

Article received on November 25<sup>th</sup> 2022

Article accepted on May 31<sup>st</sup> 2023

Original scientific paper

UDC 78.071.1 Bapež E.

DOI: 10.5937/newso23061119I

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## EXAMINING THE 'HYPER' STATUS OF VARÈSE'S 'PRISM'

**Abstract:** This paper offers an interpretation of the composition *Hyperprism* by Edgard Varèse. It provides an explanation of the work's possible meanings, placing emphasis on the investigation of the "hyper" status of the work as a "prism". Relying on the composer's poetics and bearing in mind his scientific approach to sound and sound articulation, this paper proposes the interpretation of the meaning of *Hyperprism* from the perspectives of geometry, optics, and mineralogy.

**Keywords:** Edgard Varèse, sonorism, Hyperprism, sound masses, pc set theory, goal-directed processes, chromatic aggregate

Forming the trilogy with the other two of Varèse's works – *Octandre* and *Intégrales*, the analysed composition – *Hyperprism* – reveals the composer's interest in a scientific approach to sound and sound articulation. Created in the period between November 1922 and the Spring of 1923, for an ensemble of nine wind instruments, siren, and pitchless percussion, this composition represents the author's new, radical aesthetic. This is primarily evident in the choice of instruments, as well as in his approach to sound articulation, and the articulation of the form of the work. In 1916, Edgard Varèse declared for the *New York Morning Telegraph*: "Our musical alphabet must be enriched. We also need new instruments very badly [...] In my own works I have al-

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ways felt the need of new mediums of expression [...] which can lend themselves to every expression of thought and can keep up with thought.”<sup>1</sup> As a young composer of only twenty-two years, Varèse discovered the scientific thought of Hermann von Helmholtz<sup>2</sup> whom he later referred to as a figure of inspiration. The scientist inspired the composer in thinking of music as masses of sound evolving in space.<sup>3</sup> A composer and a scientist should cooperate, Varèse regards, to create (discover) a musical instrument able to produce a continuous tone of any pitch.<sup>4</sup> This continuous tone as an “idée fixe” of his artistic path<sup>5</sup> Varèse found in the sound of a siren, which he used, inspired by Helmholtz’s experiments, in three compositions, including *Hyperprism*.<sup>6</sup> Malcolm MacDonald speaks about the siren as one of the “auditory symbols” of Varèse’s childhood that he spent in the small village in Burgundy. The sound of the riverboat’s siren, as well as the whistle of a distant train, remained in Varèse’s memory, and he recalled and recognized them later in his life in the sounds of New York City: “But even as a child Varèse was fascinated by steam engines. He spoke of one particular night when he was awakened by the long C# of the train whistle as it passed by the village; and how, many years later in New York, he heard again that C# whistle coming from the docks to where he was living on West 14<sup>th</sup> Street.”<sup>7</sup> Speaking of the

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<sup>1</sup> Chou Wen-Chung, “Open Rather Than Bounded”, *Perspectives of New Music*, 5/1, 1966, 1.

<sup>2</sup> In 1905, the young composer discovered the French edition of *Die Lehre von den Tonempfindungen als physiologische Grundlage für die Theorie der Musik* (1863), translated as *Théorie physiologique de la musique fondée sur l'étude des sensations auditives* (1868) / *Physiological Theory of Music Based on a Study of Auditory Sensations*. See: Philippe Lalitte, “The theories of Helmholtz in the work of Varèse”, *Contemporary Music Review*, 30/5, 2011, 329–330. However, the author notices that the French translation is misleading because it focuses on a theory of music, instead of a theory of the auditory sensations as applied to music. *Ibid.*, 343, see the footnote no. 1.

<sup>3</sup> See: Edgard Varèse, L. Alcopley, “Edgard Varèse on Music and Art: A Conversation between Varèse and Alcopley”, *Leonardo*, 1/2, 1968, 194.

<sup>4</sup> See: Драгана Стојановић-Новичић, “О чему је сањао Варез?”, *Музика кроз мисао – Зборник радова*, Београд, Факултет музичке уметности, 2002, 69.

<sup>5</sup> *Ibid.*, 69.

<sup>6</sup> Another two compositions with the siren as an instrument included in the orchestra are *Amériques* (1921) and *Ionisation* (1931).

