Humanistic Mathematics Network Journal

Issue 6 Article 16

5-1-1991

Ultimately, Mathematics is Poetry

Alfred Warrinnier
Katholieke Universiteit Leuven

ULTIMATELY, MATHEMATICS IS POETRY

Alfred Warrinnier
Dep. of Mathematics K.U. Leuven
Celestijnenlaan 200B
B–3030 Heverlee
Belgium

In the fall of 1987 I got in touch with the animator of the European Poetry Festival.* We discussed the possibility of editing a volume of poems. He, being himself the son of a famous professor of physics at the University of Leuven, was not surprised to meet a mathematician in his office. Why not? Because the interaction between poetry and science, although a difficult one to discuss, often occurs in western culture. We mention for the moment only a few mathematician-poets: Blaise Pascal, Lewis Carroll, Alexander Solzhenitzyn, Raymond Queneau. (Last year, Prof. D. J. Uherka of North Dakota lectured on Solzhenitzyn as a mathematician.)

Mathematics intrigues the artist and gives rise to artistic creativity: remember Salvador Dali with his Corpus Hypercubes, trying to represent the fourth dimension. Take for instance the hypercube movie of Thomas Banchoff, its striking simplicity and amazement: a fine moment of mathematical poetry. If it is easy to enumerate a lot of events in which artists and scientists realize in a moment of godliness exact or abstract science and art, it is quite new to try to describe what is exactly going on when bridging these two verges of our culture. One does not even know how mathematical or artistic creativity is physiologically generated (Although some progress has been made recently, see [1] for further references.)

But first, I would like to tell you the story of a beautiful encounter between mathematics and poetry.

1. *The story of a mathematical-poetical-pictorial encounter*

The story begins with my editor, E. Van Itterbeek. Faced with the possibility of editing the poetry of a mathematician, he suggested that I look around for some pictorial work related to mathematics. In this context we have at our disposal an illuminating example: Maurice Escher, the Dutch graphic artist, "discovered" by mathematicians as the geometer Coxeter who encouraged him in his continuous search for forms (the Möbius-strip), transformations and symmetries (the wallpaper symmetries and the space symmetries, the crystallographic groups) and even new mathematical results from the field of p-adic numbers, non-euclidean geometry and analysis.[2] But nowadays one can hardly speak of originality when using again Escher's work as an illustration of poetry. Fortunately, in the Mathematical Intelligencer[3] I discovered an article on the Russian geometer and graphic artist Anatole Fomenko. His drawings and critical remarks on the interplay between his mathematical and graphical work completely corresponded with my own work in mathematics and poetry. I began a correspondence which eventually led to his sending me almost one hundred photographs of his drawings to illustrate my poetical work with. I sent him a copy of the book[4] and a delightful mathematical encounter was realized. Not only was I delighted by the material fact of our contact, but, most importantly also, by the great similarity between his "mathematical fantasy" and the images, the symbolism, the use of mathematical ideas and language is my work, as, for example in my opening poem.

Ik herinner me de cirkels
die samen-klinken
tot een ring
Banneling
die herbronning
in het innerlijke van de cirkel vindt

(Translated by R. Leigh-Loohuizen:)

I remember the circles
harmonizing
in a ring
Exile
finding a resource
in the internal of the circle

This poem is illustrated with a drawing by Fomenko which could suggest exactly the same ideas. So, without a pre-arranged collaboration or a subsequent revision in the direction of his art, I was able to link his pictorial art with my poems. We both use the circle as the material-

ization of ideas like perfection, loneliness, a mathematical grail.

Metamofose van de cirkel

In de geslotenheid
van de cirkellijn
lig ik gevangen

zonder begin
ontgin ik eindeloos
de doorlopende zin

omknel zinloos
in kromme lijn
het open zijn

de droom
mezelf doorsnijden
van het midden bevrijden

zonder straal
omvormen tot spiraal
naar binnen draaien
narr buiten expanderen

in de kronkels
van de losse lijn
langs de kegel omvezeld
dein ik uit

om in oneindigheid
begin en eind
zorgvuldig te vergeten

(Translated by R. Leigh-Loohuizen:)

