Research

Interpretation of Atomic Theory and Invisible Particles in *De Rerum Natura*: A STEAM Approach through Music, Poetry, and Digital Heritage

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Abstract:

This paper explores the interpretation of Epicurean atomistic theory and the visualization of invisible particles and structures inspired by Lucretius' *De Rerum Natura* through a STEAM (Science, Technology, Engineering, Arts, and Mathematics) framework. This study is guided by the research question: *How do simple elements combine to generate complex structure?*

The discussion is based on the author's original methodologies, SMS (Stories based on Music about Science) and SMH (Stories based on Music about Heritage), which integrate scientific concepts, artistic expression, music, and cultural heritage. Drawing on Book I of *De Rerum Natura,* in which Titus Lucretius Carus presents one of the earliest systematic accounts of Epicurean atomism, the paper reinterprets the concepts of *semina rerum* ("seeds of things"), *corpora prima* ("first bodies"), and *primordia rerum* ("first beginnings") through three interconnected components: poetry, music, and digital visualization.

The poetic component consists of an original adaptation based on William Ellery Leonard's English translation of Book I, complemented by passages from the original Latin text. The musical component is represented by the author's original composition under the artistic name of Aleona von Sultanova, *Carmen Philosophicum*. The visual component employs digital interpretations inspired by *Splendor Solis*, a sixteenth-century illuminated manuscript attributed to Salomon Trismosin, which functions here as a symbolic and cultural framework for representing hidden processes, transformation, and the emergence of visible forms from invisible constituents. By bringing together classical philosophy, music, poetry, digital heritage, and contemporary perspectives from biophysics, the study proposes an interdisciplinary model for STEAM education and public engagement. This project was presented at the European Joint Theory/Experiment Meeting on Membranes (28 January 2026, in Ljubljana), where *Carmen Philosophicum* was also introduced alongside the related STEAM project *Architecture of the Invisible: Membranes.*

Keywords: Biophysics; De Rerum Natura; STEAM; SMS (Stories based on Musi about Science); SMH (Stories based on Music about Heritage); Tiny particles.

1. Introduction

1.1. De Rerum Natura (Book I): From Epicurean Physics to Contemporary Biophysics

De Rerum Natura (On the Nature of Things) is a six-book philosophical poem written by the Roman poet Lucretius (c. 99–55 BCE) to introduce Greek Epicurean philosophy to a Roman audience. Drawing on the teachings of the Greek philosopher Epicurus (341–270 BCE), Lucretius explains the nature of the universe through natural causes, arguing that all things are composed of invisible primary constituents moving in the void.

Albert Einstein, in his foreword to Hermann Diels' 1924 translation of *De Rerum Natura*, admired Lucretius for his conviction that nature could be understood through reason and causal relationships. Einstein regarded *De Rerum Natura* as a lasting example of a scientific worldview grounded in observation, rational inquiry, and the search for natural explanations of the physical world (O'Rourke, 2020). A century later, modern studies of complex systems, exemplified by the work of Giorgio Parisi (the 2021 Nobel Prize in Physics), continue to investigate how large-scale structures and behaviours emerge from the interactions of simple constituent elements.

Although Lucretius' "atomistic" theory differs fundamentally from modern scientific knowledge, his central question remains relevant to contemporary biophysics:
- how do invisible constituents give rise to observable structures and processes?

Bailey (1940) writes that in Book I Lucretius argues for the existence of infinitely many "atoms" moving within infinite space and maintains that the formation of the world resulted not from divine planning but from the natural interactions of these elementary particles. He emphasizes that Lucretius possesses a remarkable ability to convert philosophical argument into visual imagery, allowing abstract concepts to be perceived almost as concrete pictures.

In *De Rerum Natura*, Lucretius explains the visible world through the interactions of unseen constituents (examples: *semina rerum* and *corpora prima*) moving within the void (inane). His attempt to explain visible phenomena through invisible entities resonates with modern efforts to visualize tiny particles and microscopic structures in biological samples. Modern biophysics similarly investigates how atoms, molecules, membranes, and extracellular vesicles organize into increasingly complex biological systems. While separated by more than two millennia and based on different scientific frameworks, both approaches seek to understand how complex forms emerge from simpler underlying constituents.