<sup>7</sup> Malcolm MacDonald, “‘Only One Thing of Value’: Varèse the Burgundian”, in: Felix Meyer and Heidy Zimmermann (Eds), *Edgard Varèse: Composer – Sound Sculptor – Visionary*, Woodbridge, Suffolk, The Boydell Press, 2006, 19.

“wonderful parabolic and hyperbolic curves of sound” of the siren, Varèse emphasizes the essence of its sound quality:

It is astonishing to see at what point pure sound, without harmonics, gives another dimension to the quality of the musical notes which surround it. Truly, the use of pure sounds in music has the same effect on the harmonics as a crystal prism has on pure light. This use irradiates them with thousands of unexpected and varied vibrations.<sup>8</sup>

The premiere of *Hyperprism*, with the composer as a conductor, took place on the fourth of March 1923. The performance caused boisterous, disapproving reactions of a part of the audience, who, among other things, was very bothered by the persistent repetition of the C-sharp tone at the opening measures of the work. Paul Rosenfeld's words witness Varèse's reaction on the night after the premiere of his work, revealing at the same time the origin of this particularly irritating tone, at least for one part of the audience:

During the first performance of the work, [the c-sharps] produced convulsive laughter in the audience. But when the composer returned to his home that evening, and sat working into the night, he heard from somewhere over the city, a very familiar sound, a siren; and realized that he had been hearing it for many nights, over six months; and that the tone was exactly a very shrill high c-sharp.<sup>9</sup>

The inherent nature of sounds is, in Varèse's opinion, “intelligent” and he perceives them as constantly moving. Malcolm MacDonald gives the following explanation of Varèse's approach:

At the atomic and sub-atomic levels, everything is in motion; matter is anything but inert. At such levels, sounds are as alive, as ‘intelligent’, as crystals, or plants. The only expressions available to science to describe and manipulate such phenomena are mathematical. Music and mathematics go hand in hand: music, as an ‘art-science’ (Varèse's term) that deals in the physical reality of acoustical structures, can be seen as a symbol of the union of the mystical and the scientific at the root of matter.<sup>10</sup>

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<sup>8</sup> Edgard Varèse, *Ecrits*, Paris, Christian Bourgois, 1983, 180 and 44, see: Philippe Lalitte, op. cit., 333.

<sup>9</sup> Paul Rosenfeld, *An Hour with American Music*, Westport, Hyperion Press, Inc., 1979, 163, see: Robert Jackson Wood, *At the Threshold: Edgard Varèse, Modernism, and the Experience of Modernity* (doctoral dissertation), New York, City University of New York, 2014, 27.

<sup>10</sup> Malcolm MacDonald, *Varèse, Astronomer in Sound*, London, Kahn&Averill, 2003, 136–137.

Varèse's fascination with "the liberation of sound" is also reflected in the terminology he uses to describe the process of composing – for him, sounds are "detaching" and "projecting" themselves, they are also "sent forth", whereas sound masses "collide" with one another, "penetrate", and "repulse" one another.<sup>11</sup> Therefore, he is apparently aware of space as a comprehensive and thoroughly permeating factor in the process of composing. As a composer, Varèse examines, researches, and conquers the borders of space, making the process of sound and space liberation the fundamental and ultimate condition, means, method, and goal of his creation.

Varèse speaks of his sounds as "intelligent" entities because he considers them entities with their own will. The composer's task, he regards, is just to initiate the "projection" of a sound onto available spatial dimensions. After this projection, sound as an independent, intelligent entity will further "conquer" space on its own. Because of this independence and intelligence of sounds, able to freely move through all possible directions, Varèse considers space to be open, rather than bounded. Talking about the electronic means of creating music, and the issue of possessing control over materials, he once said:

I want to be *in* the material, part of the acoustical vibration, so to speak [...] I think of musical space as open rather than bounded, which is why I speak about projection in the sense that I want simply to project a sound, a musical thought, to initiate it, and then to let it take its own course. I do not want an a priori control of all its aspects.<sup>12</sup>

The sound travels on its own, projects itself further on its own, and conquers open space, expanding its initial boundaries to unimagined scopes. This is where the power, freedom, and intelligence of a sound lie. Regarding the issue of an open, unlimited space, and its dimensions, Varèse talks about spatial projection as a fourth dimension (except for the horizontal, vertical, and dynamic shedding). He speaks about the concept of *sound projection* as "the feeling given us by certain blocks of sound. Probably I should call them beams of sound, since the feeling is akin to that aroused by beams of light sent forth by a powerful searchlight. For the ear – just as the eye – it gives a sense of prolongation, a journey into space."<sup>13</sup> These "beams" or "blocks" of

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<sup>11</sup> Ibid., 139.