Metamorphosis of the circle

I am imprisoned in
the closed-ness
of the circular line

without a beginning
I endlessly develop
the continuous sense

senselessly clasping
the open-ness
in a curved line

the dream:
splitting myself
liberating the middle

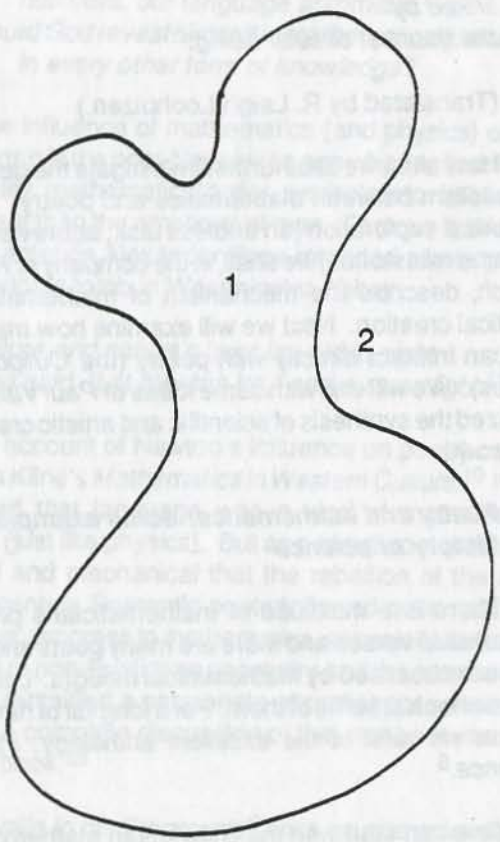
without a radius
transforming into a spiral
turning inward
expanding outward

in the coils
of the loose line
frayed around the cone
I am swaying out

in order to carefully
forget in infinity
beginning and end

A mathematical theorem can be a poetical muse:

Jordan's theorem. A simple closed curve divides the plane in two regions.



Proof

loose lines
originated
in my mind

where infinite
forces converge
to the point of uncertainties

know:
unity for the circle
is simple
unity is love

and that this plane
breaks into two parts
inseparably
united

inevitably alien
next to each other
linked by
the thinnest circular being.

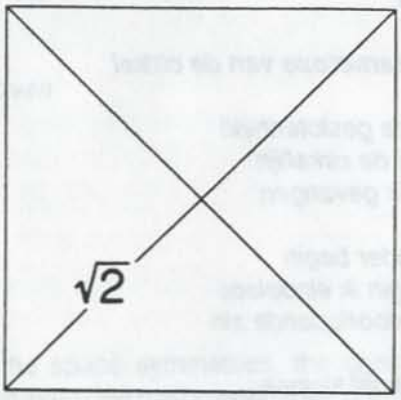
(Translated by R. Leigh-Loohuizen.)

Hereafter, we shall further investigate the question of parallelism between mathematics and poetry. After an historical exploration (an endless task, abbreviated here to some milestones) we shall, in the company of *Hermann Broch*, describe the mechanism of mathematical and poetical creation. Next we will examine how mathematics can interact directly with poetry (the *Oulipo* experiences). We will end with some ideas of *Paul Valéry*, who realized the synthesis of scientific and artistic creativity in his work.

2. *Poetry and mathematics: some examples in the history of science*

There is a multitude of mathematicians producing remarkable verses and there are many poets and writers who are obsessed by mathematical thought. Let us take a closer look at some of them. For a long list of names and poems we refer to the excellent anthology, *Poems of Science*.[5]

One can start with the Babylonian mathematicians, engraving on clay tablets their startling theorems, with nothing less than the first proof of the Pythagorean theorem in the following "poetical form":



(If we take the side of the square as unity we find the irrational number $\sqrt{2}$ on the diagonal, if we take half of the diagonal as unity then the side represents the same number $\sqrt{2}$.)

Or one can read in Plato the truly marvellous story of Menon and his slave to whom Socrates taught (in what was certainly an almost perfect example of mathematical teaching) a mathematical theorem in a language that I call poetical (just like the drawing of $\sqrt{2}$.) Euclid too, in the formulations of his definitions, axioms, and theorems used a highly poetical language, e.g. a point is what has no parts, a line is a breadthless length, a straight line is a line which lies evenly with the points on itself.

