Barbilian-Barbu – a case study in mathematico-poetic translation

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Domeniul poeziei nu este sufletul integral, ci numai această zonă privilegiată, unde răsună actele lirei. Este locul oricărei frumuseți inteligibile: înțelegerea pură, onarea geometrilor.

The domain of poetry is not the entire soul, but only that privileged part where echoes the playing of lyres. It is the place of all intelligible beauty: pure understanding, the honour of geometries.

Dan Barbilian/Ion Barbu, 1947

Abstract

Mathématiques et la poésie fonctionnent généralement dans différents domaines, en utilisant la langue et le symbole dans les domaines sémantiques apparemment disjoints. Dans cet article, nous explorons la production créative du poète/mathématicien roumain Ion Barbu/Dan Barbilian. Bien qu'il a poursuivi activement ces disciplines à différents moments, il a beaucoup écrit sur les parallèles qu'il percevait entre les mathématiques et la poésie. Nous explorons à la fois sa poésie publiée et sa recherche mathématique pour suggérer un rôle pour la traduction de plusieurs façons. D'une part, le processus de traduction de sa poésie Roumain-Anglais présente des défis intéressants à faire ressortir les allusions qui y sont riches mathématiques. Sinon, son écriture mathématique, principalement en allemand, est conforme aux normes linguistiques qui sont maintenant en commun aux mathématiques dans la plupart des cultures, indépendamment de la langue. En fin de compte, nous signalons à la façon dont ses points de travail à un idéal de traduction inter-sémiotique entre la poésie et les mathématiques.

Mathematics and poetry typically operate in different realms, employing language and symbol in apparently disjoint semantic domains. In this article we explore the creative output of the Romanian poet/mathematician Ion Barbu/Dan Barbilian. Although he actively pursued these disciplines at different times, he wrote extensively on the parallels he perceived between mathematics and poetry. We explore both his published poetry and his mathematical research to suggest a role for translation in several ways. On one hand, the process of translation of his poetry from Romanian to English presents interesting challenges in bringing out the rich mathematical allusions therein. Alternatively, his mathematical writing, primarily in German, conforms to the linguistic norms that are now common to mathematics in most cultures, independent of language. Ultimately, we point to ways in which his work aspires to an ideal of inter-semiotic translation between poetry and mathematics.

Keywords: mathematics, poetry, Dan Barbilian, Ion Barbu, inter-semiotic translation

1. Introduction

Dan Barbilian, Romanian mathematician, was pseudonymously Ion Barbu, symbolist poet. It is rare for one person to establish reputations in these two apparently disparate realms. Barbilian/Barbu, in written reflections on his ideal of a mathematical theory of poetry, provided an insight into the commonalities between them and his own attempts to create a poetry whose characteristics shared much with his conception of mathematics. In any study that seeks to illuminate connections between mathematics and poetry, Barbilian stands as a singular case.

Barbilian was born in 1895 at Câmpulung-Muscel in northern Romania. Although not always an outstanding student, by the age of 15 he was making contributions to the Romanian *Gazeta Matematică*[1]. Subsequently moving to Bucharest, he took up a hedonistic life and, perhaps partly influenced by the narcotics he started to imbibe, wrote and published in 1918 his first poems, adopting the name Ion Barbu, an ancestral form of his own family name.

In 1922, Barbilian won a doctoral grant to study pure mathematics (number theory) at Göttingen, then a great centre of mathematics led by David Hilbert. Barbilian, however, attended few classes, suffered drug addiction and abandoned his studies. Still, he joined German literary circles and continued to write and publish poetry. Having returned to Romania, in 1929 he eventually received his doctorate in mathematics from Bucharest University[2].

In 1930, his collection *Joc secund* appeared, to critical acclaim. *Joc secund* contains some 35 of Barbu's total published output of around 100 pieces. Despite its success, that same year Barbilian returned to mathematics full-time, joining the permanent teaching staff at Bucharest University. During his subsequent career he published some 60 or so mathematical papers but published no more poetry.

So Barbilian/Barbu did not simultaneously pursue literary and mathematics careers – it could be said that he abandoned poetry for mathematics. His principal biographer, Alexandre Cioranescu, argues that it was never possible for Barbu and Barbilian to co-exist and that one personality tended to prevail at the expense of the other[3]. Barbu himself offered some explanations as to why this might have been so, largely around his self-assessed lack of success in being able fully to implement a mathematical method in poetry. Cioranescu reports Barbu as suggesting that if poetry is taken to the extreme of generalisation and abstraction, as he tried to do, then it becomes eventually sterile and no longer satisfying[4]. On the other hand, in 1947, Barbu wrote to fellow poet and compatriot Nina Cassian, signalling that he could see an ideal version of himself, more imbued by mathematics, that would have been able to create the poetry of his ambition:

> Nu crezi, iubite poete, că poezia inventivă, în care un anumit Ion Barbu a căutat să se instaleze, este totuși o poezie impură : că dacă pe atunci ar fi făcut matematice (cum face acum) poezia lui ar fi cîștigat în curăție ; că și-ar fi pus invențiunea în teoreme și perfecțiunea în versuri.
> [Do you not think, dear poet, that inventive poetry, in which a certain Ion Barbu tried to establish himself, is after all impure poetry: for had he done mathematics then (as he does now) his poetry would have gained in clarity; and would have put inventiveness into theorems and perfection into verse.]

If Barbu felt he had reached as far as he could in his quest to write a pure ('mathematical') poetry, he did not entirely disengage from literary activities. He continued to take part in literary salons and to contribute to literary reviews, while later essays, composed in the 1940s and 1950s, elaborate on his theory of mathematics and poetry. He died in 1961.

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[1] Cioranescu (1981)
[2] His doctoral thesis was in analytical algebra, titled *Reprezentarea canonică a adunării funcțiilor ipereliptice*: *grupuri finite discontinue* (Canonical representations of hyperelliptic additive functions: finite discontinuous groups), completed under the supervision of geometer, Gheorghe Țițeica.
[3] *Ibid.,* Cornis-Pope (200, p52)
[4] Cioranescu (1981)

Barbu/Barbilian looms large in the pantheon of 20th century Romanian literary and intellectual achievement. There is a wealth of research, primarily emanating from Romania, into his poetry and, to a lesser extent, his mathematics, as well as the relations between the two. He furnishes what we consider to be a unique case of intersemiotic translation, in his efforts to depict through his poetic method what are ultimately indescribable ideas suggested in abstract mathematics. That is, he translates ideal concepts present in modern mathematics using a range of standard poetic devices, all the while acknowledging that mathematics, too, has its shortcomings as a fully adequate semiotic system.