<sup>12</sup> Gunther Schuller, Edgard Varèse, "Conversation with Varèse", *Perspectives of New Music*, 3/2, 1965, 36–37.

<sup>13</sup> Malcolm MacDonald, op. cit., 139.

sound, affected by this projection that encompasses all possible dimensions, Varèse calls "planes" (for linearly, melodically developed ideas) and "sound masses" (for vertical structures). Moreover, he considers planes to be capable of expanding into sound masses, which he called the "expanding plane". The opposite situation is also possible, making sound masses capable of converting into planes.<sup>14</sup>

Varèse speaks of his process of composing in terms of a "constant", and a "variation" of that constant, and says:

While in our musical system we deal with quantities whose values are fixed, in the realization that I conceived the values would be continually changing in relation to a constant. In other words, this would be like a series of variations, the changes resulting from slight alterations of the form of a function or by the transposition of one function into another.<sup>15</sup>

This constant may be the very thought (in terms of musical thought, focal pitch, or basic pitch-class set) initiated by a composer, and the variation may be all that unbound motion of the sound through space, as well as the liberation of that same space. For his process of composing, therefore, Varèse provides a metaphorical explanation, comparing it with the "process of crystallisation". Consequently, the musical form he considers not to be predetermined, but to emerge out of a process, is a result of processuality. Accordingly, he points out:

The misunderstanding has come from the thinking of form as a point of departure, a pattern to be followed, a mold to be filled. Form is a result – the result of a process. Each of my works discovers its own form [...] Conceiving musical form as a *resultant* – the result of a process – I was struck by what seemed to me an analogy between the formation of my compositions and the phenomenon of crystallization.<sup>16</sup>

He quoted the description of the crystallisation process, previously given to him by the Professor of Mineralogy at Columbia University, Nathaniel Arbieter:

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<sup>14</sup> John D. Anderson, "Varèse and the Lyricism of the New Physics", *The Musical Quarterly*, 75/1, 1991, 35.

<sup>15</sup> Malcolm MacDonald, op. cit., 140.

<sup>16</sup> Chou Wen-Chung, "The Liberation of Sound", *Perspectives of New Music*, 5/1, 1966, 16.

The crystal is characterized by both a definite external form and a definite internal structure. The internal structure is based on the unit of crystal which is the smallest grouping of the atoms that has the order and composition of the substance. The extension of the unit into space forms the whole crystal. But in spite of the relatively limited variety of internal structures, the external forms of crystals are limitless [...] the crystal forms itself is a *resultant* [...] rather than a primary attribute.<sup>17</sup>

With reference to this, he continues as follows:

This, I believe, suggests better than any explanation I could give about the way my works are formed. There is an idea, the basis of an internal structure, expanded and split into different shapes or groups of sound constantly changing in shape, direction, and speed, attracted and repulsed by various forces. The form of the work is the consequence of this interaction. Possible musical forms are as limitless as the exterior forms of crystals [...] form and content are one.<sup>18</sup>

This paper has its methodological support in Allen Forte's set theory.<sup>19</sup> Furthermore, it inevitably sheds light on the issue of the sound mass concept, as defined by Varèse himself. The study reveals the role of planes and sound masses in developing the processive musical flow, directed towards different goals. This enables the segmentation of the overall form of the composition, the recognition of its structural boundaries, and the potential symmetries within it. Designed in this way, the basic analytical approach provides three possible interpretations of the meaning of the analysed work. The first one is the interpretation of its possible meaning from a mathematical (geometrical) point of view. The second one provides possibilities for considering its meaning from the point of view offered by physics (optics, namely). Finally, the third one attempts to offer an understanding of this work with respect to the composer's poetics. Consequently, these three facets should provide the understanding of the 'hyper' status of Varèse's piece as a 'prism'.

Primarily one needs to point out that the set theory provides the detection of the presence of several parallel processes within the piece, which proved to be essential for the perception of the structural boundaries and the segmentation of the work. These processes form the musical flow and direct cognition of an analyst towards the 'nodal points'. These are the moments of

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<sup>17</sup> Ibid., 16.