The history of science and thought contains plenty of examples of poetical expressions. The main reason for this is that, as pointed out by Peter Hilton,[6] a single mathematical invention can lead many times to a really profound and original astonishment. The creator, first and thus most intensely, has the sensation of having solved the problem, the joy of discovering a new theorem.

But every perceptive reader makes the same discovery. He can even develop the results and obtain new theorems: he can, better maybe than the original inventor, link the novelty to old and new theories. In this, I see a great parallelism with poetry where the reader of the poem has so often the impression that this poem was written specially for him, if not by him. The reader appropriates the poem.

Of course, we mostly meet geometers and astronomers on the ever-moving borderline between science, mysticism, and poetry. Let us always remember Giordano Bruno (1548–1600) who was perhaps the first to declare that the universe was infinite and to foresee the principle

of relativity. He did it in a poem: "De immenso et innumerabilibus" where we find, see E. Maor[22] p. 198, a mixture of spiritualism and sound reasoning like:

The One Infinite is perfect; simply and of itself nothing can be greater or better than it. This is the one Whole everywhere, God, universal nature. Naught but the infinite can be a perfect image and reflection thereof, for the finite is imperfect.

Another geometer-alchemist-mystic was John Dee from whom we retain the beautiful mathematical poem (or hermetic geometry, translated from J. Dee by C. E. Josten[7]):

- *the first and simplest manifestation and representation of things, non-existent as well as latent in the folds of Nature, happens by means of the straight line and the circle;*
- *yet the circle cannot be artificially produced without the straight line, nor can the straight line be produced without the point.*

Dee's hieroglyph

In the Catholic tradition, I found a wonderful poem of St. John of the Cross (1542–1591) — in a French translation of Cyprian of the Nativity discovered by Paul Valéry — beginning with the stanza:

Je pénétrai où je ne savais
et je demeurai ne sachant
toute science dépassant

(Translated:)

I enter where I did not know
and remained ignorant
all science surpassed.[8]

This poem is a text, a programme, which serves as a symbolic illustration for his theological ideas. I rediscovered some reflections of the power of symbolism in the magic poetry of the Irish poet W. B. Yeats (1865–1939) who claimed: . . . "That this great spirit and this great memory can be evoked by symbols."

Interest in algebra and in the power of symbols is of course one of the aspects of the Romantic art in the nineteenth century. We read in the Fragments of Novalis[9] (1772–1801) aphorisms like:

Algebra is poetry. Each science becomes poetry.
The number system is the model of a true symbolic language. Our letters should become numbers, our language arithmetic.
Could God reveal himself in mathematics, just as in every other form of knowledge?

The influence of mathematics (and physics) on poetry began in the post-Newtonian age when writers found rationality, mathematical order, symbols, etc. to be more important than the emotions of man. Famous in this light is the sentence Alexander Pope intended as an epitaph for Newton's tomb in Westminster Abbey:

Nature and nature's laws lay hid in night
God said, "Let Newton be," and au was light.[10]

An account of Newton's influence on poetry can be found in Kline's *Mathematics in Western Culture.*[10] It was accepted that language was a kind of mathematical system (just like physics). But as a result poetry became so cold and mechanical that the rebellion of the nineteenth century Romantic poets followed quite naturally. However, progress in mathematics, especially the development of non-Euclidean geometry and the mastering of infinity, remained a passionate attraction for writers and poets. A complete discussion of this can be found in E. Maor's book.[22]

Novalis in his Fragments[9] links art and science in a surprising way:

I = not I. This is the highest principle of all art, and all science.

We cite another poem of Novalis where he links knowledge and consciousness:

> *Consciousness is a being outside being in being.*
> *Consciousness is thus an image of being in being.*
> *Needs to clarify images. Signs. Theory of signs.*[9]

