

Literature and Mathematics: An Attempt at an Inter-Thematic Analysis of Apostolos Doxiades' Novel Uncle Petros and Goldbach's Conjecture

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Introduction

This paper attempts an inter-thematic analysis of the book *Uncle Petros and Goldbach's Conjecture*. The paper constitutes only an introduction to a theme that is both huge and relatively new in the field of literature. The messages come from both nationally and internationally distinguished mathematicians who have occupied themselves with the writing of a significant number of books (both novels and poetic collections). Indicatively we refer to *Wild Numbers* by the Dutch writer Philibert Schogt, *Turing's Smile* by Christos Papadimitriou, along with *Uncle Petros and the Goldbach's Conjecture*. These works create an imposing ornamentation of imagination and aesthetics, in which a new literary language, inoculated with the signifiers of pure numbers, mathematic terms, and famous mathematicians' names, indicates a cosmogonic universe wherein is formulated an icon of a different world; a world that is characterised by the magic and ecstatic yearning for the unknown and the endeavour to grasp the ungraspable – by the common mind – conceptualisation of life. The literary dimension signifies a texture of mathematical narration where mathematics become an aesthetic piece of art by means of its transubstantiation into a literary narration. Thus, this paper, by referring to Doxiades's book *Uncle Petros and Goldbach's Conjecture*,

tries to designate a possible relationship and connection between literature and mathematics.

Literature and Mathematics: An Attempt for Coexistence

I would like to state from the outset that mathematics is not my field of expertise, nor my area of study. Having said that, however, I still retain the best recollections of studying Pythagoras' theorem, and the fascination of a successful solution to third degree equations has not left me. In short, my enchantment with logic has not abated. These mathematic interests of my own, nevertheless, are nothing when compared to the gigantic achievements of the mathematical theorems (and their solutions), with which great mathematicians, such as the author of *Uncle Petros*, are engaged. Thinking about it during the research process and subsequent writing of this paper created both mixed feelings and contrasting thoughts within me. On the one hand I felt a strong sense of panic which made me at times cease my endeavours, a sensation which mainly sprang from the strong realisation that I had entered a field of total unknowns, a field which was simultaneously a very fascinating place. This latter sensation is what ultimately attracted my interest and spurred me on to experience what this different world had to offer. A simple thought propelled me to proceed: if the authors of this particular literary genre create an art-form for mathematicians only, or readers only initiated in the field of mathematics, then it would not be necessary for them to create a literary text. Instead, they would simply publish another mathematical theorem and be done with it. Therefore, I surmised, this particular literature with a mathematical context and approach is for people that would not necessarily be mathematicians (like the author of this article, for example).

Personal concerns aside, this paper attempts to indicatively state the inter-thematic relationships between mathematics and literature by exploring Apostolos Doxiades's book, *Uncle Petros and Goldbach's Conjecture*. It must be noted that this particular book is the creation of a mathematician who, by fifteen years of age, had already studied mathematics at university level. The author, despite being an ideal expert in the field of mathematics, decided to transmute his personal fascination with numbers and mathematical theories into an artistic medium, employing literary techniques as opposed to purely scientific ones. He seems concerned with nullifying the phobia, the general dislike and the awe that mathematics engenders in most people from a very young age, and to re-address the Platonic maxim - *People that are ignorant in Mathematics are*

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not permitted in my school - by making mathematics more accessible to a wider reading populace.

Doxiades' literary technique succeeds in introducing readers to the mysterious and philosophical world of numbers in such a way as to give the opportunity to the uninitiated reader to enter the unknown and mystical sphere of mathematics. Apparently, he tries to show that numbers are not simply empty forms or shapes which are used for practical ends and characterised by their applicability to those ends, but rather supports the fact that numbers hold universal energies and dynamics that occasionally have no intellectual barriers. It is obvious that by giving mathematical dimensions to literary genre he has widened its limits immensely and has directed it towards unforeseen experimental paths.