First, we explore some of the semiotic and aesthetic links between mathematics and poetry, establishing a framework for analyzing Barbilian's work. There follows exploration of his mathematical and poetic influences. An analysis of a selection of Barbu's poems examines the extent to which the idea of inter-semiotic translation can illuminate these parallel creative lives and provides a basis for re-assessing Barbilian's mathematical poetics and the extent to which he attained his professed ideal.

2. The representation of knowledge

2.1. Semiotics

Mathematics is a semiotic code *par excellence*. Its formulae, equations and diagrams communicate deep information to its practitioners and, just as powerfully, create an impenetrable barrier to the uninitiated. In its modern guise mathematics is intensely dependent on its own special signata. Nevertheless, both in history and into the present, its practice is thoroughly interwoven with the written word. In many traditions, the communication of mathematics was indeed carried out in poetry, both because the nature of its subjects was deemed worthy of careful linguistic construction and because the mnemonic and structural form of the poem in some way reflected their algorithmic intent.

Despite serious attempts (Russell and Whitehead's "Principia Mathematica"[5] being one of the most notable) to present mathematics in purely symbolic terms, our minds, unlike computers, apparently baulk at such an uncompromising approach. We invoke the intermediation of natural language to create meaning, which thereafter mathematicians may be happy to eschew, having constructed for themselves the invisible synaptic route from signifier to signified. Even so, modern mathematics has to a considerable extent brought natural language into its more evident symbolic code by means of a standardized phraseology that emphasises austerity and depersonalisation[6]. It is interesting, therefore, that though the founder of modern semiotics, C. S. Peirce, was equally renowned as a mathematician, nevertheless mathematics has largely escaped semiotic analysis, perhaps because of the deep division, at least in the Anglophone world, between the sciences (including mathematics) and the humanities (with the exception of analytical philosophy).

Rotman (1988) addresses this and sets out a foundation for a semiotics of mathematics, drawing special attention to the difficulties that can be encountered in discerning what it is that mathematics *signifies*. Most practicing mathematicians work from a Platonist viewpoint that the objects of mathematics exist in an ideal realm, a viewpoint entrenched in the formalized language employed. There can be little doubt that Barbilian, as a mathematician, will have shared this viewpoint and, as we shall show, it is to a considerable extent the goal of Barbu, the poet, to interpret the non-mathematical world in a way that echoes this search for human understanding of a Platonic ideal underpinning that of sensory perception. Whether or not such an ideal is valid matters little to its translation between domains.

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[5] Whitehead and Russell (1910-13)

[6] Phrases such as "Let *n* be an integer…", Define a *normal subgroup* to be…", "It is clear that…". Rotman (1993).

The meaning the mathematician assigns to a theorem, whether as its writer or reader, derives from a prior knowledge of the domain in which she or he works. At a superficial level, there is the mere statement of the theorem. Its proof may require greater insight or intimacy to grasp but is intended to convince us that the statement cannot be wrong. In a similar way, the poet or his reader may see the mimetic or realist meaning in the words of a poem but draws on a deeper familiarity with the tropes of its language to grasp the deeper semiotic intent of the poem. In the words of literary theorist I.A. Richards:

> A good deal of poetry and even some great poetry exists in which the sense of the words can be almost entirely missed or neglected without loss... the form often seems as an inexplicable premonition of a meaning which we have not yet grasped[7].

The semiotics of poetry has attracted wider attention than that of mathematics. For example, the work of Riffaterre (1978) has established a substantial legacy. Half a century earlier the linguist and literary theorist Roman Jakobson took, as the subject of his first major study[8], the work of the futurist Russian poet, Velimir Khlebnikov, thereby laying the foundations of a scientific approach to linguistics and language analysis. Jakobson's approach was essentially semiotic – he proposed that that the signifier in poetry becomes more important than the signified (a theme amplified by Riffaterre). In other words, the form of expression is more important than the ostensible external content. The similarity with mathematics is evident: the counterpoint to the Platonist interpretation of mathematics is the formalist one, in which the symbolic presentation of mathematics is treated simply as a game following precise rules absent of external secondarity or signification.

Khlebnikov's poetry undoubtedly spurred Jakobson's thinking in a variety of ways. The poet combined word and picture and, significant in the context of this work, proposed a primacy of number over word so that the use of numbers and numerology featured significantly in his later work. In an essay first published in 1959[9], Jakobson classified three types of translation:

1) *Intra-lingual translation* or *rewording:* interpretation of verbal signs by means of other signs of the same language.

2) *Inter-lingual translation* or *translation proper*: interpretation of verbal signs by means of some other language.

3) *Inter-semiotic translation* or *transmutation*: interpretation of verbal signs by means of nonverbal sign systems.

Insofar as we examine, in the English language, a Romanian writing poetry in his native tongue and mathematics frequently in Romanian or in German, inter-lingual translation does play a significant role. Our goal here is to explore the extent to which the work of Barbilian/Barbu can be approached as a form of inter-semiotic translation. Whether mathematics fits in Jakobson's schema is debatable. However we make the interpretation that Jakobson's polarity between "verbal" and "non-verbal" is not the critical distinction, rather that the translation occurs between two distinct systems of code. Indeed, Jakobson does go on to describe inter-semiotic translation as transposition from one sign system to another, identifying music, painting and dance as examples, though surprisingly, given Khlebnikov's poetic interest in numbers, not mathematics. In this sense, we view mathematics and poetry as distinct sign systems, independent of the (natural) language of formation.

This places inter-semiotic translation in a different dimension from lingual translation. We are not aware of a formal theory that encodes that, but (bearing in mind Rotman's observation that the formalism invoked in semiotic scholarship is likely to follow that of the scholar's home discipline) we propose that the mathematical language of *category theory* could point to such a

[7] Walker and Walker (1989)

[8] Jakobson (1921)

[9] Jakobson (1959)

theory. Category theory was a new description and organising system of abstract mathematical structures and systems of structures, created by Samuel Eilenberg and Saunders Mac Lane[10].

Briefly, a *category* is a collection of *objects* together with *morphisms* that are relations (often depicted as arrows) between the objects. Almost any mathematical structure can be used to build a category, for example *groups* as objects, with *symmetry-preserving relations* as morphisms. A goal of the theory is to model and analyse the structural similarities *between* categories by introducing relations, called *functors*, between them.