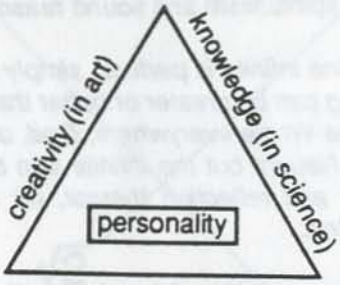
Let me end this part of my essay with a twentieth century mathematician-poet-artist: Alexander Zinoviev, born in 1922 in Russia. Zinoviev was professor at the University of Moscow. He is a logician, specializing in model theory. He wrote a lot of books on mathematical logic, e.g. *Philosophical Problems of Many-Valued Logic*; *Quantoren, Mödalitäten, Paradoxien*; *Foundation of the Logical Theory of Scientific Knowledge*; etc. He is the author of a remarkable novel translated in French under the title *Les hauteurs béantes*.[11] The book describes Stalinistic society and it is a diatribe against the homogeneous world and the programmed social machine. It takes the form of a platonic dialogue and a graphic poem about the ultimate end.

The history of science and thought is full of such examples of poetical effusions. There must be a parallelism between mathematical thinking and poetical creation. In the following section we shall try to unveil this mystery.

3. *Contemporary thinkers and writers on the relation between mathematics and poetry*

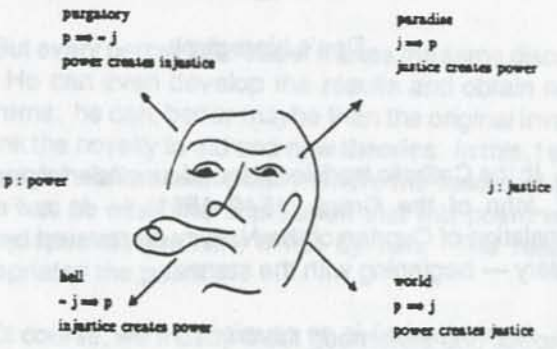
Hermann Broch (1886–1951)

F. Le Lionnais, writing on the beauty of mathematics in *Les grands courants de la pensée mathématique*,[12] frequently uses poetry to illustrate and emphasize his ideas. He cites Novalis ("Algebra is poetry"), but also Henri Michaux who claims that he cannot represent the beauty of mathematics: "Ce qu'il y a de plus intéressant dans ce pays, on ne le voit pas" (The most interesting in this country cannot be seen.). This statement illustrates how difficult it is to discover the poetical idea concealed in mathematics. With Hermann Broch[13] as explained by Hannah Ahrendt[14] in her illuminating introduction to the essays of Broch, I believe that there is a close link between poetry and mathematics. This link was present in the personality of Broch. In fact, every creator often agonizes between his logico-mathematical and poetico-visionary talents. These two poles of the creative personality can be closed by the third side of a Peircean Triangle:



This graph is a good description of Broch's personality, attracted as he always was by mathematics. Influenced by the Wiener Kreis** he even tried to find a system regulating nature, completely determined by group theory. In his view, not only geometry but all activities of the mind could be regulated by algebraic structures. In fact, in Hermann Broch's vision, poetry and science should be seen as the same kind of activity: both recreate the world by a removal of the frontiers of knowledge. He asks for poetry to become full of knowledge, for knowledge to become full of vision. However, Broch also pays attention to the latent tension between creativity in art and knowledge in science. He describes this in his powerful *The Death of Virgil*. H. Broch developed a theory of knowledge in which mathematics play a central role.

There is one constant in the theory: the human being, carrier of knowledge and vision, the intellectual. For this person, only the act can create the very moment when *the ability to create poetry meets the knowledge to handle science*. We give an example of a mathematical formulation stimulating with poetical power an act of knowledge and insight: the windrose of Hermann Broch.



Oulipo (Ouvroir de littérature potentielle - Workshop for Potential Literature)[15,16]

In the early sixties a remarkable experiment took place in Paris and Western Europe. A group, composed of writers, artists and mainly mathematicians, was formed around people like François Le Lionnais — editor of *Les grands courants de la pensée mathématique* (1948), containing the first non-technical paper of Nicolas Bourbaki, an introduction by Paul Valéry and so on — Raymond Queneau and several mathematicians (Claude Berge, Nico Kuiper, etc.). The aim of the group was to produce literature, especially poetry, with the aid of mathematics. They searched for procedures, techniques, potentially productive structures, often directly inspired by science and mathematics. Oulipo had something of a secret society that was in reality a serious workshop producing many publications and trying out a multitude of experimentations. In fact, their position in the cultural landscape of France became stronger and stronger during the last decade. They have had a real influence in literature (George Perec, Italo Calvino, Jacques Roubaud), in semiotics (structuralism) as well as in mathematics and science (Schutzenberger and his palindromes or the theory of free structures, information theory and algorithmic poems).