<sup>18</sup> Ibid., 16–17.

<sup>19</sup> Allen Forte, *The Structure of Atonal Music*, New Haven – London, Yale University Press, 1973.

closure that are primarily related to the occurrence of the last member of a certain "family of entities".<sup>20</sup> In Varèse's work, this family is represented by twelve pitch classes, whose completion represents the occurrence of the chromatic aggregates. The occurrence of the last pitch class represents the moment of closure. The completion of these processes is in some cases limited to only one section, which makes boundaries easily perceptible. In other cases, these processes unfold through a wider time-space span, thereby connecting different, time-distant points and segments of the form. Thus, these goal-directed linear processes, unfolding in various directions and at various speeds, show Varèse's aspirations towards the liberation of sound and exploration of the open, unlimited, unbounded space. By monitoring directed processes in different dimensions which they 'occupy', as well as by monitoring inextricably connected planes and sound masses, which are responsible for the development of these processes, it is concluded that the overall form of the analysed work consists of three parts, each composed of three sections (example no. 1).

**Example 1:** The overall form of Hyperprism

### Edgard Varèse - *Hyperprism*

#### I part (b.1-30)

first section (b.1-12)	second section (b.13-18)	third section (b.17-30)
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#### II part (b.31-59)

first section (b.31-40)	second section (b.40-45)	third section (b.45-59)
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#### III part (b.60-90)

first section (b.60-76)	second section (b.77-84)	third section (b.85-90)
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<sup>20</sup> Miloš Zatkalik, "Reconsidering Teleological Aspects of Nontonal Music", in: Denis Collins (Ed.), *Music Theory and its Methods: Structures, Challenges, Directions*, Frankfurt am Main, Peter Lang Publishers, 2013, 287.

Varèse's piece develops from one basic "internal structure", or to use Anderson's term, "germinal cell",<sup>21</sup> hereinafter referred to as the B – B-sharp – C-sharp1 trichord of the tenor trombone. It seems, in fact, that this basic trichord (012) is also developed from one (focal) C-sharp1 pitch. Regarding Varèse's poetics, we could conclude that this focal pitch represents the basic "idea" initiated by the composer himself. All the successive development of this focal pitch represents the result of its further projection, independent movement and conquest of the open space. The projection of that independent, "intelligent" sound onto the horizontal dimension (through the *plane* of the tenor trombone) results in a trichord that establishes itself as a basic building unit of the piece, or the "constant", to use Varèse's own term. The further development of this initial trichord and its projection onto the horizontal and vertical dimensions denote a gradual expansion through space, simultaneously acting as a "variation of the constant". It is first reflected in the expansion of the B – B-sharp – C-sharp1 trichord (012) into the C-sharp1 – D1 – E-flat1 – E1 – F1 pentachord (01234), which gives the pitch-class set (0123456) within a complete horizontal flow. Besides the expansion through the horizontal dimension, which is reflected in the developing melodic line of the tenor trombone, the expansion is also present in the vertical dimension. It can be noticed in the occurrence of the first 'accompanying vertical' C-sharp1 – D (01) between the sound mass of horns, and bass trombone (m. 6). The further "variation" of "the constant", relying on the developed pentachord (01234), can be seen with the occurrence of the (0134) tetrachord (m. 12) in the plane of the first horn. The projection of the initial pitch and the further free motion of sound through the horizontal dimension of the space within the first section (mm. 1–12), initiate the first process of the piece which is related to the completion of the chromatic aggregate. The horizontally conquered space of the first section (012345678) obtains its vertical realisation in the second section (*Molto calmo*, mm. 13–18). By the verticalisation of the previously horizontally exposed pitch-class set, the process of "the liberation of sound" continues in two ways. The first way is directly related to conquering the new dimension of the physical space, whereas the second one is related to gradually conquering the space of the chromatic scale. The appearance of the tenth pitch (F-sharp) within the sound mass of horns (m. 15) 'provokes' the establishing of the first vertical occurrence of the pitch-class set (012345678). Further development goes in the direction of re-estab-

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<sup>21</sup> John D. Anderson, *op. cit.*, 35.