The focus in category theory is not the "atomic" make-up of the objects themselves, but rather their morphisms and how the structure of the category can understood by these morphisms. In other words, it is the *relations*, and their qualities of preservation, that are significant. This approach is essentially phenomenological. Category theory provides a potential framework, or at least a paradigm, for inter-semiotic translation and, in particular, the relationship between mathematics and poetry. The act of inter-lingual translation would be a morphism between texts whereas inter-semiotic translation would act at the level of a functor between different codes as categories of objects.

2.2. Aesthetics

Mathematicians and poets recognise the aesthetic values of their creations. Often cited in Anglophone scholarship, for making the link between the two, is Bertrand Russell:

> Mathematics, rightly viewed, possesses not only truth, but supreme beauty – a beauty cold and austere […] The true spirit of delight, the exaltation, the sense of being more than man (*sic*) which is the touchstone of the highest excellence, is to be found in mathematics as surely as poetry[11].

Earlier, Karl Weierstrass, one of the founders of modern mathematical analysis, was also attracted to the poetic aesthetic: "und es ist wahr, ein Mathematiker, der nicht etwas Poet ist, wird nimmer ein vollkommener Mathematiker sein"[12]. According to Growney (2008), Weierstrass meant that a good mathematician, like a poet, must take particular care with language, in that both require attention to saying the essential *and* to not saying the unnecessary, in the best possible style. We would argue that, in addition, Weierstrass is referring to an imaginative or creative side of mathematics that is essential, yet more often associated with poetry. In similar vein, the algebraist Leopold Kronecker observed: "Are not mathematicians veritable and innate poets? Indeed they are, just that their representations ought to be demonstrated"[13]. Kronecker proposes that mathematics differs from poetry only in that its objects (theorems as against poems) need step-by-step theoretical exposition, in the form of a logically deductive proof.

This prompts the question as to whether a poem resembles more the simple statement of a theorem or a theorem *together* with its proof. It could be said that the proof furnishes the meaning that, in Richards' observation, is yet to be grasped. On the other hand, the formal layout of a proof could be seen to have more in common with the structural form of a poem and that, in any case, the uninitiated reader is no more likely to garner meaning from the proof than from the statement.

If mathematicians invoke poetry as an aesthetic ideal, perhaps fewer poets of renown directly seek parallels in mathematics. The French and Russian symbolist poets, however, of whom Barbu may be considered a descendant, were frequently seeking to emulate the

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[10] Eilenberg and Mac Lane began their collaboration on category theory in 1945. Eilenberg was a member of Bourbaki for 15 years, and was also a collector and dealer in Indian art. He reputedly at tried to devise an 'axiomatic method' for art dealing, perhaps itself a form of inter-semiotic translation. Mac Lane, an American, worked in the early 1930s in Göttingen under Hilbert and Noether (see Section 2). See Bass *et al.* (1998) and Mac Lane (1971) for further information.

[11] Russell (1907)

[12] "It is true that a mathematician, who is not somewhat of a poet, will never be a perfect mathematician", quoted from a letter from Weierstrass to Kovalevskaya, Mittag-Leffler (1900, p.149).

[13] Brescan (2009, pp.104-105)

mathematical method. Novalis (Friedrich von Hardenberg), the German poet and philosopher who became a strong influence in the movement was much influenced by the mathematics and mathematicians of his time. He wrote in his (posthumously titled) "Hymns to Mathematics":

> Mathematics is poetry [...] The mathematician is, therefore, a poetic philosopher contemplating the mind as a distinct universe […] algebra and structure symbolize the intellectual features of poetry[14].

Stéphane Mallarmé, a central figure in the symbolist/modernist movements, in *Un coup de dés* (A Throw of the Dice) manifestly experimented with form, making multiple references to number, counting and chance[15]. His conceptual *Livre*[16], a scarcely realised work planned as a grand theory of aesthetics, was to be written in a "language of mathematics".

The American writer Emily Dickinson also employed extensive mathematical imagery in her poems[17]. The Paris-based US modernist novelist and poet Gertrude Stein claimed that her poetry had a "mathematical aesthetic"[18]. In both cases, it has been argued that the mathematical referents go beyond mere imagery to a direct attempt to capture a deeper meaning through their use.

Among more recent poets, a special case is the collective, Oulipo (*Ouvroir de littérature potentielle*), of French-speaking writers and mathematicians, who drew a comparison between mathematical operations and syntax. Founder member, Raymond Queneau set out to describe literature following the axiomatic method of the mathematician David Hilbert. Oulipian, Jacques Roubaud, both mathematician and poet in similar vein to Barbilian, was also a member of the mathematical collective Bourbaki[19].

While much of the foregoing points to an attempt to share (or borrow) aesthetics one from the other, it starts to go beyond that to finding a means to create a shared or exchangeable semiotics. We explore this further in the person of Dan Barbilian.

3. Barbilian/Barbu

3.1. Barbilian: the mathematician

Mathematics in the nineteenth century underwent radical development, in many ways prefiguring or at least echoing wider intellectual ferment. The Cartesian revolution of the early half of the 17th century that brought algebra to bear on geometry, opened up a completely new way of representing the physical world. The work of the subsequent century came to fruition in the infinitesimal calculus of Newton and especially Leibniz for whom the algebraic method presented a more revolutionary approach than that adopted by Newton. After another century of mathematical development building on these foundations, by the 1800s many fundamental questions about the nature of mathematics, its objects and objectives could no longer be left unaddressed. Over the next 80 years: Gauss, Bolyai and Lobachevsky demonstrated that the geometry of Euclid could not logically be taken as the sole plausible model of space; Galois sowed the seeds of abstract algebra through his idea of a 'group' embodying the notion of symmetry; Riemann and Klein put forward manifestos for a new conception of space and geometry; Weierstrass and Cauchy provided a rigorous meaning to the concept of limit; Cantor opened up the nature of infinity and by the beginning of the 20th century Hilbert was asking whether all of mathematics could be ascertained by logical axiomatic deduction.