In this context, the word "potential" is important. Oulipo is empirical and tries to liberate new possibilities from existing mathematical objects, structures and techniques. Here are a few examples of its findings:

1° Applications to poetry of some surprising properties of the Möbius strip: write a poem on one side of a slip of paper; write a second one on the back side of the paper; construct the Möbius strip and realize a new poem this way.

2° The introduction of mathematical expressions in literature: set, class, $\in$ (is an element of), $\subset$ (inclusion), $\cup$ (union), $\cap$ (intersection), $\setminus$ (complementation), etc. There is a volume of poems by J. Roubaud entitled $\in$; and we have discovered a book by Gaston Compère, a Belgian poet, in which each poem is illustrated and introduced by one of Euclid's theorem.

3° The use of permutations in literature. Combinatorial structures are widely employed in the attempts of the Oulipo-members to create new forms of poetry. Example: "Cent mille milliards de poèmes" by R. Queneau; try to find ten poems of fourteen verses in such a way that each verse can be replaced by one of the nine corresponding verses: you obtain 10^{14} poems. We came across the beautiful poem "Oeufs de Pâques" by Stéphane Mallarmé[17]: each verse was written on an egg numbered so that one could rebuild the poem.

1. Pâques apporte ses voeux
2. Toi vaine ne le déjoue
3. Au seul rouge de ces oeufs
4. Que se colore ta joue.

Only four even permutations (1 2 3 4, 2 1 4 3, 3 4 1 2, 4 3 2 1) are retained. Why?

The Oulipo people (R. Queneau, together with François Le Lionnais and J. Roubaud, was certainly the driving force of the group) discovered also the sextine of the troubadour Arnaut Daniel and tried to generalize this to a quentine, constructed by using the rule: a word ending verse p (or in place p), $p \leq n/2$, where n is the number of strophes in the poem, and the number of verses in the strophe, is put in place 2p and a word in place p, $p > n/2$, comes to the place $2n + 1 - 2p$.

Northrop Frye said it like this: "Both literature and mathematics proceed from postulates, not facts."

The Oulipo experiment in mathematico-literature is, of course, of high interest, often very enjoyable, and it puts new forms and surprisingly new viewpoints to old facts. Because of the highly technical aspect of its work, we can consider Oulipo as a primitive system of knowledge. The poetical act is, in general, absent from its work. But reading I. Calvino and G. Perec (his *La vie mode d'emploi*[18] is largely based on techniques elaborated by Oulipo), we now see that this kind of work can create the conditions that lead to an absolute system. The novel of G. Perec, entirely deductive and written within a fixed structural framework, is an example of this.

The work of R. Thom and E. C. Zeeman, two mathematicians, well-known as the fathers of catastrophe theory, is related to the Oulipo doctrine. In René Thom's book, *Stabilité structurelle et morphogénèse,*[19] a completely new approach to the explanation of the phenomena of acquisition of knowledge is explored. Thom shows how global regularities can be envisaged as geometric structures in a many-dimensional space. These forms have their own dynamics: and each form of life can be described in dynamic mathematical models. Thom was influenced by the English scientist D'Arcy Thomson[20] famous for his book *On Growth and Form*, from which Thom quotes:

The waves of the sea, the little ripples on the shore, the sweeping curve of the sanding bay

between the headlands, the outline of the hills, the shape of the clouds, all these are so many riddles of form, so many problems of morphology . . .[20]

According to this theory, events in nature, in social or cultural life, in biology or any other science, in literature, etc. occur in points of catastrophe which can be studied by means of singularities of functions. Zeeman and Thom can describe in this way the splitting of a cell, the working of the brain, certain light phenomena, etc. Thus a highly poetical image of science was created using mathematical language as the vehicle of thought.

We can see a poem as a form endowed with its own dynamic; this form can change as a pure form (by techniques similar to the one of Oulipo), giving rise to different new poems; the poem also changes in form (and content) from one reader to the other, and has its own life! Poetry belongs to the field of structural morphogenesis of Thom: more, poems are themselves morphogenesis:

Pour nous autres Grecs
Toutes choses sont formes.
(For us, the Greek
All things are forms.)