lishing the horizontal dimension, with the appearance of the plane of the flute. It is exactly in the flute that the first chromatic aggregate of the work will be completed (m. 22). The last three pitches (the aforementioned F-sharp1 in m. 15, G2 and A-flat2 in the flute, m. 20 and m. 22), whose absence is accountable for the unfolding of the process through three sections of the first part, also represent a pitch-class set (012). At the same time, the distinctive appearance of the flute plane within the third section of the first part (Calmo, a tempo – Tempo I, mm. 19–23) is the first time that one instrument was treated as a solo instrument. The flute passage misses only C and D in order to complete its own linear chromatic aggregate. As the surrounding pitches of the starting, initial pitch (C-sharp1), they were the distinctive pitches of the 'accompanying verticals' during the first and the second sections (mm. 1–18). It is thus additionally confirmed that these three sections belong to the first part of the composition. Likewise, this is another subtle way in which Varèse "liberates" the sound and expands it through space, avoiding the domination of one dimension over another in "the process of liberation". All dimensions must be equally included in this process and a musical piece must be realized in a general, universal space in which all dimensions are merged into one. Perhaps we should at this point recall Varèse's fourth dimension in the music, which gives the feeling of "prolongation" and the sense of "a journey into space."<sup>22</sup> The second process, conducted in parallel with the aforementioned one, also considers the completion of the chromatic aggregate. However, it is realized through the vertical dimension, with the appearance of 'accompanying verticals' (01) characteristic for the piece. This process can be traced through the verticals of the first part (C-sharp1 – D in the first section, C3 – C-sharp2 in the second section, and E-flat2 – E3 and A3 – B-flat2 in the third section). It is completed within the first section of the second part (Pesante, mm. 31–40) in which the vertical dimension dominates. The first vertical (mm. 31–33), which represents the verticalized pitch-class set (01234) from the beginning of the piece, completes the previous array with F, G-flat1, G, and A-flat, whereas the second one completes the array with B pitch. Thus, the process of completing the chromatic aggregate through the interplay of vertical and horizontal dimensions is expanded onto four sections, comprising two parts of the composition, respectively.

The beginning of the second part (mm. 31–59) of the composition is primarily marked with the occurrence of the new sound mass. For the first

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<sup>22</sup> See the footnote no. 13.

time, horns and trombones are explicitly joined in one compact sound mass. Novelty can also be noticed in the simultaneous and, in a smaller space obtained, alternate development of the horizontal and vertical dimensions. The most significant characteristic of this part is reflected in the abundance of the parallel goal-directed processes. These processes seem to be unpredictable and unintentional consequences of a free movement of the projected intelligent sound. However, they reveal a complex, dense network of tightly connected, well-planned activities of sound masses. In the second part both dimensions are represented as equally credited for the development of structurally important pitch-class sets. The second part is also marked with the first withdrawal of the percussion sound mass. The second section of this part (*Lento*, mm. 40–45), is linked to the previous section with E-flat in the first horn. At the same time, this section is also marked with the most complex vertical from the beginning of the second part (012345689, mm. 43–44), which highlights the basic trichord (012), and the resulting trichord (013). The pitches missing from this vertical – E, G, and G-sharp – are prominent in trumpets at the beginning of the second section (E in the first trumpet, mm. 40 and 41), and within the third section (G2 and G-sharp1 as the accompanying vertical of the trumpet sound mass, mm. 47–50).

The third part of the form (mm. 60–90) represents the recapitulation of the previous two parts. Certain planes and sound masses, rhythmic patterns, and pitch-class sets of the previous two parts of the form, are recapitulated in a virtually transformed manner. This way, the third part functions as a “variation” of “the constant”, represented by the first two parts. The sound masses developed within the first two parts, are now transformed in different ways, concerning the pitch, rhythmic image, or timbre. However, compared to this direct way of transformation, the idea of recapitulation is recognized indirectly as well, even to a greater extent. This is realized through strong associative connections with certain materials (pitch-class sets, namely) from the previous two parts. This enables the elevation of the aforementioned processes from the level of sections and parts, to the level of the whole composition. The first distinctive change at the beginning of the third part is the disintegration of the initially coherent sound mass of the tenor trombone and horns (at the beginning of the composition). Here, for the opening of the third part, Varèse uses the bass trombone, followed by the upper two horns. This is where the varied form of the “germinal cell” firstly appears. It is in the first horn, transposed on the F-sharp, and primarily represented as (01234) pentachord. Only after that does the “germinal cell”, also transposed on the