To expand somewhat, the enduring classic of mathematics, Euclid's Elements, 13 books written around 300BCE was a compendium of the mathematics, both geometry and arithmetic, of

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[14] (*Ibid.,* p.107)
[15] Mallarmé (1914)
[16] The notes for this grand project are held at the Houghton Library, Harvard University.
[17] Chu (2006)
[18] Hoff (2010)
[19] See footnote 4.

its era. Famously, Book 1 concerning plane geometry commences with a set of postulates or axioms – incontrovertible truths from which all else is to be deduced. Among these, the *parallel postulate* asserts what amounts to the statement that for every line and every point not on that line there exists a unique line through that point which does not meet the given line. There is no doubt that Euclid was reluctant to include this and over subsequent millennia many attempts were made to demonstrate that this postulate could logically be derived from the others. That this is not the case was the momentous conclusion, arrived at in the early 19th century, independently by the Hungarian János Bolyai and Russian Nikolai Lobachevsky (and arguably, though unpublished, by Karl Friedrich Gauss). They constructed models of geometry that forewent only the parallel postulate and yet were internally consistent, thereby demonstrating that non-Euclidean geometries had to be admitted as valid models equally with the classical Euclidean one. Thus was set in train a wholly new way of conceiving the mathematical enterprise, one in which the axiomatic basis of each branch of the discipline must be ascertained and its truths be demonstrated by logical deduction from them.

Thence, the period 1880-1930, described as one of modernist transformation in mathematics[20], is associated with a more rigorous, formalist and abstract approach to the discipline. As well as bringing into doubt much received mathematical wisdom, it led to new paradigms, and sometimes to bewildering levels of abstraction (such as category theory) that, nonetheless, miraculously led to the resolution of deep problems. Modernist mathematicians were thus faced with a fascinating array of new and abstract thought and immersed in a period of deep contemplation as to the nature of mathematics and the validity of its assertions[21].

All of this laid the foundations for the mathematical world Barbilian discovered as a student and then entered as an academic. He initially went to Göttingen to study number theory but while there was exposed to the geometric-algebraic work of Gauss, Riemann and Klein. He took a particular interest in abstract algebra, especially the work of Emmy Noether, "the mother of modern algebra" (in Irving Kaplansky's phrase) and consequently in mathematics as morphology[22].

Following completion of his thesis, concerning symmetry groups that arise in analytic geometry (a topic that has recently seen a revival owing to applications in cryptography), Barbilian became further involved in the axiomatic foundations and group-theoretic approaches to geometry and number theory. Later, he focussed on problems in modern algebra, ultimately returning to spatial geometry[23].

Two areas of contribution deserve attention because they help both to illustrate Barbilian's mathematical style and to illuminate why it is closely linked to his poetic aspirations. The first he arrived at quite early in his mathematical career. In a short 1934 paper, he introduced a new notion of distance (a *metric*) within a bounded convex region[24]. This was in the tradition of the non-Euclidean geometries, discovered in the previous century, and also the later work of Felix Hausdorff on more general notions of space[25]. His metric was constructed using the idea of reflection in the boundary, perhaps suggested by consideration of light rays. It transpired that the interesting examples coincided with the hyperbolic geometries of Bolyai and Lobachevski, more than a century earlier. Again, it is worth attempting to set out Barbilian's idea. Essentially, in a bounded convex region such as an oval, he replaces the standard (Euclidean) distance between two points, *A* and *B,* in the region by a new measure (metric) which is the logarithm[26] of the ratio

[20] Gray (2008)
[21] (*Ibid.,* Chapter 1)
[22] Cioranescu (1981, p. 38)
[23] Barbu (1968, p. 27)
[24] Barbilian (1934)
[25] Hausdorff (1914)
[26] The use of the logarithm simply ensures that the metric distance between a point and itself is zero.

of two quantities: the maximum and minimum values of the ratios of distances from *A* and from *B* to any point on the boundary of the region. While the mathematical details may seem opaque, later we put forward the suggestion that the concept carries resonances with Barbu's poetry.

Barbilian himself termed these metric spaces *Apollonian* (after the late-classical Greek geometer, Apollonius of Perga). Soon afterwards, Blumenthal referred to them as *Barbilian spaces*[27]. Barbilian was apparently unaware of this attribution until many years later when he returned to investigate them further. There has been some subsequent interest in these spaces, for example his original contribution is included in a history of the evolution of twentieth-century mathematics[28].

His second contribution to mathematical research that we highlight was Barbilian's major interest during his most productive period. Still at the interface of algebra and geometry and in the spirit of abstraction, he sought to tease out what features of algebra were the minimal essentials in order to give rise to a sensible notion of geometry. Somewhat confusingly, these objects have also been termed Barbilian spaces and they generated a greater degree of interest among mathematicians than his metric spaces. Veldkamp observed that Barbilian is to be credited with initiating the "systematic study of projective planes over large classes of associative rings"[29]. In remedying some shortcomings in Barbilian's work, Veldkamp set out an approach drawing on and extending Barbilian's earlier work on metrics, thereby creating an unforeseen link between the two.

An intriguing aspect of Barbilian's original paper on this topic is that in the introduction to an otherwise wholly mathematical article, he comments, "Just as in aesthetics the extremely lyrical is considered anti-poetic, so we can justly describe the extreme Ideal as anti-geometric"[30]. In saying this, Barbilian alludes to what will transpire to be one of his poetic precepts, that limitations on allowable method and style are essential. Further, in keeping with his view on the unity of mathematics, Barbilian is at the same time deliberately mixing a geometric simile with an algebraic one as well as playing between the modern algebraic concept of "ideal" and its usual notion of perfection.

In summary, we could say that fundamental abstract relations between objects shaped Barbilian's interests. One colleague is quoted as saying that Barbilian took the axiomatic approach in mathematics to an extreme[31]. In this Barbilian was, in all likelihood, in thrall to Noether's credo:

> All relations between numbers, functions and operations become perspicuous, capable of generalization, and truly fruitful after being detached from specific examples, and traced back to conceptual connections[32].

This tendency towards modern, abstract and axiomatic mathematics is important: it is frequently asserted that similar characteristics are directly reflected in the poetry of Barbu[33].

3.2. Barbu: the poet

While his first volume of poetry, *După melci* (After Snails) was published in 1921, *Joc secund*, published in 1930, stands as Barbu's major collection of poetry. Although it precedes his time as a productive mathematician, he had already been awarded his doctorate and taken up an academic position. In poetic mode, he declared that the lyrical potential of the Romanian

[27] Blumenthal (1938)

[28] Pier (1994, p. 20)

[29] Veldkamp (1995, p. 1035)

[30] Barbilian (1940)

[31] Gheorghe St. Andonie, cited in Barbu (1968, p. 28)

[32] Van der Waerden (1983)

[33] Barbu (1930)

language was being stifled under the assimilated poetic convention of the time and *Joc secund* was his attempt to address this[34].