— P. Valéry

Fire is in rest when changing. Fire is changing while in rest.

— Heraclitus

Paul Valéry (1871–1945):
The Synthesis of Science and Literature

In his famous Cahiers,[21] twenty-nine volumes written between 1894 and 1945, and the *Variété I to V*,[21] Paul Valéry exposes the power of the mind and the force of language. The interplay between science and literature plays a special role in the development of his ideas. We quote:

It is remarkable that mathematics has in common with poetry and music the fact that the idea (le fond) becomes the act of the form: the truth depends on formal conditions.[21]

What poetry and mathematics has in common is said here loud and clear. Mathematics works around ideas — problems or paradigms, e.g. the twenty-three problems of Hilbert, the continuum hypothesis and its relations to the Zermelo-Fraenkel axioms, a property of lines in the plane, the conjecture of Goldbach, etc. The mathematician, faced with his creative work, has to make a formalism: some definitions, a system of axioms (satisfying conditions, creating new objects and so on), some nice examples, a few new theorems. Once these ingredients are found, the mathematician, guided by an idea, can put his formalism to work. The poet also has his raw material: the language (le langage ordinaire), the form of his poem (e.g. a sonnet), also called the space of the poem, the rhyme and rhythm, the examples, the metaphors and so on. Now by means of his idea the poet can force the form onto his idea.

Paul Valéry, in his essay "Poésie et pensée abstraite," Variété V, made a profound analysis of the possible contradiction between poetry and the abstract idea. There is no such contradiction, Valéry claims. In fact, poetry and science are complementary sides of an intellect motivated by the attempt to understand all the problems of man.

Valéry's main hope was that a mechanics of thinking would exist, using mathematics as formalism (see again H. Broch: the only knowledge is the logico-mathematical knowledge). In the case of poetry, Paul Valéry described how a number (he was very intrigued by the Pythagorean idea of number) came first in his mind and how afterwards a poem was based on this number (determining the number of syllables in a verse and the rhythm). He also claimed that analogies were more important than metaphors in poetry. For him, analogies were comparisons based on the structure allowing a certain type of reasoning, i.e. functional analogies. Metaphors and analogies are particular cases of general transformations: their general group (group in the mathematical sense) is the "nervous system."

Valéry was very unhappy with the distinction between the so-called "esprit géométrique" (geometrical thought) and "esprit de finesse" (poetical thought), made by Blaise Pascal.[23] If such ways of thinking existed there had to be a bridge between them, Valéry claimed: 1° "esprit géométrique" is dangerous because the geometer cannot study what he cannot define: he also automatically follows certain ways of thinking and has a tendency to always replace terms by values; 2° "esprit de finesse" is dangerous because it is reasoning by means of rather loose notions or badly defined items (emotions!).

The bridge consists of a sacred moment: 1° the geometer looks for a definition (or for a deep insight!) and wants to pass from imagination to structure and form; this is the moment of poetry: he has to choose, to delete, to adapt, to force the concrete towards the abstract, he has to engage his whole being; only after this, his formalism, guided by imagination and idea, can move into results

using transformations of this formalism; 2° sometimes the poet wants to construct!

The geometer is the one who sees in a problem or in a situation what can be rendered by a system of definitions, axioms, symbols, operations, etc. in order to obtain results about the problem or situation which are straightforward, clear and proved — hence acceptable to others. The artist disposes of the means of expressions offered by the form of his art and of the subject (idea); but he disposes of form and idea as long and as freely as he wants. The goal of his art is the correspondence, the suggestion. Inspiration is for him a strong excitement directly caused by the object-subject relation of his art. But this object-subject situation (which causes and is the cause of artistic activity) is as free as possible, excited during the creation by profound knowledge of the means of expression as well as by the passionate desire to bring this knowledge alive.

