the proudest and most haughty woman that was ever seen. ... [Cinderella was a girl] of unparalleled goodness and sweetness of temper.

The provided text is organized according to subjects and attributes as in Table 2 (a). A relation table can be constructed resulting in Table 2 (b). The resulting lattice is shown in Figure 7.

Table 2: (a) Organizing the scene by subject and attribute. (b) A relation table between the characters and their attributes based on (a).

(a)

Subject	Attribute
Stepmother	the proudest and most haughty woman that was ever seen
Cinderella	a girl of unparalleled goodness and sweetness of temper

(b)

	the proudest and most haughty woman that was ever seen	a girl of unparalleled goodness and sweetness of temper
Stepmother	1	0
Cinderella	0	1

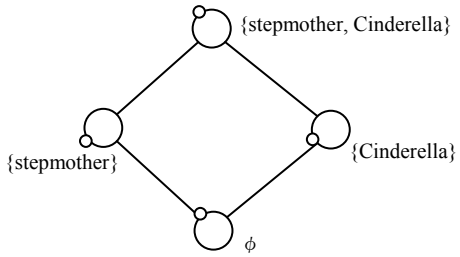


Figure 7: A lattice based on Table 2 (b). This is a Boolean lattice since every element in the lattice has a single complement. The matching orientation of the smaller circles relative to the larger circles indicates the complement pairs.

In Table 2 (b), each character plays a unique role in constructing this scene. Each character's attribute stands out against the other character's attribute. There is no attribute overlap between the characters. The lattice in Figure 7 has two pairs of complements. One pair is the top-bottom element with the universal set {stepmother, Cinderella} as the top element and the empty set ϕ as the bottom element. The other complement pair is the atoms {stepmother} and {Cinderella}. This complement pair tells us that there is a contrast between the attribute of the stepmother and Cinderella, allowing a figure-ground symmetry. When the focus of attention is on the stepmother, the stepmother is the figure and Cinderella is the ground. When the attention is on Cinderella, the opposite is true. The lattice supports figure-ground reversal. The stepmother and Cinderella together constitute the whole of this scene. This is a Boolean lattice. All lattices have a top-bottom complement by definition. Therefore, they will not be discussed in the following examples unless it is necessary.

Here is an example similar to the previous one, except it has three characters. Every subject has a different attribute and none in common, as in the previous example. As a result, every character is contrasted against the rest of the characters, providing a figure-ground symmetry for every character in the lattice.

> One day the king's son (prince) hosts a ball. Both stepsisters were invited to the ball. They search for an appropriate dress for the dance. Cinderella had to clean up the messy dresses after the stepsisters.

The subject-attribute information is organized in Table 3 (a). Figure 8 is the lattice based on Table 3 (b). The stepsisters are treated as a single subject in the following examples.

Table 3: (a) Organizing the scene by subject and attribute. (b) Relation table between the characters and their attributes based on (a).

(a)

Subject	Attribute
Prince	hosts a ball
Stepsisters	invited to the ball; search for an appropriate dress
Cinderella	clean up the messy dresses after the stepsisters

(b)

	hosts a ball	invited to the ball; search for an appropriate dress	clean up the messy dresses after the stepsisters
Prince	1	0	0
Stepsisters	0	1	0
Cinderella	0	0	1

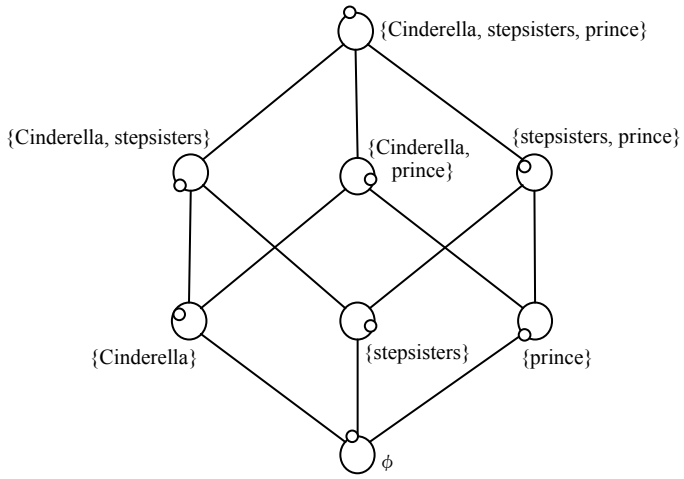


Figure 8: A lattice based on Table 3 (b). This is a Boolean lattice since every element in the lattice has a single complement. The matching orientation of the smaller circles relative to the larger circles indicates the complement pairs.