From literature, the Symbolist influence on Barbu the poet is significant, and Barbilian devoted several essays to the examination of Symbolist poets, making specific comparison with particular mathematicians[35]. In 1927, another interview with Barbilian appeared in the literary press, in which he approvingly compares the poets Paul Valéry and Stéphane Mallarmé with the mathematicians Hilbert and Gauss, but at the same time noting the poets' essential dissimilarity:

> Valéry plătește un bir trecutului analitic și didactic […] Experiența lui Mallarmé se așează într-un Absolut, într-un antiistorism, care interzice o prea mare apropiere poeziei lui Valéry[36].
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> [Valéry pays tribute to an analytic and didactic past […] Mallarmé situates himself within an Absolute, within an anti-historicism, that precludes too close a comparison with the poetry of Valéry.]

In 1929, Barbilian wrote about the Romanian poet and philosopher Lucian Blaga, commenting that Blaga knew exactly where poetry should seek its inspiration: the poetic principle must be a spiritual vision. Furthermore, remarks Barbilian, Blaga has encapsulated that spiritual vision in his overtly religious expression, *Geometrie înaltă și sfântă*[37]. Alongside the spiritual, Barbilian extols Blaga's "just and pure" vocabulary, and his calm state of mind, suggesting a poetry that, like mathematics, is the outcome of slow and measured consideration.

Returning to the Symbolists in his 1947 prose piece, "Jean Moréas"[38], Barbilian praises him for his "clear and melodic formulations", and as one who purified and reduced rather than invented. Comparing him with his mathematical contemporary, Hilbert, Barbilian then suggests that geometry represents a pure and aesthetically pleasing form of expression and understanding in the quotation that prefaces this paper.

Stylistic influences from mathematicians cast their reflection on the poetic style of Barbu. Perhaps first among them is Gauss, whose motto was *pauca sed matura,* "little but ripe". In a eulogy to Gauss, Barbilian cited a maxim of Minkowski summarising his view of Gauss's hermeticism: "un minim de formule oarbe unit cu un maxim de idei vizionare"[39]. For Barbilian, this encapsulates not only Gauss's style, but it also touches on deeper issues around the dismissal of formulae in favour of broader conceptual ideas in mathematics, which becomes a recurring theme for Barbilian. In the case of Gauss, he explicitly links this style to the arts:

> Am pomenit de ermetismul teoremelor lui Gauss. El derivă dintr-o anumită concepție a artei teoremei, pe care Gauss o vedea ca un text august, ca o inscripție, al cărei laconism e însăși garanția durabilității ei[40].
>
> [I have noted Gauss's hermeticism in his theorems. This derives from a particular concept in art theory, by which Gauss sees that a wise text, like an inscription, is brief and it is this that guarantees its durability.]

This citation is interesting, since it immediately suggests a two-way relationship between mathematics and poetry: Hermeticism is a quality or type of poetry which Barbu himself ascribes to his later work, particularly *Joc secund*.

Barbilian also noted his indebtedness to Klein's "Erlangen Programme" (in which he set out a systematic and unified approach to geometry based on the idea of groups of transformations), explicitly likening his poetic approach to that mathematical manifesto[41]. How Barbilian

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34 Nicolescu (1972)

35 See for example Barbilian's juxtaposing of French poets with mathematicians - Pascal, Galois, Rimbaud and Riemann – in his essay "Rimbaud" first published in 1941, see Barbu (1968, pp.339-342).

36 From an interview with the critic I. Valerian: Aderca (1927); also Barbu (1968, p.48).

37 "Geometry on high and most holy." Barbu (1929); also Barbu (1968, p.95)

38 (*Ibid.,* pp.119-120)

39 A minimum of blind formulae combined with a maximum of visionary ideas, Barbilian (1955)

40 Barbu (1930, p. xvi)

41 Boskoff *et al.* (2009)

conceived of it in later years is illustrated in a note he wrote to Bucharest University in 1940 (translated):

> I consider myself an adherent of the Erlangen Programme in the sense of a logical system of ideas, and holistic points of view. […] Mathematical research can lend its organisational characteristics to poetry, whereby disjointed metaphors take on a universal sense. Similarly, the axiomatic foundations of group theory can be assimilated into a larger moral concept of a unified universe. Without this, mathematics would be a laborious Barbary[42].

Of all the mathematicians that influenced Barbilian, perhaps he was most indebted to David Hilbert. Prompted by the discovery of non-Euclidean geometries, Hilbert was the first to construct a complete axiomatic system for these different geometries. Hilbert's proposal that all mathematics could be generated in a formal way – a programme that was ultimately confounded by Gödel's famous "incompleteness theorems" in the early 1930s – was one of the driving themes of the mathematics of its era. Barbilian attended lectures of Hilbert when he was in Göttingen and later asserted that Hilbert had been seeking in mathematics a highest status for geometry (*starea de geometrie*), likening this to the search for an ultimate opiate (*opiu*).

4. Mathematics into poetry

If a claim is to be made that between the mathematics of Barbilian and the poetry of Barbu there is some notion of inter-semiotic translation, then it is largely through *Joc secund* that this will be uncovered. For it is in this volume that Barbu most directly sought to fulfil his vision of a poetry which adhered to the same virtues that he perceived in mathematics. At the level of pure mimesis, we will not find evidence of translation. Barbilian did not directly set out to convey exactly the same semantic relationship between the words and tropes of his poems as in the structures and theorems of his mathematical writing. No explicit morphism will carry the one to the other. Rather, any such translation will be at a deeper level – in the language of category theory, it is functorial – and we propose that, at this level, Barbilian's own writing suggests that he hoped to find a deeper unity in the meanings of his binary opera.

This conception of a universe describable through unified theories that bring together otherwise disparate areas of thought can be seen in Barbilian's own reflections and in his poems themselves. In 1927, he gave an interview in which he describes the mix of mathematician and poet within him, repeatedly returning to an image of geometry to illustrate where the two intersect:

> I consider myself more of a practitioner of mathematics and less of a poet, and that only insofar as poetry recalls geometry. No matter how contradictory these two terms might seem at first sight, there is somewhere in the high realm of geometry a bright spot where it meets poetry[43].

It seems clear that his conception goes beyond a notion of metaphor; certainly poets have sought to make use of mathematical imagery for that purpose. Barbu, on the other hand, is seeking a more even-handed alignment between poetry and mathematics in which each uses its own aesthetic and delves into its own psychic universe but there is an ultimate convergence, as Euclid's parallel lines can be thought to intersect at infinity.