1.2. Carmen Philosophicum: Book I

Drawing on Book I of *De Rerum Natura*, the author presents *Carmen Philosophicum* as an original musical interpretation of Lucretius' philosophy. The composition is based on a poetic adaptation of William Ellery Leonard's English translation of the summary of Book I and incorporates selected passages from Lucretius´ original Latin text, intentionally inserted in the poem in English language. Drawing on Book I of De Rerum Natura, the author presents Carmen Philosophicum as an original musical interpretation of Lucretius' philosophy. The composition is based on a poetic adaptation of William Ellery Leonard's English translation of the summary of Book I and incorporates selected passages from Lucretius' original Latin text, intentionally inserted into the English-language poem.The work is presented under the artistic name Aleona von Sultanova and is available on YouTube as Book I. De Rerum Natura by Lucretius): https://www.youtube.com/watch?v=47jhNO0_8IE *Carmen Philosophicum* was developed within a STEAM (Science, Technology, Engineering, Arts, and Mathematics) framework and integrates three interconnected components: Mu-sic-Poetry-Digital Visualisation (described in Methods).

Together, all these components explore the research question of how simple elements combine to generate complex meaning and structure. Although the philosophical foundations of Lucretius and the symbolic tradition of *Splendor Solis* differ, both provide frameworks for understanding how visible forms emerge from underlying invisible principles.

Although Epicurus and Lucretius are often described as materialists (see, for example, Masi and Verde, 2024; Galloway, 1986), they did not deny the existence of the gods. Rather, they rejected the notion that the gods intervene in the affairs of the world, maintaining instead that divine beings exist in a state of perfect tranquility, detached from human concerns and natural processes. Lucretius' *De Rerum Natura* opens with a celebrated *Hymn to Venus*, in which Venus is invoked not merely as the Roman goddess of love but as the generative force of Nature itself. This poem attracted the attention of John Evelyn, an early

Fellow and founding member of the Royal Society, who in 1656 published An Essay on the First Book of T. Lucretius Carus De Rerum Natura (Evelyn). According to Butterfield (2015), Evelyn's translation formed part of the early modern rediscovery of Lucretius. Significantly, the First Book contains both the famous invocation to Venus and the poem's foundational philosophical arguments concerning nature, matter, and the structure of the universe.

Inspired by Lucretius' *Hymn to Venus*, this composition was first written and performed in October 2024 as a musical introduction to Book I of *De Rerum Natura* during the Socratic Lectures Symposium. It later became part of the broader philosophical-musical project *Carmen Philosophicum*, which was presented at the *European Joint Theory/Experiment Meeting* on Membranes on 28 January 2026 alongside another STEAM-related composition, Architecture of the Invisible: Membranes.

1.3 Symbols in Words and Images: Lucretius´ Invisible Particles and the Imagery of Splendor Solis

Epicurus adopted the Greek concept of atomos ("indivisible" or "uncuttable" particle; from a- = "not" and tomos = "cut"). Lucretius, however, does not use the Greek term *atomos* and prefers a variety of philosophical Latin expressions to describe the fundamental constituents of reality: *semina rerum* ("seeds of things"), *corpora prima* ("first bodies"), and *primordia rerum* ("first beginnings"). He also occasionally uses broader or more poetic expressions such as materies ("matter") and genitalia corpora ("generative bodies"). Through this diverse vocabulary, Lucretius emphasizes not only the material nature of these invisible constituents but also their generative role in producing the observable world.

"*Splendor Solis*" is employed by the author of this paper as a visual interpretation of Lucretius' "semina rerum". The symbolism of *Splendor Solis* lends itself naturally to this reading. The manuscript repeatedly depicts: hidden processes, transformation of matter, emergence of new forms, cycles of dissolution and recombination, relationships between microcosm and macrocosm. "Splendor Solis" seems to be identical with that of the 22 keys of the Tarot, and they observe the same order, and it "has both a Physical-Alchemical, and a Spiritual-Mystic meaning" (Trismosin, & Godwin, 2021, pages 8-9).

Among the images of *Splendor Solis*, the peacock may be interpreted as a visual analogue of Lucretius' *semina rerum* (Figure 1, Table 1). In alchemical symbolism, the peacock represents transformation and the emergence of complexity from hidden processes.

The multitude of colours generated from a single living form reflects the transition from simple elements to complex structures. The presence of musical instruments further reinforces the idea of harmony and organisation, suggesting that invisible principles may generate both visual and musical order. In this respect, the image also provides a symbolic response to our research question:

"How do simple elements combine to generate complex meaning and structure?"

According to Dovgiĭ et al. (2015) in the Christian tradition the peacock was associated with immortality, in alchemy it symbolized the attainment of the Prima Materia (First Matter) and the successful completion of the first stage of the Great Work (Magnum Opus or Great Work).