In Table 3 (b), each character plays a unique role. In Figure 8, the atoms are {Cinderella}, {stepsisters}, and {prince}. Each atom is a single subject. The complement of these single subjects consists of the rest of the characters. The complement pairs are {stepsisters, prince} to {Cinderella}, {Cinderella, prince} to {stepsisters}, and {Cinderella, stepsisters} to {prince}. This is a Boolean lattice.

Again, the lattice models gestalt psychology, where if the attention is on the prince (foreground), the remaining characters (Cinderella and stepsisters) are the ground. Similarly, when the attention shifts to the stepsisters, this newly focused character becomes the foreground while the previously focused character (the prince) becomes part of the ground with Cinderella. Also, if the attention is on the element with multiple characters (stepsisters and the prince) and therefore the figure, its complement of the single character element (Cinderella) becomes the ground.

The next example is also with three characters. However, the scene does not form a Boolean lattice.

> The next day the two sisters were at the ball, and so was Cinderella, but dressed even more magnificently than before. The king's son (prince) was always by her ... .

The subject-attribute information is organized in Table 4 (a). Figure 9 is the lattice based on Table 4 (b).

Table 4: (a) Organizing the scene by subject and attribute. (b) A relation table between the characters and their attributes based on (a).

(a)

Subject	Attribute
Stepsisters, Cinderella	at the ball
Cinderella	dressed even more magnificently than before
Prince	always by Cinderella

(b)

	at the ball	dressed even more magnificently than before	always by Cinderella
Cinderella	1	1	0
Stepsisters	1	0	0
Prince	0	0	1

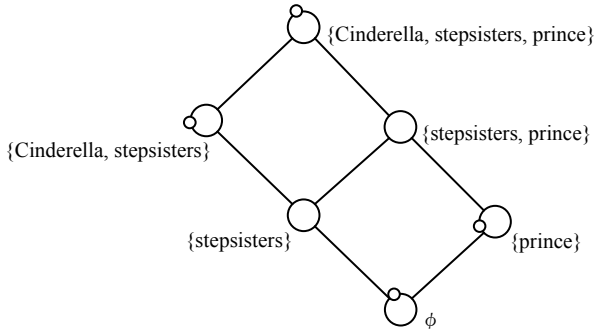


Figure 9: A lattice based on Table 4 (b). This is a non-Boolean distributive lattice. The matching orientation of the smaller circles relative to the larger circles indicates the complement pairs.

In Table 4 (b), the attribute of the stepsisters is included in the attributes of Cinderella. The prince shares no attributes in common with others. Figure 9 is a non-Boolean distributive lattice. There are elements that do not have a complement ({stepsisters} and {stepsisters, prince}). The atoms are {stepsisters} and {prince}. The complement pair is {prince} to {Cinderella, stepsisters}. If each character had a distinct attribute and none in common as in the previous example, the lattice would be a Boolean lattice shown in Figure 8 with three complement pairs. However, the lattice shown in Figure 9 does not

have all of the elements of a Boolean lattice as in Figure 8. The only remaining complement pair is the {prince} to {Cinderella, stepsisters} and this provides the only figure-ground symmetry in this scene. Due to the attribute overlap, some contrasts are compromised, reducing the possibility for other figure-ground symmetries. For example this scene does not allow the figure-ground symmetry with Cinderella alone or the stepsisters alone. It is exclusively between the elements {prince} and {Cinderella, stepsisters}.

The next example is an extract from the previous example, which also results in a non-Boolean distributive lattice. The only complement pair is the top-bottom elements.

> The next day the two (step-) sisters were at the ball, and so was Cinderella, but dressed even more magnificently than before.

The subject-attribute information is organized in Table 5 (a). Figure 10 is the lattice based on Table 5 (b).

Table 5: (a) Organizing the scene by subject and attribute. (b) A relation table between the characters and their attributes based on (a).

(a)

Subject	Attribute
Cinderella, stepsisters	at the ball
Cinderella	dressed even more magnificently than before

(b)

	at the ball	dressed even more magnificently than before
Cinderella	1	1
Stepsisters	1	0

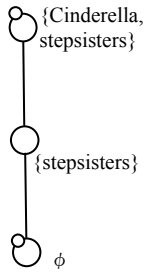


Figure 10: A lattice based on the relation table from Table 5 (b). This is a non-Boolean distributive lattice. The only complements are the universal set {Cinderella, stepsisters} and the empty set ϕ. The matching orientation of the smaller circles relative to the larger circles indicates the complement pairs.

