A VOYAGE INTO THE LITERARY MATHEMATICAL UNIVERSE

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ABSTRACT

This paper sketches a joint history of the mathematics and literature of the western world, from the perspective of our modern times. As we progress along our road, we shall comment on literary processes (literal insertions, analogies, mathematical structures, characters doing mathematics) and on how literary art can enhance the motivation for exploring, understanding and memorizing mathematical concepts.

First stop: in a Greek theatre of the fifth century B.C.E.

Mathematics, to the best of my knowledge, makes its entrance onto the western literary stage in the Greek theatre of the 5th century B.C.E. Someone called Meton appears, encumbered with his instruments: a compass and a flexible ruler. He offers his services to Pisthetairos, one of the principal characters of *The Birds* (414 B.C.E., Aristophanes). This Athenian, weary of his city rotted by corruption and demagogues, has decided to create another town (Νεφελοκοκκυγία, Cloudcuckooland) in the sky, with the help of the birds.

P I S T H E T A I R O S[1]
For heaven's sake, who are you?
M E T O N *[s h o c k e d]*
Who am I? I'm Meton, famous throughout Greece and Colonus.
P I S T H E T A I R O S
What are these things you've got?
M E T O N
Rods to measure air. You see, the air is, in its totality, shaped like a domed pot cover. . . Thus. . . and so, from up above I'll lay my ruler. . .it bends. . .thus. . Set my compass inside there. .You see?
P I S T H E T A I R O S
I don't get it.
M E T O N
With this straight ruler here I measure this, so that your circle here becomes a square—and right in the middle there we have a market place, with straight highways proceeding to the centre, like a star, which, although circular, shines forth straight beams in all directions . . . Thus . . .

[1] Aristophanes, *The Birds*, Translation by Ian Johnston, 2003, on line.

P I S T H E T A I R O S
This man's a Thales !

Pisthetairos immediately chases off after this charlatan, just as he had previously chased off after a poet and a prophet. Meton disappears from the scene once and for all.

So what do we find in this popular comedy written in 414 B.C.E.? A reference to Meton, an astronomer (which gave his name to a famous astronomical cycle, circa 432 B.C.E) and to Thales, who lived at least a century earlier, appearing here in his capacity as a paradigm of geometry. Note that another century will elapse before the arrival of Euclid.

Although it is doubtless too farfetched to see an allusion to the quadrature of the circle in the above, nevertheless problems of comparison of perimeters or of ruler and compass constructions can be read into it. If the public found this amusing, it was because there was already a strong mathematical culture.

Twenty-five centuries later: A discussion occurs during a meeting of the Transnoctial Discussion Group in the novel by Thomas Pynchon *Against the Day*, 2006. This group will never appear again.

"Time moves on but one axis," advised Dr. Blope, "past to future—the only turnings possible being turns of a hundred and eighty degrees. In the Quaternions, a ninety-degree direction would correspond to an *additional axis* whose unit is $\sqrt{-1}$. A turn through any other angle would require for its unit a complex number."

"Yet mappings in which a linear axis becomes curvilinear—functions of a complex variable such as $w = e^z$, where a straight line in the z-plane maps to a circle in the w-plane," said Dr. Rao, "do suggest the possibility of linear time becoming circular, and so achieving eternal return as simply, or should I say complexly, as that."

Is this funny? Is the question of linear time being transformed into circular time by functions of a complex variable more understandable by modern readers than that of a circle becoming a square with a bent rule? Pynchon's novels are sprinkled with fragments of culture (not only mathematical, but the list of mathematical themes cited is impressive [Koehler]).

When a text involves terms, expressions, and more or less coherent mathematical statements and names of mathematicians—but without a real relationship to the unfolding of the narrative I will call this literary mode "literal insertion".

The effect of this kind of fragments certainly depends on the readers, and on their mathematical knowledge. They might either be amused, moved, impressed or will simply skip such a digression. This kind of reference only shows that the author has some acquaintance with the subject. The mathematical coherence of a fragment of mathematics cannot be easily determined. Coming back to Aristophanes, different translators have interpreted him differently, some seeking to make the text coherent at all costs.