F-sharp, appear in the tenor trombone also as a (01234) pentachord. This is the first direct recapitulation of the previous materials, and planes and sound masses as well. We cannot escape the impression that Varèse deliberately chose the F-sharp for this recapitulation, by which he achieves a kind of allusion to the idea of subdominant recapitulation in a sonata form. This idea of recapitulation is also followed by the sound mass of percussion instruments repeating rhythmic patterns from the beginning of the composition. The occurrence of the sound mass of the piccolo flute and clarinet (m. 69) represents an example of the direct recapitulation of the previous sound masses, as well as their materials. It is the recapitulation of the first and the third sections of the second part (Pesante, m. 31 and onward, and Mosso, m. 45 and onward). The C – B – B-flat (012) trichord in the sound mass of the piccolo and clarinet (from the third section of the second part, mm. 45–48, and mm. 56–59), is recapitulated and rhythmically modified by the piccolo in the mm. 69–72 (within the sound mass of the piccolo flute and clarinet). This melodic motion is accompanied by the clarinet melody consisting of the G-flat3 – F2 – E3 (012) trichord. The selection of instruments emphasizes the connection between these two, spatially and temporally distant points. Furthermore, the clarinet melody horizontalizes the vertical of the horns from the first section of the second part (Pesante, mm. 31–33), making dense associative spatial connections. This brings us to the conclusion that the two original distinct dimensions (the vertical one from Pesante section, and the horizontal one from Mosso section) merged into two horizontals sounding together in the vertical dimension. The other four pitches of the piccolo melody (E-flat4, A3, F-sharp3, and G4), with the following A-flat3 in the clarinet, represent the horizontalisation of the horns and trumpets from the third section of the second part (Mosso, mm. 46–48, and m. 56). This is additionally confirmed by the appearance of the quarter tone in the bass trombone (between D-flat and D), which is a direct reference to the rest of the material from the third section of the second part – namely, to the sound mass of trombones. Another confirmation of these connections comes with the ‘accompanying vertical’ of the sound mass of the piccolo and clarinet (G4 – A-flat3), which is a reference to the most prominent accompanying vertical of the second part (Mosso – Vivace, mm. 48–50). This recapitulation hence embraces the entire third section of the second part within one sound mass.

The indirect recapitulation (achieved by using associative connections) is apparent in the first section of the third part (mm. 60–76) in several ways. The distinctive F-sharp pitch of the beginning of recapitulation, as well as the

prominent ‘accompanying vertical’ of the piccolo and clarinet sound mass (G4 – A-flat3), which concludes the first section, make associative connections with the first section of the first part (mm. 1–12), mainly because they form the (012) trichord, but also because these pitches were accountable for the closure of the first process in the composition – the completion of the chromatic aggregate, namely. Another associative connection is achieved by insisting on the bass trombone timbre and its D-flat – D quarter tone (mm. 69, 72, 74–75), while the only two missing pitches in the piccolo and clarinet sound mass are C-sharp and D. C-sharp, as the initial pitch of the composition, was accompanied by the D of the bass trombone. This time, the recapitulation misses the C-sharp and D, but insists on the D-flat – D quarter tone of the bass trombone. Therefore, it simultaneously makes an associative connection with the first ‘accompanying vertical’ of the composition. Another indirect way of recapitulation, which is related to the process of completing the chromatic aggregate expanding through all three sections in the first part of the composition, can be noticed in the plane of the tenor trombone (in mm. 67–69). In the recapitulation of the initial (012) trichord, namely, it is possible to notice the appearance of the whole chromatic scale downward from the C1 (m. 67). This process is completed by the D-flat – D quarter tone of the bass trombone and this is also the first explicit appearance of the chromatic aggregate. Moreover, this process is completed within the narrowest temporal and spatial frame. The completion was for a moment disrupted by another appearance of the initial (012) trichord (D – D-sharp – E), which interrupted the perfect chromatic downward array by using a conventional imitation of laughter (“slide”), followed by a ‘jesting’ appearance of the quarter tone. However, the missing D will finally appear as the first pitch of the horn sound mass at the beginning of the last section of the third part (m. 85), significantly emphasized with the use of *fortissimo* (*ouvert*), simultaneously as a directly varied recapitulation of the Pesante section from the beginning of the second part (mm. 31–34).