In Table 5 (b), the subject-attribute relation is that of Cinderella and stepsisters in Table 4 (b); the attribute of the stepsisters belongs to the attributes of Cinderella. In Figure 10, the atom is {stepsisters} and the only complement pair is the universal set {Cinderella, stepsisters} and the empty set ϕ. The atom {stepsisters} has no complement pair. Since there are two subjects involved in this scene, if they both had unique attributes, the lattice would look like a Boolean lattice shown in Figure 7 with atoms {Cinderella} and {stepsisters} forming a complement pair. However, in Figure 8, the {Cinderella} element has been dropped, leaving only the {stepsisters} as an atom and the top-bottom elements as the only complement pair. The stepsisters do not have a complement since it does not have an original attribute.

The resulting lattice in this scene can be interpreted as the figure-ground symmetry constructed by the universal set (Cinderella and the stepsisters together) as the figure against the empty set or "nothingness" or "absence of characters" as the ground. The alternative is the absence of characters as the figure against the presence of characters as the ground (figure-ground reversal). One would obtain a similar lattice with top-bottom complement pair when dealing with only one character, for example. The same figure-ground interpretation holds.

3.2 Unclear figure-ground symmetry

An unclear figure-ground symmetry is represented by lattices with elements that possess more than one complement pair. As before, the top-bottom complement pair is ignored in our discussion.

In the 1-0 patterns of the relation table presented in the following example, the character attributes partly overlap each other. None of the characters have their own unique attribute. The example used here comes from the Japanese translation of Cinderella. An attribute "makes an unkind comment" has been added to the stepmother for demonstration.

> The two stepsisters decide on their dresses for participating in the ball. The older stepsister makes an unkind comment to Cinderella. The stepmother and the younger stepsister laugh at the older stepsister's comment. Then the stepmother also makes an unkind comment to Cinderella.

The subject-attribute information is organized in Table 6 (a). Figure 11 is the lattice based on Table 6 (b).

Table 6: (a) Organizing the scene by subject and attribute. (b) A relation table between the characters and their attributes based on (a). The characters possess partially overlapping attributes, but no attribute is common to all characters. Additionally, none of the characters have an attribute unique to themselves. This character-attribute pattern results in an unclear figure-ground symmetry.

(a)

Subject	Attribute
Older stepsister, younger stepsister	decide on a dress
Stepmother, older stepsister	makes an unkind comment to Cinderella
Younger stepsister, stepmother	laugh at older stepsister's comment

(b)

	decide on a dress	makes an unkind comment to Cinderella	laugh at older stepsister's comment
Stepmother	0	1	1
Younger stepsister	1	0	1
Older stepsister	1	1	0

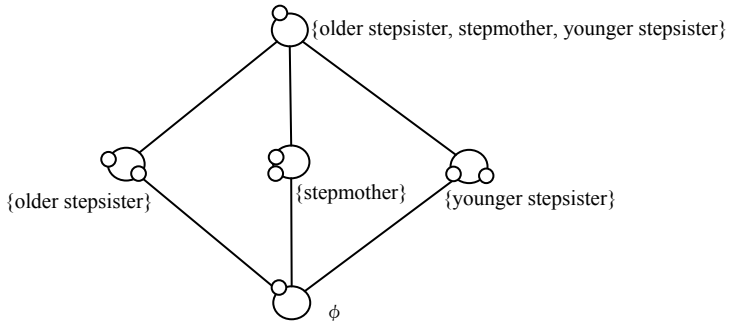


Figure 11: A lattice based on Table 6 (b). This type of lattice is known as M_3. It represents an unclear figure-ground symmetry since each element has complements with all of the other individual characters. The matching orientation of the smaller circles relative to the larger circles indicates the complement pairs.