However the appearance of numbers in art, poetry or prose, and even music, is not an entirely new phenomenon. Within the Greek literary sphere, for example, there is the poetry of the mathematician/poet Hector Kaknavatos. Kaknavatos' poetical collection entitled "Chaotic I" constitutes a panorama of poetic signifiers based on a mathematical vocabulary; signs, names and forms which in their totality reflect the philosophy of such contemporary mathematics as the "Theory of Chaos".¹ Even earlier than Kaknavatos' poetry, Odysseus Elytis, in *Axion Esti*, writes about the "virtue with the four right angles" and "the cross edges of Pythagoras's *tetraktys*" – that is, the sum of the four first numbers being ten ($1+2+3+4=10$), a number that has been considered by the Pythagoreans sacred and the source of all divine creations. Elytis demonstrates his deep knowledge of mathematics and the significant relationship between numbers and letters. In his theoretical article "The Method of the Therefore", he analyses mathematics and their aesthetic value in the realm of poetry.² Moreover, in the article entitled "The Divisor K in Contemporary Life", he states that "if Plato has clarified the theory of "eidetic" numbers, who knows, we perhaps could move in the field of aesthetics with more certainty".³

However, the coalescing relationship between letters and numbers has its roots in antiquity. Aeschylus, in his tragedy, *Prometheus*, reminds us that amongst the gifts that were offered to the people were the letters and the numbers. In a similar tone Aeschylus states that "letters and numbers together, first wisdom, I gave to them, both art, mother of Muses, memory of everything" (470-472). According to Morris, ancient Greeks considered

¹ Artemiades, N, *History of Mathematics*, p. 7.

² Elytis, O., *En Leuko*, 5h edition, Ikaros, Athens 1995, p. 165

³ Elytis, *Ibid.* p.187.

mathematics aesthetic creations, like the Parthenon, for example, because mathematics contained the elements of harmony, clarity, simplicity and order⁴.

The ancient Greeks identified mathematics with the natural world, and they demonstrated that, through mathematics, the "Truth" could be revealed. They perceived the Universe as a limited entity, which was possible to be both shaped and comprehended through numbers (primarily through the art of geometry). Scholars do not have any doubt today that aesthetics led the Greeks to search and enquire about the space around them, perhaps more so than was considered necessary for their needs, in order, it would seem, to comprehend the natural world. Aristotle, in his *Poetics*, said that nature was dictated by laws that were homologous to the laws that dictated art. Poetics and mimesis, two elements that characterise art, exist in direct connection with nature. Thus, according to Aristotle, poetry is mimesis and mimesis is poetry, which is to say, art and creativity. Creativity, we must keep in mind, is for the Greeks a process which requires the questioning of nature's laws, which, dictated as they are by movement, inevitably lead towards the Truth. Mathematics then, which the Greeks used extensively in order to research nature's laws, is, by necessity and by definition art, like any other creative action, such as literature (poetry and prose) theatre, music and so on.⁵

Uncle Petros: A Platonic Mathematician?

Around the character of "Uncle Petros" Doxiades weaves the whole spectrum of the Greek mathematic tradition, ancient and modern; the evolution of mathematics during the 20th century and the place of Greek mathematicians in that field. The reader feels strongly that the author tries to demonstrate through his own experience the Greek presence in the world of mathematics. He tries therefore to trace, through memory, a line from present towards past, by referring not only to famous ancient Greek mathematicians but also to contemporary ones. Thus, by referring to the Greek mathematician Karatheodory, "Uncle Petros" and himself as Greek mathematician, he alludes to the Greek contribution in the world of mathematics. Additionally, he discloses the mathematician's community and reveals the thoughts, actions and, often, the pettiness, as well as the whole psycho-synthesis, of its body. The narrator-nephew refers back to his own experience as mathematician and, in the process, he concentrates on

⁴ Kline, Morris, *Mathematics in Western Culture*. Oxford University Press. Oxford. 1982, p. 28.

⁵ Aristotle, *Complete Works*. Introduction, by H. P. Nikoloudes, *Ancient Greek Literature*, Vol. 34, (Athens, Kaktos1995), p. 71.

his “uncle” endeavours. Uncle Petros exists in the novel as a mysterious mathematical enigma who quests for a solution in order to reveal and understand his own innate self-existence. In other words, Uncle Petros is a projected self, a psychological mode of research which the narrator uses so as to discover the unexpected sides of human nature. It becomes obvious, though, that Uncle Petros’ physiognomy reflects the author’s own phobias, his crucial choices, his inevitable indecisions and his reservedness regarding the mathematical route he has chosen to follow. The narrator (author-nephew) appears to the readers as an uninformed mathematician, who is himself in need of explanations in order to comprehend mathematical rules and concepts. It is clear however that this is an authorial ruse, a narrative technique employed by Doxiades in order to inform the uninitiated and ignorant reader and allow him/her access into the larger world of mathematics.