One definition of a prism we can find in mathematics, where it is defined as a three-dimensional shape with two identical sides of equal bases facing each other. The idea of the mathematical notion of prism can, on the one hand, be perceived at the level of each individual section, as well as on the level of each part of the form, on the other hand. In addition to this, it can be recognized on the level of the entire work. The material of each section is based on the initial (012) trichord (“germinal cell”) and its further development through two different dimensions (through the planes and sound

masses, correspondingly). The "germinal cell" is itself based on the three equidistant pitches. Each part of the overall form of the composition is built from three sections sharing the same processes which, in this way, make them 'equal'. Finally, on the level of the whole composition, the third part, putting the emphasis on all the structurally important pitch-class sets, as well as all the important materials, planes, sound masses, and processes of the previous two parts, becomes 'the same', 'consistent', and 'parallel' with other two parts. The third part can be observed from a higher hierarchical level, like an instance that 'reflects' the first two parts of the form, parallelising itself with the previous two parts within the paradigmatic axis. The notion of a mathematical prism implies the existence of an  $n$ -sided base (in the case of the analysed composition, 'the base' is three-sided), and a second base which is a translated copy of the first one. As far as the form of this work is considered, the third part is a translated copy of the first two parts of the form.

The perception of the piece through the vision of the optical prism can be gained in two ways – through the notion of a dispersive, on the one hand, and a reflective prism, on the other. The third part of the composition could be viewed in both ways since the processes and different forms of the liberation of the musical space (realized through the aforementioned goal directed processes), recorded in the first two parts of the composition, spread themselves through the space of the entire composition. This is realized in such a way that the third part positions itself as a syntagmatic and paradigmatic prism of the first two parts at once. On the syntagmatic plane, the third part is the evident recapitulation of the previously presented materials (pc sets) and sound masses. On the paradigmatic plane, as already mentioned, the third part positions itself as a hierarchically higher unit, as a 'magnifying mirror' of the processes of the first two parts. Compared to the first two parts, the third part functions as a dispersive prism, which breaks a beam of light into its basic colours. The third part, in a similar way, contains the essential, elementary part of the entire composition. If we reverse the perspective and take the angle of view from the third part of the form, we will see that the third part 'breaks' the *sound* (all the materials and sound masses of the composition) into elementary materials presented in the first and the second parts. At the same time, the aforementioned numerous transformations of the materials in the third part reveal the qualities of the reflective prism which reflects light in order to flip, rotate, deviate and displace the light beam. The entire piece and its *sound* can be perceived through the vision of the dispersive prism. Two non-related sounds presented through the

planes and sound masses of wind instruments, on one side, and percussion instruments, on the other, could not ‘merge’ and blend into a common sound due to their different natures of sound. This should not be surprising, considering Varèse’s sonoristic approach to the issue of timbre, and his striving towards the differentiation of colours and densities:

The role of colour would be completely changed from being incidental, anecdotal, sensual or picturesque; it would become an agent of delineation like the different colours on a map separating different areas, and an integral part of form. These zones would be felt as isolated, and the hitherto unobtainable non-blending (or at least the sensation of non-blending) would become possible.<sup>23</sup>

We cannot, then, resist the impression that the siren, as a *pure sound*, which Varèse compares to a *crystal prism*, is a kind of paradigm of the entire work.

A famous transmutation as a result of collision and penetration of sound masses was not used in *Hyperprism* in full swing – it seems, moreover, that Varèse did not aim at merging these two different sounds. On the contrary, it seems that he intentionally wanted to put emphasis on the two different colours of the ensemble. In that sense, the work positions itself as a dispersive optical prism towards two non-related (raw, basic) sounds of the orchestra. The piece exists in their mutual consonance, but simultaneously ‘breaks’ the wholeness of sound into two divided, essentially different elementary sounds. In the same way, the dispersive prism merges the unity and differences of a beam of light in one moment. As a piece, *Hyperprism* positions itself as an aural counterpart of the optical prism.