In Table 6 (b), every subject has two attributes, but no attribute is held commonly by all subjects. There is no particular subject-attribute combination that stands out. In Figure 11, the atoms are {older stepsister}, {stepmother}, and {younger stepsister}. The complement pairs are {older stepsister} or {stepmother} to {younger stepsister}, {stepmother} or {younger stepsister} to {older stepsister}, and {younger stepsister} or {older stepsister} to {stepmother}. Every atom has complements with all of the other atoms. The lattice in Figure 11 is called an M_3 lattice. M_3 is known for each element having more than one complement. Note that the pattern of 1's and 0's in Table 6 (b) is exactly the opposite from that of Table 3 (b), the clear figure-ground symmetry. Since

there are three characters, if each character had its own unique attribute and no attributes in common as in Table 3(b), the lattice would result in a three atom Boolean lattice as in Figure 8. However, due to the attribute relationship in Table 6 (b), the elements with two characters are dropped, resulting in an M_3 lattice.

The stepmother, the older stepsister, and the younger stepsister share some attributes in common. The character attributes blend in among each other, therefore none of the characters stand out. The focus of attention is scattered since {older stepsister} has complements with both elements {stepmother} and {younger stepsister}. The same applies to all of the character elements. Thus the M_3 lattice is insufficient to describe a figure-ground symmetry.

Another lattice structure that has an unclear figure-ground symmetry is called N_5 (Figure 12). This lattice structure is created by eliminating an attribute of one of the characters from the relation table in Table 6 (b), as seen in Table 7 (b). The scene is the same as the previous example, without the extra attribute added to the stepmother.

> The two stepsisters decide on their dresses for participating in the ball. The older stepsister makes an unkind comment to Cinderella. The stepmother and the younger stepsister laugh at the older stepsister's comment.

Table 7: (a) Organizing the scene by subject and attribute. (b) A relation table between the characters and their attributes based on (a). It is similar to Table 6 (b), without an attribute for the stepmother. The stepmother no longer has a common attribute with the older stepsister. This character-attribute pattern results in an unclear figure-ground symmetry.

(a)

Subject	Attribute
Older stepsister, younger stepsister	decide on a dress
Older stepsister	makes an unkind comment to Cinderella
Younger stepsister, stepmother	laugh at older stepsister's comment

(b)

	decide on a dress	makes an unkind comment to Cinderella	laugh at older stepsister's comment
Stepmother	0	0	1
Younger stepsister	1	0	1
Older stepsister	1	1	0

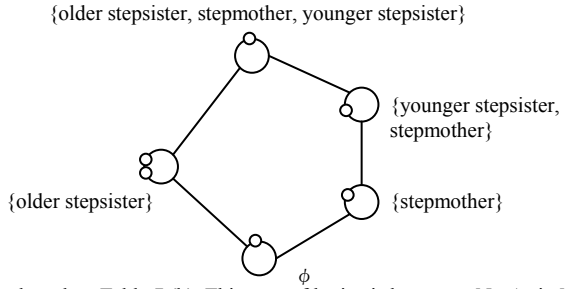


Figure 12: A lattice based on Table 7 (b). This type of lattice is known as N_5. As in M_3 of the previous example, N_5 also represents an unclear figure-ground symmetry. The matching orientation of the smaller circles relative to the larger circles indicates the complement pairs.

The subject-attribute information is organized in Table 7 (a). Figure 12 is the lattice based on Table 7 (b).

Table 7 (b) is similar to Table 6 (b), except an attribute to the stepmother is eliminated. The attribute of the stepmother fits completely in the attributes of the younger stepsister. The younger stepsister shares some attributes in common with the stepmother and the older stepsister. In Figure 12, the atoms are {older stepsister} and {stepmother}. The element {older stepsister} has complements with {stepmother} and {younger stepsister, stepmother}. The element {stepmother} has an inclusion relationship with {younger stepsister, stepmother}, reflecting the attribute inclusion of the stepmother and the younger stepsister in Table 7 (b).

An impression of a clear figure-ground symmetry is scattered, since {older stepsister} has complements with both elements {stepmother} and {younger stepsister, stepmother}. Therefore the N_5 lattice serves as an unclear figure-ground symmetry.

3.3 Compounding multiple figure-ground symmetries

We have seen two examples of basic lattices with unclear figure-ground symmetry. Now we present a scene with two N_5's fused together. We use the same scene from the previous example. In the beginning of the scene we add a unique attribute to the stepmother that is not shared by any other character.

> The stepmother rushes the stepsisters to prepare for the ball. The two stepsisters decide on their dresses for participating in the ball. The older stepsister makes an unkind comment to Cinderella. The stepmother and the younger stepsister laugh at the older stepsister's comment.

The subject-attribute information is organized in Table 8 (a). Figure 13 is the lattice based on Table 8 (b).