Joc secund literally translates as "second game". It carries the notion of striving towards a purer reality, a Platonic ideal, but the title itself has attracted a variety of interpretations and translations, such as "mirrored play" or "counter play". Boskoff *et al.* (2009) explore interactions between Barbilian's mathematics and his poetry, describing the second game as an "overthrow of reality" and its subsequent transformation into an underlying and "hidden play"[44]. Petrescu (1993) considers the second game to refer to transcendence. Cassian, fellow poet and close

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[42] (*Ibid.,* p30)

[43] Barbu (1968, p. 39). Translation modified from Mihaescu (1985).

[44] Boskoff *et al.* (2009)

associate of Barbu, argues that it refers to life mirroring itself in art[45]. Petroveanu (1972) claims that *Joc secund* rejects any immediate temporality and historical context in favour of a timelessness, and that Barbu saw this as a way to access an ideal human "essence". Perhaps, in its most simplistic interpretation, poetry itself is Barbu's "second game", alongside mathematics.

It can be seen already in these multiple interpretations and varied translations of just the title of the volume, that an additional level of difficulty is added to the process of translating his poetry by the extent to which the translator seeks to capture any mathematical essence they might convey. Solomon Marcus, the pre-eminent mathematically-trained Barbilian scholar, remarks: "Ion Barbu left ineffaceable traces on Dan Barbilian and vice versa: Ion Barbu's work is incomprehensible without grasping the essence of Dan Barbilian's thinking and work"[46].

Secondariness, especially in the context of reflection which, as we shall see, plays an important role in these poems, lies at the core of mathematical symmetry. This is a central concept in group theory and is at the heart of Klein's Erlangen programme. The mathematical nature of *Joc secund* is strongly projected. The pieces in the collection, some previously published, were carefully chosen and ordered, reflecting his commitment towards unity, concision and brevity, characteristics of the mathematics admired by Barbilian. Secondariness can also be witnessed in the process of translation especially, in our context, translation both inter-lingual and inter-semiotic.

In the poems, the reader is presented with discrete and multiple images, leaving their full interpretation to the cumulative effect of multiple poems that complement and build upon one another. *Joc secund* attempts to build an external ideal through suggestion: the book's epigraph, due to Mallarmé, is "ne fût-ce que pour vous en donner l'idée"[47].

The building up, in an "aedical" manner[48], of repeated, complementary images across the collection is an important feature. In the way that axioms or postulates form the basis of an axiomatic approach to mathematics, so too do core images form a common, albeit differentiated, basis for many of Barbu's poems. This poetic style is an elaboration of a type of "axiomatic" poetics, whereby short and concise words and expressions are presented to the reader for interpretation. In this way, Barbu is drawing on an understanding of Hilbertian axiomatic mathematics that allows for the maximum of interpretation, towards an absolute ideal, but subject to the various limits and restrictions on the possibilities allowable within that axiomatic system. Whenever possible, the particular and personal is not stated, but only inferred from the axioms.

If Barbu is seeking to present an axiomatic form of poetry then, unlike Euclid or Hilbert, in *Joc secund* he leaves the reader in the dark as to what the "axioms" might be. In this respect, entering the collection of poems is rather like starting Euclid midway through Book I, where use commences of the parallel postulate in the lead up to proving the famous theorem of Pythagoras. A sense is conveyed but the deeper meaning is elusive.

The theme of translation, as mentioned before, plays out in several dimensions. Here, we present inter-lingual translation of three of Barbu's poems and observe that the extent to which mathematical allusions appear may be dependent on the translator.

The untitled poem that opens *Joc secund* and from which it draws its title has, unlike most, been translated into English several times.

[DIN CEAS, DEDUS…][49]

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[45] Cassian (1993)

[46] Brescan (2009)

[47] "Were it only to give you the idea." From "Villiers de L'Isle-Adam" in Mallarmé (1945, p. 495).

[48] Nicolescu (1972). By "aedical", we understand Nicolescu to be alluding to a building up, or cumulative construction, of operations.

[49] Originally untitled, this poem is often named for the phrase giving the book's title. See, for example, Rosetti and Calin's 1966 edition, Barbu (1930, p. 63). Barbu's textual notes suggest that he preferred either the first-line title "Din ceas, dedus…" or to leave the poem untitled.

Din ceas, dedus adâncul acestei calme creste,
Intrată prin oglindă în mântuit azur,
Tăind pe înecarea cirezilor agreste,
În grupurile apei, un joc secund, mai pur.

Nadir latent! Poetul ridică însumarea
De harfe resfirate ce-în sbor invers le pierzi
Și cântec istovește : ascuns, cum numai marea,
Meduzele când plimbă sub clopotele verzi.

This quite literal translation is from Băjenaru (1995, p.193):

[FROM TIME, DEDUCED…]
From time, deduced the depths of this calm crest
Entering through the mirror the redeemed azure,
Cutting on the sinking of the great rustic herds,
In groups of water, a second game, more pure.

Latent Nadir! The poet lifts up the sum
Of harps dispersed you lose in inverse flight
And song exhausts: hidden as only the sea hides
Medusas as they walk underneath the green chimes.

An alternative translation into English is that by Paul Doru Mugur and Alina Savin, in Boskoff *et al.* (2009, p.90).

SECONDARY GAME
From time inferred, the depth of this calm peak
Through mirror crossed into redeemed azure.
The herds' immersion cutting on the cheek
Of water groups, a second game, more pure.

Latent nadir! The poet lifts the tree
Of scattered harps that fade in reverse flight,
And song exhausts: it's hidden like the sea
Under medusas' drifting bells of light.

Words that have mathematical familiarity – deduction, sum, group, inverse – occur in the one but not the other. That said, these are in any case fleeting allusions and it is not clear that they carry semantic weight. The poem describes Barbu's attempt to reach a 'second game' or alternative and transcendent reality, the reflection of the herds of beasts on a mountainside reflected in the dark lake beneath. That the attempt is ultimately unsuccessful is acknowledged, since the poet's music and songs are lost and dispersed in the ocean's depths and under the weight of water, but there nonetheless remains a strong suggestion of the heights (or depths) to which the poet is trying to reach[50]. In that sense, the poem captures Barbu's ultimate disillusion with his own attempt to create a mathematical poetics.

The images of water are a common feature of many of Barbu's poems, suggesting weight and drowning, but also light, reflection and diffraction. For him, water represents sight – or vision, in its many senses – enhanced and enriched, if ultimately distorted[51]. The opening phrase is evocative since its simple translation, "from time" (*din ceas*), carries in Romanian not only connotations of "from time to time" but also of moving out beyond time. This suggests Barbu's ultimate aim of reaching a state of transcendence.