The process of crystallisation is perceived in the projection of the focal C-sharp1 and in the free movement of the “intelligent” sound. During this free movement, the “germinal cell” (012), or the B – B-sharp – C-sharp1 trichord is formed, whose further projection enables the formation of different pitch-class sets in both the horizontal and vertical dimensions of the musical space. Additionally, by virtue of this projection, many teleological processes are initiated and completed during a shorter or longer period of time. These processes are sometimes realized and completed within one segment of the form, making the boundaries more reliable, whereas, in other cases, they are ‘prolonged’ through a longer time period, crossing the structural boundaries. These linear processes, with the individual speeds of development and the different dimensions and time frames they ‘occupy’, point out

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<sup>23</sup> Edgard Varèse, “New Instruments and New Music”, 12. see: Malcolm MacDonald, op. cit., 141.

to a liberated, "intelligent" sound which, once projected, travels freely through musical time-space exploring its "openness". Thus, the whole musical flow becomes "an acoustic vibration", an intelligent substance that constantly moves, varies, and pulses. At the level of pitch-class sets, the process of crystallisation is evident. Each succeeding pitch-class set is derived from the "germinal cell" (012), which functions as "a constant", while all of the derived pitch-class sets represent the "variation" of that constant. These derived sets can therefore be regarded as crystals produced by the projection of the initial cell – they are particular, but not all possible evident forms created as a result of the projection of a basic crystal unit. Furthermore, the projection of the "germinal cell" initiates distinct goal-directed processes which unfold themselves in different ways and with different speeds, and achieve their closure through shorter or longer time periods. These processes affect the creation and identification of structural boundaries, determining as well the complete form of the work in a way that every three sections group themselves within three parts of the complete form. The complete form of the piece, as well as the form of the crystal, thereby emerges from this free movement and processes it triggered, representing only one of its countless possible forms. Just as the crystal, developed on a limited number of internal structures and exempted from the rules related to its unlimited complete form, this piece, developed from one pitch solely, takes up only one of the countless numbers of its external possible forms. In that sense, it is possible to provide an explanation for its name. Developing from the basic internal structure, its complete external form, as a *resultant*, may have taken any other way. The projected focal pitch, as well as the "germinal cell" as an "intelligent" sound, may have taken a different way. Just as the crystal, whose complete form depends on current external factors which make it unique, this piece is also a resultant of one particular motion and 'behaviour' of the initiated projected sound. There are countless forms of external realisation of the piece derived from the initial pitch, or germinal cell, and this is only one of its possible forms, because of which Varèse's 'prism' is manifold in nature.

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## Summary

The analyzed work – *Hyperprism*, written between 1922 and 1923 in a unique way reveals the composer's scientific approach to the issue of sound articulation. Edgard Varèse manfully combines different timbres, creating the work for the ensemble of nine wind instruments and non-pitched percussion instruments. This way, the composer creates new sound horizons, examining all of the available dimensions of musical space. Establishing the fourfold division of the musical space, which includes the spatial sound projection as a fourth dimension, alongside the horizontal and vertical dimensions, and dynamic shedding as well, Varèse in an utterly individual way approaches the examining of musical space borders.

As an independent, intelligent entity, sound conquers *open, unbounded* space on its own after being initially projected by the composer himself. The sound accomplishes this through the horizontal dimension or planes on the one hand, or through the vertical dimension or sound masses (blocks of sound), on the other. During its free movement, sound liberates the open space, at the same time revealing the specific time profile of the composition. It is through planes and sound masses that goal-directed processes are initiated and completed during a shorter or longer period of time. These processes are, as a rule, directed towards the chromatic aggregate as the goal of



the movement. Thus, inextricably linked, space and time are being simultaneously developed and liberated.

Examining the possibilities of the interpretation of the analyzed work, this paper relies on historical sources that include numerous lectures and interviews given by the composer himself. These sources serve as a guide mark in a process of examining the composer's poetics. The inspiration for this paper is also drawn from the very name of the composition, which reveals the scientific provenance. Accordingly, the paper sheds light on the possibility of the interpretation of *Hyperprism* from the geometrical and optical, as well as the point of view of mineralogy. Through the analysis of different goal-directed processes governed by planes and sound masses, as well as through the monitoring of different relations these planes and sound masses achieve, the paper reveals some of the many "faces" of Varèse's prism. The *hyper* status of the work as a *prism* will thus be considered from the perspective of the generic cell projection and its further development through the work. This will inevitably include the issue of the overall form construction as the *resultant* of this specific projection and free unlimited movement of the sound through the musical time-space.