In Table 8 (b), all characters separately share different parts of their attributes. The stepmother and the older stepsister have a unique attribute to themselves ("rushes the stepsisters" for the stepmother and "makes an unkind comment" for the older stepsister). The younger stepsister does not have an original attribute; all of her attributes are shared with the other characters. In Figure 13, the lattice contains two N_5's. The {stepmother} has two complements, with {older stepsister} or {older stepsister, younger stepsister}.

The {older stepsister} also has two complements, with {stepmother} or {stepmother, younger stepsister}. This multiple-complement portfolio suggests that the figure-ground symmetry is convoluted in this scene.

Excluded from Table 8 (a) and (b) but part of this scene is Cinderella, hurt by the older stepsister's unkind comment and saddened. We add another line to include Cinderella and her attribute, as shown in Table 9 (a) and (b).

> The stepmother rushes the stepsisters to prepare for the ball. The two stepsisters decide on their dresses for participating in the ball. The older stepsister makes an unkind comment to Cinderella. The stepmother and the younger stepsister laugh at the older stepsister's comment. Cinderella is hurt by the unkind comment and saddened.

Table 8: (a) Organizing the scene by subject and attribute. (b) A relation table between the characters and their attributes based on (a). This character-attribute pattern results in an unclear figure-ground symmetry.

(a)

Subject	Attribute
Stepmother	rushes the stepsisters
Older stepsister, younger stepsister	decide on a dress
Older stepsister	makes an unkind comment to Cinderella
Stepmother, younger stepsister	laugh at older stepsister's comment

(b)

	rushes the stepsisters	decides on a dress	makes an unkind comment to Cinderella	laugh at older stepsister's comment
Stepmother	1	0	0	1
Older stepsister	0	1	1	0
Younger stepsister	0	1	0	1

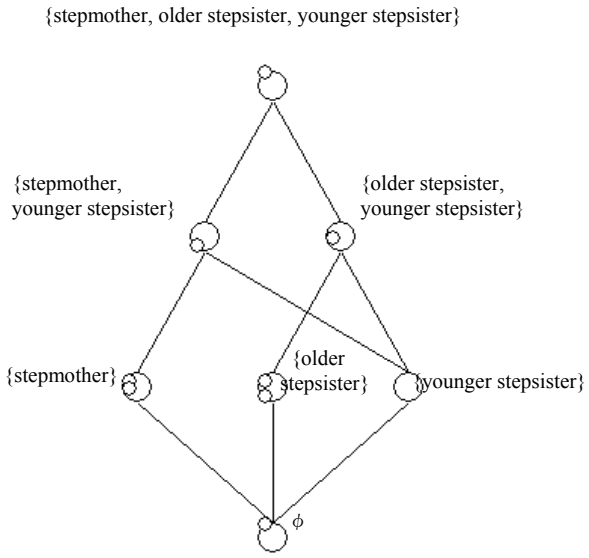


Figure 13: A lattice based on Table 8 (b). This lattice contains two N_5's. The matching orientation of the smaller circles relative to the larger circles indicates the complement pairs.

The subject-attribute information is organized in Table 9 (a). Figure 14 is the lattice based on Table 9 (b).

Table 9: (a) Organizing the scene by subject and attribute. (b) A relation table between the characters and their attributes based on (a). This scene is obtained by adding another character Cinderella and her attribute to Table 8 (a) and (b). This character-attribute pattern creates a clear figure-ground symmetry, in the midst of a convoluted figure-ground symmetry.

(a)

Subject	Attribute
Stepmother	rushes the stepsisters
Older stepsister, younger stepsister	decide on a dress
Older stepsister	makes an unkind comment to Cinderella
Stepmother, younger stepsister	laugh at older stepsister's comment
Cinderella	feelings hurt and saddened

(b)

	rushes the stepsisters	decides on a dress	makes an unkind comment to Cinderella	laugh at older stepsister's comment	feelings hurt and saddened
Stepmother	1	0	0	1	0
Older stepsister	0	1	1	0	0
Younger stepsister	0	1	0	1	0
Cinderella	0	0	0	0	1