This can create a bridge to Lucretius: semina rerum - as the invisible origins of visible forms and Prima Materia as the original substance from which transformation proceeds. Thus, Peacock (Cauda Pavonis) symbolizes as the emergence of multiplicity, colours, and complexity from an underlying process.

In the Image of *the Peacock* there are depicted musical instruments connecting all three components: Poetry - meaning, Music - harmony, Image - visual structure. Trismosin & Godwin (2021, p.18) notes that "Art produce extraordinary things", and "out of the aforesaid natural beginnings such as Nature of herself would never be able to create". "For unaided Nature does not produce things whereby imperfect metals can in a moment be made perfect, but by the secrets of our Art this can be done. Here Nature serves Art with Matter, and Art serves Nature with suitable Instruments and method convenient or Nature to produce such new forms".

Figure 1. According to Trismosin & Godwin, 2021 p. 57), inside the Cucurbit there is the painted peacock who is looking down upon a group of musicians: "one of them is playing a guitar, and another a viol; a lady dressed in red and gold also is playing a viol, while another lady in blue and gold and one in yellow and gold are singing a concert". Among the images of Splendor Solis, the peacock may be interpreted as a visual analogue of Lucretius' *semina rerum*. The presence of musical instruments further reinforces the idea of harmony and organisation, suggesting that invisible principles may generate both visual and musical order. In this respect, the image also provides a symbolic response to the research question: How do simple elements combine to generate complex meaning and structure?

Table 1. From Simple Elements to Complex Structures: A Comparative Model across Lucretian Philosophy, Language, Music, Visualization, and Biophysics

Elementary principle Generative principle	Structured combination Fundamental constituents	Emergent form Observable world
Semina rerum (seeds of things)	Corpora prima (primary bodies)	Res (Visible bodies/forms or Realities)
Letters	Words	Poem
Notes	Melody	Music
Pixels	Image	Visualisation
Atoms/Molecules	Microscopic biological structure (cells/membranes/vesicles)	Biological systems

2. Methods

2.1. Stories based on Music about Heritage SMH and Stories based on Music about Science (SMS) Methods

The SMH and SMS methods were introduced in 2012 year by Istileulova Yelena.

2.1.1. SMH

"Carmen Philosophicum" is written on the basis of the STEAM approach (Science, Technology, Engineering, Arts and Mathematics), using one of the author's original methods - SMH (Stories based on Music about Heritage — a historical, cultural, and scholarly framework). This method, developed in 2012, comprising three elements:

1. Music – an original composition;
2. Poetry – a concise poetic adaptation and summary of Book I of De Rerum Natura, reflecting Lucretius' concepts of semina rerum ("seeds of things"), corpora prima ("first bodies"), and inane ("void"), the literary and scientific heritage of antiquity;
3. Image or Visualisation of the main idea.

Digital Visualization is interpretation inspired by Splendor Solis, a sixteenth-century illuminated manuscript attributed to Salomon Trismosin, employed as a cultural and symbolic framework for representing hidden processes, transformation, and the emergence of visible forms from invisible constituents. Poem - De Rerum Natura - on the nature of the atom. Book I of Lucretius in translation from Latin - is a literary and scientific heritage.

2.1.2. SMS

In the context of Carmen Philosophicum, the emphasis is placed primarily on concepts derived from modern science and their relationship to Lucretian philosophy. In other SMS projects, the author has also employed the related framework Stories based on Music about Scientists. Like SMH, SMS is built upon three core components: storytelling (poetry), original music, and digital visual imagery.

Describing the method in greater detail, Istileulova (2024, p. 141) outlines the conceptual framework of SMS (and SMH) as follows

In the context of *Carmen Philosophicum*, the emphasis is primarily made on the concepts of modern science. In other SMS projects, the author has also employed the framework Stories based on Music about Scientists. Like SMH, SMS is based on three key elements: Storytelling (poetry); Original music; Digital visual imagery. In Istileulova (2024, p. 141), the method is described in more details. In fact, the SMS (also SMH) method has the following conceptual framework:

1. Research about the scientist of the Past time
2. Story about a Scientist-Polymath of the Past time (mainly, the 17-th -20-th centuries)
3. Key idea of Scientific Innovation, or inspiring facts from the life of Scientist
4. Lyrics (a): written based on research)/or by Scientist himself or construction of the key shorter version
5. Music (supporting the idea of lyrics)
6. Visual Arts (digital images /pictures, video, etc.) to explain the key ideas to those who do not understand the original languages of lyrics (English, Russian, Slovenian, or Latin).
7. Performance (for example Socratic Lectures Symposiums, and other scientific events)