Thus, the character of Uncle Petros, who is characterised as an early mathematical genius during the first decades of the 20th century, excels in the most significant European universities. In the context of university life, Uncle Petros experiences a failed love affair, which he transubstantiates into his extensive ambition of solving the hypothetically unsolvable mathematical conjecture. His wounded ego finds solace in the space that he is most familiar with, namely, mathematics. His failed love is a powerful physical feeling almost akin to death - “as strong as death and love” according to Dionysios Solomos⁶ - which Doxiades interprets here as a moving force, a dynamic energy which leads to the realisation of significant achievements. Doxiades demythologises, or, rather, simplifies the “inborn” talent myth postulated by Aristotle, by alluding to those exogenic factors which contribute in equal measure to one’s natural inclination and ultimately assist in the creation of great achievements.

In order to win her heart back, Petros now decided, there could be no half-measures. To impress her at a more mature age he should have to accomplish amazing intellectual feats, nothing short of becoming a Great Mathematician.⁷

So, in this way, Uncle Petros decides to be “the greatest mathematician of the world” by solving one of the most difficult mathematical problems: Goldbach’s Conjecture. But what is Goldbach’s Conjecture? Christian Goldbach, a Prussian mathematician, first proposed the conjecture that

⁶ Dionysios S., *Apanta*. Edit. By Politis L., 5th edition (Ikaros, Athens, 1986), p. 205.

⁷ Doxiades, *Uncle Petros and Goldbach’s Conjecture 26th Edition (Kastanotes, Athens, 2001)* - Greek Edition, author’s own translation- p. 94.

troubled his mind in a letter to the Swiss mathematician Leonard Euler in 1742. In the letter, he claimed, first, that “every even natural number is equal to the sum of two prime numbers”, and, second, that “every natural number greater than two, even or odd, is equal to the sum of three primes”. Although the first conjecture has been verified for all even numbers up to 100,000 and some beyond, no definitive proof for it has been found until now (I. M. Vinogradov presented partial proof of the second conjecture in 1937).⁸ Uncle Petros, however, was attracted by both the “combination of external simplicity and the notorious difficulty” involved in the conjecture, facets which for Uncle Petros “pointed of necessity to a profound truth”⁹.

Brought up with a traditional mathematical education in numbers, Uncle Petros followed the method that had been tried and tested by the ancient Greeks, namely the geometric model. According to this model, the conjecture, having been conceptualised in a limited universe and expressed as a true mathematical hypothesis, presupposes by its very nature a solution. Should Uncle Petros successfully solve Goldbach’s Conjecture, will it lead him to a Platonist vision of the Truth or, conversely, is Doxiades trying to suggest the theory of the “Mandelbrot Set”, according to which a schism exists within the mathematical community, with the Platonists on the one hand and the anti-Platonists on the other?¹⁰ Artemiades has much to say concerning the anti-Platonic and Platonic trends that partially characterise the realm of mathematics. According to Artemiades, Platonic mathematicians support the “metaphysical” study of mathematics, which questions the existence of abstract objects, above time and place. Objects such as these are neither natural nor spiritual, nor do they constitute a cause of existence. The theoretical framework and the belief that such objects exist are one of the underpinnings of Platonism.¹¹ Platonism, sustains the idea that human thought aspires towards an exterior “truth” that has, on the one hand, independence from mankind, and, on the other, an objective existence which is revealed only to a select few. That is to say those theorems and their solutions exist independently, and their revelation by only a few talented mathematicians constitutes a “genius accident”. It seems then that even Uncle Petros belongs to this category: He believes that he has the abilities – he wants to be a great mathematician to impress his lover – to discover the Absolute Truth, by finding the solution to Goldbach’s Conjecture. He believes that since it has been expressed, its solution exists somewhere in the intellectual universe.