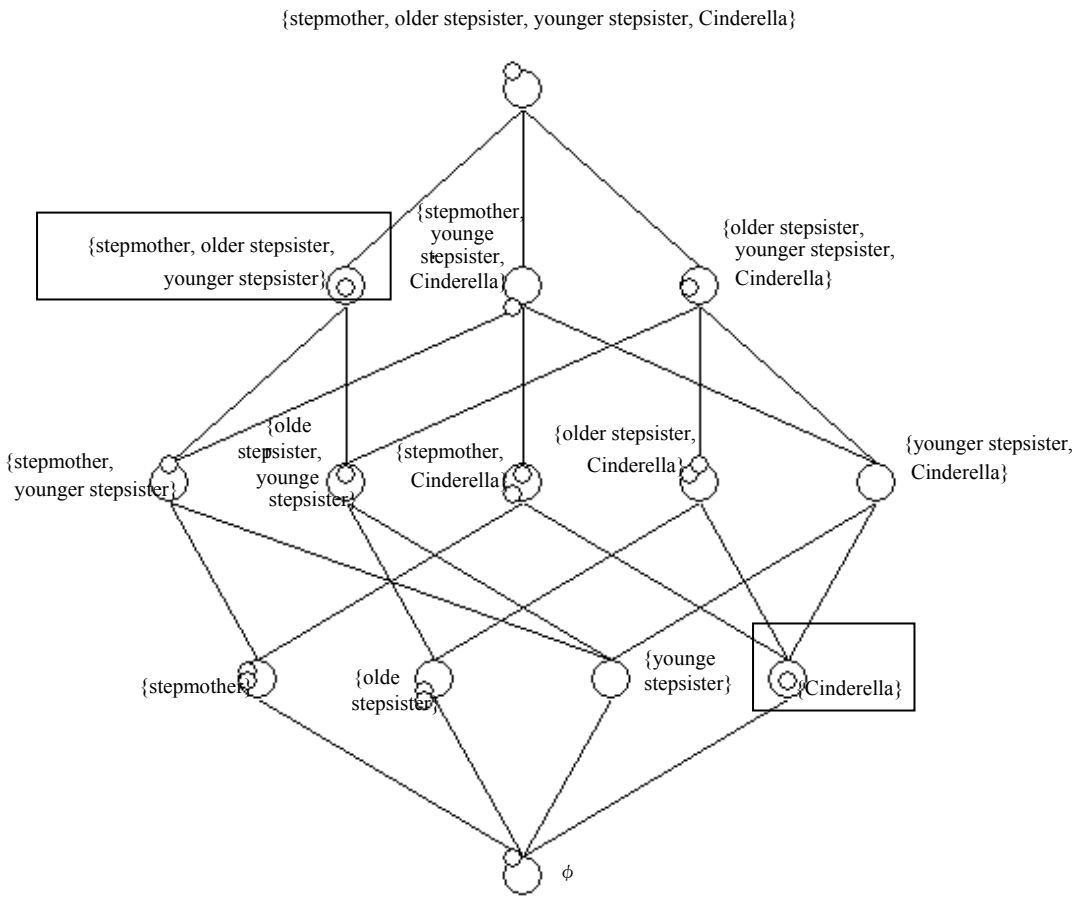


Figure 14: A lattice based on Table 9 (b). Adding another character with a unique attribute induces a clear figure-ground symmetry. Only the element {Cinderella} has a unique complement and it is the element with the rest of the characters.

We get Table 9 (b) by adding Cinderella to Table 8 (b), who has no common attributes with the other characters. In Figure 14, the clear contrast is between the element {Cinderella} and the element with the rest of the characters (both marked with a box). The addition of a new character with its original attribute results in a clear figure-ground symmetry between {Cinderella} and the rest of the characters, who have an unclear figure-ground symmetry relationship among themselves as seen in the previous example (Figure 13).

4. DISCUSSION

This rough set induced lattice method visually represents the formation of figure-ground symmetry of characters based on the text. The story may contain scenes with clear/unclear figure-ground symmetry or where the only contrast is the presence and absence of characters. Such symmetry contrasts cannot be obtained by probabilistic or attribute inferential methods.

Clear figure-ground symmetry resulting in Boolean lattices tells us that if the atoms of the Boolean lattice are individual subjects and when the attention is on one subject (foreground), the rest of the subjects (the complement of the atom) are the ground. Additionally, when the attention is shifted to another individual subject atom, the previous subject atom joins the ground. This is analogous to figure-ground reversal of gestalt psychology; when the attention is on target A, the rest of the perception forms the ground and when the attention shifts to target B, the previous target A becomes part of the ground. Figure-ground reversal is also achieved by shifting the attention to the complement element.