3. Results

These are quintessential Book I: "Semina rerum. Corpora prima." "Bodies and the void" "But from nothing nothing comes, Nor to nothing things return.". The musical component is represented by the author's composition, Carmen Philosophicum (created under the artistic name Aleona von Sultanova), presented here: https://www.youtube.com/watch?v=47jhNO0_8IE

While Lucretius is commonly associated with ancient atomism, his preferred expression semina rerum ("the seeds of things") suggests a broader conception of invisible generative entities underlying the visible world.

This metaphor provides a productive framework for contemporary STEAM interpretations linking ancient natural philosophy with modern scientific visualization.

The text of the adapted poem "Carmen Philosophicum":

Lightnings pass through walls of stone,
Iron whitens in the flame,
Rocks ignite and burst apart,
Gold dissolves, yet stays the same.
Warmth and cold through silver creep,
Bronze turns liquid, fire wins—
All we touch and all we see
Shows no solid form within.
Yet true reason calls us back:
There must be something standing fast —
Bodies firm and everlasting,
Seeds from which all forms are cast.
Semina rerum. Corpora prima.
Semina rerum. Corpora prima.
Twofold is the nature known,
Different utterly in kind:
Body stands, and space receives,
One is mass, the other blind.
Where there is the empty place,
Body cannot dwell inside;
Where the body holds its ground,
There the void itself must hide.
Corporibus atque inani.
Bodies and the void remain.
Corporibus atque inani.
Bodies formed in endless plane.
Only where the void resides
Can a thing be crushed or torn;
Fire and cold and seeping damp
Break what space has let be born.
More the void a body holds,
More it trembles, more it bends—
What is solid without void
Never breaks and never ends.
If the primal seeds were not
Everlasting, firm, and sure,
Long ago all things had fallen
Back to nothing, cold and pure.
But from nothing nothing comes,
Nor to nothing things return—
Thus the seeds of all that is
Hold immortal frame and form.

The poem follows the logical progression of Book I: Observation of physical change (lines 1–12), Inference of invisible permanent constituents (lines 13–20), Doctrine of body and void (lines 21–36), Explanation of change through void (lines 37–48), Necessity of eternal first bodies (lines 49–56), The principle that nothing comes from nothing and nothing returns to nothing (lines 57–64)

3.2. De Rerum Natura and the Concept of Invisible Particles

Democritus (5th–4th century BCE) was one of the founders of ancient atomism. He proposed that all matter is composed of indivisible constituents moving through empty space (the void). Epicurus (341–270 BCE) further developed Democritus' atomistic theory and incorporated it into a broader philosophical system aimed at explaining nature through natural causes rather than divine intervention. Although most of his works have been lost, written in Ancient Greek, some fragments survive through later sources, particularly the writings of Diogenes Laertius and the Herculaneum papyri.

Finally, Lucretius (c. 99–55 BCE) transmitted Epicurean philosophy to the Roman world through his Latin didactic poem *De Rerum Natura* ("On the Nature of Things"). While the

philosophical foundations derive from Epicurus, Lucretius reinterpreted them in poetic form, employing expressions such as *semina rerum* ("the seeds of things"), *corpora prima* ("the first bodies"), and *primordia rerum* ("the first beginnings") to describe the invisible particles underlying the visible world.

These expressions more accurately reflect Lucretius' own language and philosophical imagery. From the author's perspective, these concepts offer a broader interpretive framework than the modern notion of the atom, allowing for multiple representations of invisible generative structures and different stages in the formation of visible reality.

The poem *Carmen Philosophicum* (see Results) was conceived as a concise poetic adaptation of Lucretius and is based primarily on Book I. Most of the poem is devoted to the fundamental doctrines. In the present study, the original Lucretian terminology is retained rather than replaced by the modern term "atom".

The author of this paper used the original Lucretian terms rather than the modern translation of "atoms". Lucretius' own expressions fit this interpretation much better than the modern word "atom", because from the position of the author it shows different and rich variations and different stages of the "seeds".