[50] The juxtaposition of height and depth has been noted in Barbu's poetry by Vianu (1970, pp85-89).

[51] Barbu initially planned to call this collection *Ochean* (spyglass), with its references to light, distance transformed and embodying the idea of creating a parallel, higher, world that relies on transforming, metaphors. Cornis-Pope (2000).

The creation of a "second game", an alternative reality, prefigures Barbilian's mathematical work on metrics. There, too, the ordinary notion of distance is distorted, by a kind of reflection, yet, in some sense, the result is a purer geometry, free of the unnecessary encumbrance of the parallel postulate. At the same time, reflection is a form of symmetry, just as is the rhyme pattern Barbu employs, which as we have seen forms the basis for the modern algebra that so influenced Barbilian.

Barbu uses this concept in several of his poems, including the eponymous "Grup". Once again, Barbu's poetry strives to replicate some of the same concepts that motivate his mathematical work.

GRUP
E temnița în ars, nedemn pământ.
De ziuă, fânul razelor înșală ;
Dar capetele noastre, dacă sunt,
Ovaluri stau, de var, ca a greșeală.

Atâtea clăile de fire stângi !
Găsi-vor gest închis, să le rezume,
Să nege, dreaptă, linia ce frângi :
Ochi în virgin triunghi tăiat spre lume ? [52]

This translation draws, with modifications, from translations by Paul Doru Mugur in Boskoff *et al.* (2009, p.20) and George Băjenaru (1995).

GROUP
It is a prison on burned, unworthy earth.
In the day, the sheaf of rays deceives;
But our heads, if they be,
Ovals remain, of lime, like an error.

Many stacks of lefthand threads!
Will they discover a closed gesture, to summarise,
To deny, straight line that brakes:
Eyes in a virgin triangle cut towards the world?

It is also interesting to compare Constantin Frosin's translation into French[53]:

GROUPE
Un vrai cachot, cette terre brûlée, indigne.
À l'aurore, la gerbe des rayons illusionne.
Pourtant, nos têtes, au cas où elles s'alignent,
S'érigent en ovales de chaux, presqu'une maldonne.

Si nombreuses les tignasses à cheveux gauches.
Trouveront-elles ce geste ferme pour la réduction,
Pour le déni de la ligne droite qu'on fauche :
Cet œil en vierge triangle taillé pour la création ?

The poem may describe Barbilian's reflections on group theory, as a method which attempts to depict the "highest states" of being. "Grup" draws on mathematical imagery to represent an image of creative promise that is ultimately stultified. The mathematical images are those that suggest the mathematico-poetic ideal towards which Barbu is struggling. For Barbilian the mathematical humanist, the goal is clear, but as he describes in his essays, and as also seems apparent throughout these poems, he believes the attempt to be ultimately beyond his reach.

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[52] First published in 1927 in *Sburătorul.* Barbu (1970, p.69)

[53] Barbu (1956)

In this regard, the group is a prison that it is a concept that traps, rather than illuminates; on the "burned unworthy earth" are found the earlier foundations of mathematics that have been discredited, yet not adequately replaced. The former misrepresentations are evident in the words "deceives" and "error". The rays and threads are hopeful, but their innate propensity for confusion – left-handedness – suggests failure. Indeed, "left-handed" is used elsewhere by Barbu[54], contributing to a semiotic lexicon in his poetry, much as in mathematics the terms, once defined have a constant external reference.

The aim is to find a "closed gesture", a theorem or a unified theory[55], that will give the lie to the straight-lined Euclidean view of geometry, in favour of a truer non-Euclidean version. In hyperbolic, or non-Euclidean space, the angles of a triangle sum to less than two right angles: the "eyes" may be the angles in this case[56].

Of all Barbu's poems, "Grup" is the one most consistently chosen by critics interested in their mathematical content because of its overtly mathematical title and given Barbu's known interest in group theory. Mandics (1984) describes "Grup" as about finding a universal and analytical system of knowledge by revealing alternative possibilities of being. Nicolescu (2004) views "Grup" as somewhat of an exemplar, arguing that *Joc secund* in its entirety refers to a transformation from reality into abstraction; in other words, real concepts are examined through abstract group theory. For Nicolescu the *fânul razelor* (literally, hay of beams) is a geometric term. In the translation above, we have drawn on Frosin's interesting French translation of *fânul* as *gerbe* (sheaf [of hay/wheat]): *gerbe* is also a term used in a branch of algebra, associated with the Bourbaki group member, Alexander Grothendieck. The wheat sheaf also allows for the image of germination and new life, reinforced by Frosin's translation of "day" as *aurore,* and his translation of *fringi* as *fauche* (reap), and introduction of the term 'creation' in the last line.

Thus, "Grup" is perhaps the most successful poem in the collection, in unifying algebra and geometry with poetry in an evocative and succinct way.

The last poem we examine is "Ut algebra poesis", written around 1947 to the poet Nina Cassian, but unpublished during Barbilian's lifetime[57]. Compared with the poems in *Joc secund*, this piece is strongly biographical, more direct and less abstract. It alludes to Barbu's regret at having abandoned his studies in Göttingen, his missed mathematical opportunities, and an awareness of those whom he later fully appreciated to be great mathematicians: Noether, in person; and Gauss, who lived a century before Barbilian, but left a deep legacy at Göttingen. The title echoes Horace's *ut pictura poesis*, in which he suggested that poetry merits the same

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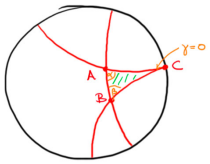
54 For example, in the 1924 poem Paralel Romantic.

55 Nicolescu (1972) argues that the *gest închis* refers to Hilbertian unifying theories of geometry; Boskoff *et al.* (2009) agree that the *gest inchis* refers to a complete description of existence, similar to the completeness of a theorem.

56 In this depiction of a Poincaré disc, one model of non-Euclidean geometry in which straight lines become curves, the resulting triangle looks like an eye (http://dgd.service.tu-berlin.de/wordpress/geometryws12/category/hyperbolic-geometry/).