For non-Boolean distributive lattices, options for shifting the attention are reduced. Some elements in the lattice are compromised, leaving fewer figure-ground symmetry pairs that can be considered. In the lattice shown in Figure 9, there is only one pair of figure-ground symmetry. The lattice suggests that the only pair of figure-ground symmetry, the {prince} and {Cinderella, stepsisters} symmetry, can be considered in this scene, even though there are three subjects. Such figure-ground symmetry compromise is caused by a character's attribute blending in with that of another character, losing its shine as a unique character.

In an extreme case, the only complement pair that exists is the top-bottom pair (Figure 10). In this case the figure-ground symmetry is the "presence of all subjects" (the top element or the universal set) vs. the "absence of all subjects" (the bottom element or the empty set). Such contrast exists as a possibility in all lattices, for both clear and unclear symmetry.

The unclear figure-ground symmetry is associated with M_3 (Figure 11) or N_5 (Figure 12) lattices. Multiple complements exist for some elements in these lattices. Such lattices occur when the subjects' attributes partially overlap. As a result, none of the characters stand out. This prevents the formation of a clear figure-ground symmetry from a scene. The impression of characters in the scene is considered as unclear, since a

figure-ground symmetry cannot be recognized. A lattice with unclear symmetry may involve multiple M_3's or N_5's (Figure 13).

Even when multiple unclear symmetries are present in a lattice, when another subject with an original attribute is added, for example, the resulting lattice shows a clear figure-ground symmetry in the midst of an unclear symmetry. In the case of Figure 14, we do have a figure-ground symmetry, although we don't have a flexibility of choice in the figure-ground relations. There is only the {Cinderella} and {stepmother, older stepsister, younger stepsister} figure-ground symmetry that can be considered. The clear contrast in the attribute between Cinderella and the rest of the characters in Table 9 (b) causes a clear figure-ground impression.

For most of the story, the characters' relations result in a clear figure-ground symmetry, resulting from a Boolean lattice; quite often each character has distinct attributes/roles propelling the plot forward. However, in some scenes character attributes are mobilized to create a particular figure-ground symmetry between characters or groups of characters and as a result other potential figure-ground symmetry relations are discarded. For example, in the final case in this paper (Figure 14), the majority consensus is jointly against the heroine in the Japanese translation. The attribution of the lone character is contrasted against the remaining characters, while the figure-ground symmetry among the remaining characters is unclear. These are reflected in the complement relations of the resulting lattice structures. The resulting complements or clear figure-ground symmetry relations are important because these particular character relation landscapes shape the story.

Other methods to measure the presence of characters in theatrical plays and to characterize literary works using algebraic and probabilistic methods were developed by Marcus (1970) and Dinu (1968, 1970). Marcus' models, initially applied to Romanian plays, have been applied to Shakespearian plays by Brainerd et al. (1974), to ancient Greek drama by Mihnea (1977) and to comparisons of Greek and Roman ancient comedies by Hubka (1984). These methods can tell us the character appearance frequency, appearance duration, character interaction frequency, the change of appearance status, etc. to rank characters according to their appearances or involvement in activities. These methods are useful in characterizing plays and prioritizing characters according to their importance or impact. However, since the characters are mainly evaluated according to their appearances, the methods do not consider the qualitative similarities and contrasts of characters portrayed while on stage or in the literary works. The qualitative contrast of characters in the scenes is not preserved,

therefore it makes no difference whether the characters stand out or blend in among the background. Ranking of characters cannot provide a framework of figure-ground symmetry in the scenes and therefore cannot accommodate concepts such as figure-ground reversal.

Applications of psychological principles to literary text to better understand how readers perceive a literary character's disposition is discussed by Culpeper (1996). In this research Culpeper introduces attribution theory (Jones et al., 1965; Kelley, 1967) from psychology and foregrounding theory (Jakobson, 1960; Leech, 1969; Mukařovský, 1970) from literary analysis. Emphasis is on observing the regularity or irregularity in the behavior of characters (attribution theory) and in literary or phonetic patterns (foregrounding theory). Our method does not conclude with qualitative attribution of characters. Using the result from Figure 14 as an example, we can possibly infer the younger stepsister as mean and passive (since she does not have an original attribute), the older stepsister as mean and domineering (since she has her own aggressive attribute), the stepmother also as mean and domineering, and Cinderella as passive and patient. Such interpretations are legitimate inferences of character qualities. However, such qualities do not suggest a figure-ground symmetry landscape as the lattice complement relations provide. We use words attributed to characters in sentences and these attributes are treated as the "same" or "different" among the characters. When the attributes of characters are the same, the characters are treated as "concomitant" characters as in the model developed by Marcus (1970; Brainerd, 1973). When there is a difference in attributes between the characters, complements can occur in the lattice which is interpreted as figure-ground symmetry.