⁸ The New Encyclopedia, 15th edition (by Encyclopedia Britannica, Chicago, 2003) p. 338.

⁹ Doxiades, A., *Uncle Petros and Goldbach’s Conjecture* (Greek edition, 2001), p. 95.

¹⁰ Artemiades, N. *History of Mathematics*, p.6 p. 7.

¹¹ *Ibid.* p.6.

The process of solving the Conjecture, however, could be related in the process to revealing the psychology and psycho-synthesis of Uncle Petros. To this end, the narrator, re-examines Uncle Petros' mental undulations, his anxieties, his weakness, his doubts and the painful and absolute loneliness instigated by his quest for a solution as well as the spiritual ecstasy that vitalises the human mind, like the discovery of one more "truth", not to mention the social satisfaction and pride that such a discovery promises. Both satisfactions are complementary to one other or, better yet, exist in a dialectic relationship with each other. This relationship reveals elements of human nature hitherto unknown, and proves that people are multi-layered entities whose minds have the ability to work on multidimensional levels and travel into unknown realms of their own universe. The paths of the mind according to most mathematicians, however, are only lightened with the examination of the mathematical truths, "not a crystal, even if it is very clear and limpid, is able to be as bright and transparent as the mathematical truth".¹²

The grand resplendence of the mind, however, comes from young people: "in the history of Mathematics, no significant achievement ever took place from people over thirty years of age" says the narrator¹³. According to Doxiades, it is young people – for whom youth passes only far too quickly – who find delight in the realm of mathematics and athleticism. Moreover, it is talented young people who have the ability to conceive, with amazing rapidity and incomparable acuteness of mind, theorems and their solutions. Uncle Petros knows this only too well, for despite being only 24 years of age when starting out, he was already very eager to attain the height of mathematical success which a successful career in mathematics would bring. To this end, he dedicates his early years of scientific exploration hunting for the revelation of an absolute truth, that is, the solution of a conjecture. In this process, Uncle Petros experiences intense psychological changes and, through them, the narrator probes his Uncle's personality further while simultaneously taking the opportunity to demythologise some stereotyped opinions that usually govern the field of mathematics. Through this introspection into Uncle Petros, Doxiades shows us that Uncle Petros does not constitute an exception. As a literary figure he is a portrait of both himself and of the wider scientific community. Goldbach's Conjecture becomes an obsession for him, a vaulting-block to be used in order to discover the "Absolute Truth". As the novel progresses, he grows ever more suspicious about his colleagues, a

¹² Philibert Schogt, *Wild Numbers*, trans. T. Michealides (Athens: Polis, 2001), p. 105.

¹³ Doxiades, A., *Uncle Petros and Goldbach's Conjecture* (Greek edition, authors' translation). Kastaniotis, 26th edition, Athens, 2001, p. 108.

state triggered by his fear of being beaten to the solution and losing the glory which he believes belongs to him. The inevitable result is that we soon find him hovering on the threshold of paranoia. On the other hand, the anxiety that characterises the creative process, the trials and tribulations and doubts as to whether he really is a genius with the potential to become a famous mathematician, are elements that alludes more or less the natural state of the human conscience, regardless of an individual's field of research and scientific background.

In time, numbers gradually pass deep within Uncle Petros' subconscious. The hyperactivity of his mind finally begins to influence his entire emotional universe. The numbers revive, break out from their limited barriers and lodge themselves in the labyrinthine thalamus and hypothalamus of his mind; his sleep descends into a nightmare as horrific icons march around in his dreams. Numbers are no longer simple shapes, but "anthropoid beings", "odd icons", "hermaphroditic elements", which hunt Uncle Petros and ask him for release. They speak, however, in ancient Greek, "they honoured Euclid, because he gave them the infinity".¹⁴ It is obvious that Uncle Petros is very close to paranoia, a situation that is a sad reality in the field of science. A similar situation is narrated in the book *Wild Numbers*, where the narrator has great difficulties defining the line between logic and paranoia;¹⁵ close to these cases is the cinematographic event of *A Beautiful Mind*, as well.