3.3 Visualisation

Splendor Solis is regarded as one of the most famous alchemical manuscripts. According to Völlnagel (2011), its miniatures are among the most beautiful and best-known images in the history of alchemical illustration. At the same time, despite its prominence within the Harley Collection and the broader tradition of alchemical manuscripts, many aspects of the work remain uncertain, and comparatively little critical research has been devoted to its historical and symbolic interpretation (Völlnagel, 2011). While Splendor Solis does not represent atoms or microscopic particles in a scientific sense, it provides a rich symbolic language for visualizing invisible processes of transformation and generation. In this respect, the manuscript serves as a visual analogue to Lucretius' concept of *semina rerum*, offering an artistic framework through which hidden structures may be imagined and interpreted (Figure 1).

4. Discussion

Thus, we return to a fundamental question: how do invisible constituents give rise to observable structures and processes? Historians of philosophy commonly describe Lucretius as an atomist. Yet Lucretius himself frequently employs more poetic expressions such as semina rerum ("seeds of things"), corpora prima ("first bodies"), and genitalia corpora ("generative bodies") to describe the invisible constituents underlying the visible world. Although these concepts are related to ancient atomism, they should not be uncritically equated with the modern scientific concept of the atom.

Indeed, some scholars prefer not to translate semina rerum simply as "atoms," since the phrase "seeds of things" more accurately reflects Lucretius' own imagery and philosophical vocabulary. The metaphor of the seed evokes generation, growth, emergence, and hidden potential. For a classicist, semina rerum signifies the invisible origins of visible things. From a contemporary scientific perspective, the same idea may resonate with atoms, molecules, cells, membranes, extracellular vesicles, and other microscopic entities that participate in the formation of increasingly complex structures. While ancient atomism differs fundamentally from modern science, Lucretius' notion of unseen constituents provides a useful philosophical starting point for contemplating how visible forms emerge from invisible foundations. Lucretius imagined invisible generative principles (semina rerum, corpora prima); modern chemistry identifies atoms and molecules as fundamental building blocks of matter, while modern biology demonstrates how molecules organize into membranes, cells, and complex living systems.

The author further proposes that Lucretius' expression genitalia corpora may be interpreted as reflecting a multilevel process of generation and differentiation. Although Lucretius employs the term primarily in the sense of "generative bodies" or productive constituents of nature, the symbolic perspective adopted in this study invites a broader interpretation. The transition from primordial unity to differentiated forms may be viewed symbolically through the emergence of complementary principles, often represented in later alchemical traditions by male and female figures. Although such an interpretation is

not explicitly present in De Rerum Natura, it provides a conceptual bridge between Lucretius' generative vocabulary and the visual symbolism of Splendor Solis, where transformation and creation are frequently depicted through the interaction of masculine and feminine elements.

In De Rerum Natura, *semina rerum* refers to the generative principles from which all forms arise, while corpora prima denotes the fundamental constituents of matter. Through their combinations, arrangements, and movements, these invisible elements give rise to res ("things"), namely the visible forms and structures perceived in nature. In the present study, these Lucretian concepts serve as a conceptual model for understanding how simple elements combine to generate increasingly complex forms, meanings, and systems across language, music, visual representation, and biophysics.

Table 1 illustrates a common principle across the domains examined in this study: simple elements combine to generate increasingly complex forms. In Lucretius' philosophy, *semina rerum* and *corpora prima* give rise to *res*, the observable world. Similar patterns can be seen in language (letters–words–poem), music (notes–melody–music), visualization (pixels–image–visualization), and biophysics (atoms and molecules–cellular structures–biological systems). Although these domains differ in their nature and mechanisms, they share the idea that complex forms emerge from the organization and interaction of simpler constituents.

5. Conclusions

Lucretius proposed that nature operates according to laws, that natural phenomena arise from natural causes, that invisible structures underlie visible reality, that matter consists of fundamental constituents, and that the universe can be understood through reason and inquiry. These principles remain central to science today. The research question—How do simple elements combine to generate complex meaning and structure?—operates on several levels within the project.

In Lucretius' philosophy, invisible primary constituents (semina rerum, corpora prima) combine to form the visible world. In language, individual letters combine to create words and poetic meaning. In music, individual notes form melodies and harmonic structures. In digital visual media, symbols and images generate complex interpretations. The poem therefore functions not only as an adaptation of Lucretian atomism but also as a demonstration of the same generative principle across science, art, and culture: complex structures emerge through the combination and organization of simpler elements.

The present study focuses primarily on Book I of De Rerum Natura. Future research may extend this approach to Book II, exploring how the same research question can be investigated through the SMS and SMH methodologies within a STEAM framework.

Conflicts of Interest: The author declares no conflict of interest.

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