Afterword

We are living in a time of bulkheads, in a society splintered into the many "holy chapels." Bridge-builders, like Paul Valéry, are solitary and scarce. It has become suspect to look over the wall. I believe in a renewed renaissance, neither because we want to adore the god of others, nor because we do not recognize our own god. Our god is the hidden treasure in our heart. This is the content of the following "Psaume" of Paul Valéry:

Tu n'adoreras pas les dieux des autres:
(Mais prends garde de te tromper sur le tien!)
Tu connaîtras le Tien à sa simplicité
Il ne te propogera pas des énigmes vides
Il ne s'entourera pas d'éternité
Il sort de toi comme tu sors de ton sommeil
Comme la fleur et le parfum sortent de la terre confuse et du fumier qui se décompose, il sort quelquefois de ta vie, un peu de Lui et une idée de son énergie.
Cache ton dieu. Que ce dieu soit ton trésor — que ton trésor soit ton dieu.

Bibliography

1. DUTTON, D. and KRAUSZ, M., *The concept of creativity in science and art*, The Hague, Martinus Nijhoff Publishers, 1981.
2. COXETER, H.S.M., *The Mathematical Intelligencer*, Vol. 7, nr. 1, 1985, p. 59–69.
3. NEAL and ANN KOBLITZ, *The Mathematical Intelligencer*, Vol. 8, nr. 2, 1986, p. 8–17.
4. *Het innerlijke van de cirkel*, Leuvense Cahiers nr. 79, LSA, Leuven, 1988.
5. HEATH-STUBBS, J. & SALMAN, P., (eds.), *Poems of Science*, London, Penguin Books, 1984.
6. The coming article of HILTON, P., *Mathematics, Its Role in Education.*
7. JOSTEN, C.H., A Translation of Dee's "Monas Hieroglyphica" with an Introduction and an Annotation. Ambix. 12, 84–221, 1964.
8. PELLE-DOELL, Y., *St. Jean de la Croix*, Paris, Editions du Seuil, 1960.
9. *Pollell and Eragments*, Selected Aphorisms of NOVALIS, Translated by Arthur Versluis, in Temenos 9, 1988, p. 128–136.
10. KLINE, M., *Mathematics, in Western Culture*, Oxford, Oxford University Press, 1953.
11. ZINOVIEV, A., *Les hauteurr, béantes*, Lausanne, L'âge d'homme, 1977.
12. LE LIONNAIS, F., (ed.), *Les grands courants de la pensée mathématique*, Paris, Cahiers de Sud, 1948.
13. BROCH, H., *Erkennen und Handeln, Essays II, Gesammelte Werke Hermann Broch*, Band 7, Zürich, Rhein-Verlag, 1955.
14. AHRENDT, H., "Einleitung zu 'Dichten und Erkennen'", in *Essays I, Gesammelte Werke Hermann Broch*, Zürich, Rhein-Verlag, 1955.
15. OULIPO, *La littérature potentielle*, Folio Essais 95, Paris, Gallimard, 1973.
16. OULIPO, *Atlas de la littérature potentielle*, Folio Essais 109, Paris, Gallimard, 1981.
17. MALLARME, S., Poésies, Paris, Gallimard, 1945.
18. PEREC, G., *La vie mode d'emploi*, Hachette, P.O.L., 1978.
19. THOM, R., *Stabilité structurelle et morphogénèse*, Reading, Massachusetts, Benjamin, 1972.
20. D'ARCY THOMPSON, *On growth and form*, Cambridge, Cambridge University Press, 1945.
21. VALERY, P., *Cahiers I et II*, Paris, Gallimard, 1972; VALERY, P., *Variété I, II, III, IV, V*, Paris, Gallimard, 1924, 1929, 1936, 1938, 1945.
22. MAOR, E., *To infinity and beyond*, Basel, Boston, Birkhäuser, 1987.
23. PASCAL, B., Pensées et opuscules, Paris, Hachette, 1920.

* The 11th congress of the society took place from 24-30 November 1989 and had as main theme "Poetry and Science." The address of the society is Blijde Inkomststraat 9, 3000 Leuven, Belgium.

** Group of philosophers and scientists formed around Moritz Schlick in the twenties, amongst which people like K. Gödel, K. Reidemeister and later R. Carnap and A. Tarski. They promoted a new philosophy of science, called neo-positivism or logical positivism, characterised by the idea that theology and metaphysics are imperfect modes of knowledge and that only rigorous reasoning is valuable.