Uncle Petros, however, was not distracted at this point in time by such things. He was prevented from heading down this path because of Godel's Incompleteness Theorem. This theorem, which for many mathematicians essentially meant the end of mathematics as they knew it, states that arithmetic and all mathematical theories are not complete, thus "every unproved statement can in principle be unprovable" therefore "truth is not always provable".¹⁶ This theorem - which is just a theory, existing as long as it takes for another mathematician to overturn it - shook Uncle Petros' certainty about Goldbach's discovery, rendering it null and void due to its improbability. Following this revelation, Uncle Petros' resignation is complete and since then he considered by his relatives, except the nephew-narrator, as a failure.

The Incompleteness Theorem doubts the way that ancient Greeks expressed the existence of "Absolute Truth" or other eternal truths. Largely as a result of this, the theorem did not influence everybody's mathematical

¹⁴ Doxiades, *Uncle Petros and Goldbach's Conjecture* (Greek Edition, 2001), p. 133

¹⁵ Schogt, *Wild Numbers*.

¹⁶ Doxiades, *Uncle Petros and Goldbach's Conjecture* (Greek Edition, 2001), p. 191.

studies. Most mathematicians do not search for the “Platonic” eternal truth, but rather they remain satisfied with the seeking of various smaller “truths”, by following less painful processes. Uncle Petros’ dogged persistence, on the other hand, for the discovery of the eternal truth, leads him towards arrogance, which, in turn, provokes punishment. This is the general interpretation that the reader acquires through the recording of various facts, including a sad list of names of famous scientists who died young or became insane, perishing in the psychiatric clinics.¹⁷ Scientific arrogance is the equivalent of *hubris*, and, as a result, *nemesis* inevitably manifests itself in the form of either death or insanity and sometimes even both, as in the case of Uncle Petros. In the book we read:

Godel’s insanity – for unquestionably he is in a certain sense insane – is the price he paid for coming too close to Truth in its absolute form. In some poem it says that “people cannot bear very much reality”, or something like that. Think of the biblical Tree of Knowledge or the Prometheus of your mythology. People like him have surpassed the common measure; they’ve come to know more than is necessary to man, and for this hubris they have to pay.¹⁸

Is Uncle Petros a tragic hero, like his ancestor Prometheus, who was commanded by Fate to approach within breathing distance of Truth and yet dared not touch it? Is the Incompleteness Theorem a pretext in order to avoid it? These questions remain unanswered. Towards the end of the book, the nephew/narrator transubstantiates himself into the form of Divine Justice and intervenes in order to illuminate Uncle Petros’ two halves, the mysterious mathematical personality and the equally dense psycho-spiritual existence. Uncle Petros is provoked into a final estimation of his own self, at which point he admits his weakness.

The perfectly structured justification for the Incompleteness Theorem collapses by carrying away his already fragile psychological resistances. When his arrogance disappears, Truth is released and becomes manifest in her ecstatic and transparent simplicity. After a painful voyage into the field of theoretical mathematics, at the end of the novel we have one more attempt at a solution for the Conjecture. Uncle Petros, unexpectedly, in a moment of ecstatic revelation, he touches the *Truth*. The Conjecture at the very end is painfully simple: “So simple, so simple my child! How come so many years, so infinitely years, I wouldn’t realise how superbly simple it

¹⁷ Doxiades, *Uncle Petros and Goldbach’s Conjecture* (Greek Edition, 2001) p. 227.

¹⁸ *Ibid.* p. 222.

is!”¹⁹ The revelation of such a simple (and ultimately powerful) truth leaves Uncle Petros speechless. The psychological vibration caused by the revelation is so strong that it provokes his death. We, the readers, do not learn about the solution to the Conjecture. It forever remains, both literally and symbolically, a conjecture. The solution to it, when finally discovered, will verify once more the Universe’s mathematical, structural repercussion. As for “Uncle Petros”, he lived until the very end of his life in the dream of one conjecture. Whether Uncle Petros really discovered the solution of the conjecture towards the end of the novel or not does not make any difference. Probably it is better that it stays just a conjecture, because it gives both the mathematicians in the real world, and the readers in the field of literature, a spiritual, entertaining trip.

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¹⁹ *Ibid.* p. 280