57 First published in *România literară* in 1969, and not included in Barbu's collected editions during his lifetime. According to Nina Cassian the poem was written to her at some point in 1947 or 1948. Cassian'a poetic style is described as said to have been "truly revolutionised" by Barbu. Some of her own work includes mathematical references, for example "Planul Înclinat"/"The Inclined Plane", first published in Cassian (1967). In a personal conversation with Kempthorne, Cassian herself claimed that while Barbu profoundly influenced her, her own writing is not mathematical in the way Barbu's was.

attention as art, both in detail and viewed as a whole. Barbu is suggesting that poetry might be dealt with in the same way as mathematics.

UT ALGEBRA POESIS [Ninei Cassian]
La anii-mi încă tineri, în târgul Göttingen,
Cum Gauss, altădată, sub curba lui alee
- Boltirea geometriei astrale să încheie -
Încovoiam poemul spre ultimul catren.

Uitasem docta muză pentru-un facil Eden
Când, deslegată serii, căinței glas să dee,
Adusă, coroiată, o desfoiată fee
Își șchiopăta spre mine mult-încurcatul gen.

N-am priceput că Geniul, el trece. Grea mi-e vina…
Dar la Venirea Două stau mult mai treaz și viu.
Întorc vrăjitei chiveri cucuiul străveziu

Și algebrista Emmy, sordida și divina,
Al cărei steag și preot abia să fiu,
Se mută-m nefireasca - nespus de albă ! - Nina.

This English translation is by Glaz and Growney[58]:

AS ALGEBRA, SO POETRY [For Nina Cassian]
In my young days I strolled the lanes of Göttingen -
Where Gauss, beneath arched canopies of leaves,
Sealed once for all the vaults of higher geometries -
And curved a poem towards its last quatrain.

For easy Eden I scorned the learned muse
And nights without restraint unraveled me
As they drew forth a hook-nosed, exposed Eve
With hobbling gait and writing style abstruse.

I failed to see the transience of genius. The guilt is mine…
But for the Second Coming I watch and am prepared
To turn the magic helmet against my fevered head.

And algebraist Emmy, both common and divine,
Whose priest and standard-bearer I would dare emerge,
Surpasses Nina – transcendental and indescribably fair!

The reference to Gauss and "sealing the vaults" of geometry refers to his status as a founder of modern geometry, and the 'curving' of the poem to the last quatrain (oddly, not the case in this sonnet!) points to the legacy that Gauss passed on to the great, modern algebraist, Noether; that is, early modern geometry leads to modern algebra. "Curve" also brings to mind to aspects of non-Euclidean geometry. *Incheie* (sealing) is related to the term used in "Grup": the elusive closed gesture (*gest inchis)*. Here, however, it is used to suggest the attainment of an ideal.

The poem draws also on a number of Symbolist pre-occupations: the imperfect poem that fails to reach the ideal is suggested by the de-petalled fairy, a common Symbolist image for a ruined poem. Similarly, a Parnassian white, almost unnatural (*nefireasca*) appears to represent the ideal, which in this case is Noether, and equally, Nina. The white (limed) ovals in "Grup" thus

[58] Barbu *et al.* (2006)

acquire this same interpretation of Parnassian perfection, but interestingly they are not perfect circles, but the less symmetric mathematical ovals or ellipses.

The tangled poem (*incurcat*, line 8) resembles the poet's frustration in "Grup" with the stacks of left-handed threads – an image that can also in the original Romanian suggest tangled head of hair (haystack). In Romanian, *serii* (to the evening) is very similar to the mathematical term series *(serie)*, meaning the progressive summing of terms in a sequence. This is, however, lost in translation.

Barbu's intention with this poem was obviously less ambitious than his earlier published work. It stands here as a poetic illustration of a rare personal and more accessible reflection, written some fifteen years after publishing *Joc secund*. By then he was established in his career as a mathematician. While regretful, it is a clear recognition of his esteem for the Göttingen mathematicians and Noether in particular.

5. Conclusion

The selected poems from *Joc secund* put into practice much of Barbilian's theory of mathematical poetics. They are rich in mathematical allusion, drawing in particular on themes from his preferred fields, modern algebra and geometry. They are exemplars of his interest in minimalist style, with maximum implication and inference, and the collection operates as a unified whole. The poems draw on images of spirituality and religiosity that Barbu identified in connection with modern geometry. Put together, they operate as a poetic *group*, a collection of images coming together in a tightly structured syntax, perhaps fittingly – from the perspective of poetry – marginal and oblique.

From the outset Barbilian saw mathematics and poetry as equally capable of holding the answer to understanding and reaching an ideal. As elaborated in his "mathematical humanism", he was convinced of the basic importance of mathematics, yet at the same time he acknowledged that had he been more adept, poetry could also have offered that possibility.

Barbilian's poetic theory accepts that restrictions on the use of mathematical metaphor are in fact liberating, as they allow for a pure representation of inference, a sentiment shared by the Symbolist poets in their search for universal meaning. He takes a consciously and deliberately mathematical approach to poetry, starting with building blocks of discrete images or ideas, and juxtaposing and arranging them to create a structure of inference and interpretation. His method resembles an axiomatic, Hilbertian one, where metaphor is abstract and in many respects impersonal. However, the interpretation required of the reader is profoundly individual, given its scant references to common shared images.

If Barbilian himself believed he had failed to achieve that "bright spot" where geometry meets poetry, yet it was a heroic attempt. His poetry and his mathematics stand on their own merits and each has inspired others to seek their own deeper understanding in each realm. It is our contention that, viewed through the prism of inter-semiotic translation, Barbu's singular achievement is in a realization, albeit flawed, of his goal to illuminate the same sense of Ideal through these apparently disjoint creative forms.

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[59] Kempthorne (2014)

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About the authors

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I was first introduced to symbolist poetry while studying French literature, simultaneously with completing a degree in mathematics. The expressive possibilities of the poetic text and the process of intellectual discovery were manifestly present in the creative process of formulating and solving a mathematical problem. This intuition led to conceiving an interdisciplinary project that became my doctoral thesis, completed in 2014. I am grateful to Marco Sonzogni and Peter Donelan for their support and critical encouragement in undertaking the research.

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I have been a working mathematician and lecturer for over 30 years. My research has been in the fields of singularity theory and algebraic geometry with applications in engineering. As an undergraduate at the University of Bristol, UK, I had the good fortune to study the philosophy of mathematics under Brian Rotman and this left me with an abiding interest in the nature of mathematical thought as well as its history. It was my further good fortune to encounter Loveday Kempthorne who introduced me to that rare breed of mathematician-poets that includes Barbilian/Barbu and who, with her knowledge of European languages, literature and mathematics, opened up an unexpected world that has led to this work.