The rough set induced lattice method is helpful in analyzing the attributes assigned to the characters by the author to obtain a desired figure-ground impression or story dynamics. An author can manage the characters by changing their figure-ground impressions. A character which initially blended in with the rest of the characters may stand out later with a distinct attribute. This can be modeled by relocating a character from the "background" element to its complement "foreground" element in the lattice.

This method is potentially useful, although further consideration is needed for practical applications. One of these is strictness towards dealing with textual information. This can be on a vocabulary level or on a sentence level. In terms of the vocabulary level, for example, an object with a red color can also be described as "rosy". Treating such synonyms as the "same" would alter the figure-ground symmetry profile. In terms of the sentence level, one can strictly use the literal text only or use added information

based on the imagination of the reader, as discussed in the Methods and Procedures section. Each of these choices would provide results reflecting the input. Another consideration is how to determine a meaningful "scene," that is, the location and the size of a scene to analyze. As of now the scenes are treated as an arbitrary choice. One way to investigate this issue is to prepare a fixed window size and slide this window of consideration as the story progresses (Kitamura et al., 2010), and repeat this method with various window sizes. Additional consideration is the choice of categories for the two relationships when forming the lattice. In this paper we have considered the relationship between subjects and their verbs, adjectives, and adverbs together. It is also possible to focus on subject and verb only or subject and adjective only. These topics will be examined in future investigations.

5. CONCLUSION

We have developed a method to analyze figure-ground symmetry of character relations in texts. The complement relationships of elements in lattice structures are suited for analyzing figure-ground symmetry. To obtain diverse lattice structures suited for text analysis, we have analyzed the text based on two equivalence relations. The two interpretations used as the two equivalence relations were the subject information and the attribute information of those subjects. These two different equivalence relations were used when applying rough set theory to obtain fixed point characters. A lattice structure was built based on these fixed points.

The clear or unclear figure-ground symmetry is reflected in the complement relations of different types of lattices. Clear figure-ground symmetry appears in Boolean lattices (Figure 7 and 8) and non-Boolean distributive lattices (Figure 9 and 10). Unclear figure-ground symmetry occurs when an element has multiple complements such as M_3 (Figure 11) or N_5 (Figure 12) lattice. In compounded lattices (Figure 13 and 14), a clear figure-ground symmetry may appear in the midst of an unclear symmetry (Figure 14). Due to the definition of a lattice, all lattices have a U-ϕ (top-bottom) complement pair. This is the contrast between the presence and the absence of all characters.

When all characters in a scene have original attributes, this results in a Boolean lattice with as many atoms as the number of characters. In this case, the Boolean lattices represent maximum flexibility in the figure-ground symmetry patterns. Every character can stand out against the rest of the characters. When there are some commonalities in attributes of characters, the lattice may no longer be a Boolean lattice. For non-Boolean

distributive lattices, the choices in the figure-ground symmetry configuration are reduced. Some characters lose their status as an atom or lose their complement. When the character-attribute overlap becomes more common and evenly distributed, the lattice may result in M_3 or N_5 lattices. Such lattices suggest an unclear figure-ground symmetry, since the elements may have more than one complement.

This method provides a way to extract figure-ground relations of characters in a story that would not be possible with statistical or character-disposition interpretive methods. If the amount of information processed is limited, the figure-ground impression may be intuitive. However, as the subject-attribute relations increase, the complements in a rough set induced lattice structure effectively extract the figure-ground relations in a scene.

The information from the text is processed based on "similarity and dissimilarity" of the character attributes. Analyzing the figure-ground symmetry in a story may be useful in characterizing the style of the author or it may help authors create a story with such figure-ground impressions in mind. Just as the author's descriptive style alters the impression of the reader, variations in the input or interpretation of text also alters the resulting lattices. Diverse application methodologies would be investigated in the forthcoming research. Overall, our method can potentially contribute a new dimension, a qualitative figure-ground symmetry impression of characters based on their similarity and differences in attributes, as an additional method for analyzing texts.

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