But so, these fragments can arouse interesting discussions about their coherence or relevance: what can a flexible ruler be used for? Measuring? You could introduce the theme of the rectification of curves. Is a straight ruler (or a straight line) best adapted for work on a sphere? Could Meton have discovered "non Euclidean" geometry before Euclid? In a more general context, the question of "The

Straight and the Curve"[2] has given rise to many works in the history of mathematics. And further, is it necessary to employ quaternions (complex numbers) to give analytical representations of a straight line and a circle? What role does time play in Hamilton's "*Essay on Algebra as the Science of Pure Time*"? If it is a question of modelling time, shouldn't you be interested in its psychological aspect, its speeding up or slowing down, etc.

Such discussions allow for lively teaching in the most interesting way. They let us make concepts precise, bringing the imagination into play, in the double sense of stimulating creativity and creating mental images. Thus we can make mathematics not only more pleasant but also easier to use and to memorize. It also gives an opportunity to enrich everyone's general culture, by making them interested in the mathematical and literary context. In some experiments, after a decent amount of exposure to such ideas students are asked to write poems or short stories[3].

So I am inviting you to take a little voyage to examine some of the tracks left by mathematics in "literary texts" (i.e. all those which are not claimed to be "mathematical texts"). Each of us can trace our own route through the ocean of citations that can be found in our own reading or on the web[4]. A good number of us let ourselves be guided by mathematical themes in order to find examples adapted to our teaching curriculum, but, since we are historians of mathematics, I want to lead you through time (complex!), bringing together mathematics, literature and history. Alas, if I know a little mathematics and a little of the history of mathematics, I know very little of the history of literary cultures other than mine. So this is why I limit myself to here, at the same time asking anyone who wishes, to help me broaden this study.

Second stop: In the world of the Romans and of the Gods of the Vth century C.E.

We don't find much mathematics in the fiction of the Roman World, but, at Carthage Martianus Capella published *De nuptiis Philologiae et Mercurii* (On the Marriage of Philology and Mercury). He recounts here the marriage of the god, Mercury and of the mortal, Philology, whose name speaks volumes for his love of words. For this union she must mount up into the Milky Way. In order to lighten herself, Philology starts by vomiting up books which lie heavy on her breast, but her thirst for Knowledge will be satisfied by her new husband, who offers her seven heavenly teachers, seven young girls who will teach her everything. They present themselves in order: Grammar, Dialectic, Rhetoric, Geometry, Arithmetic, and Harmony. The first three present the three literary areas that Boethius will call the trivium, and the last four the mathematical sciences (quadrivium). This division of knowledge will become the standard formulation of academic learning, right up to the Renaissance.

This work is thus both an encyclopedia and a work of *popularization*[5]. It carefully explains the mathematical knowledge of the author (limited alas), but in a pleasing form: flowery prose, rich in oddities and metaphors, passages versified in many different ways, a mixing of the serious and the grotesque. The objective is to teach while entertaining. It goes back to the Greek concept of σπουδογέλοιον (seriousness under the laughter). As wrote Lucrèce (341-271 B.C.E.) "To make children drink bitter absinthe,

[2]Cf Barbin
[3]Cf Lipsey
[4]See for instance the excellent website : `http://kasmana.people.cofc.edu/MATHFICT/`
[5]I don't like this word, but I didn't find a better one.

begin by coating the rim with pure golden honey".

Mathematics is definitely in a minority among the other sciences in this type of literature, probably because it is difficult to understand mathematics without really doing it. However, this genre is flourishing today. It is a difficult genre for learning mathematics without guidance, but many teachers in the world today use this kind of literature successfully with their students.

The historians of mathematics will be interested in Capella's book : his geometry speaks mainly of geography, and his arithmetic is mainly interested in the "qualitative" properties of numbers. The renewal of western mathematics will not come from this source but from the work of Al Kwharizmi (translated in the XIIth century). Practical arithmetic, in particular, will be revolutionized by the system of decimal place values, by the introduction of "Indian" calculation replacing calculations with the abacus or counters, as Roman numeration is incompatible with the least arithmetical calculation.

Third stop: in a chateau of the Middle Ages

In order to fill in their evenings, noble knights and gentle ladies listened at great length to poems set to music about the exploits of valiant knights, or to short sophisticated poems which sang of a platonic and impossible "courtly" love for a beautiful lady. From the 12th century on, the authors of chivalric poems delighted in playing with large numbers which the new decimal system allowed them to express easily. They also present many artificially concrete, small arithmetical problems which use "The Rule of Three" or "The Golden Rule".[6] This kind of arithmetical calculation will remain common for a long time, for example, in the philosophical tales and satires of the 18th century (e.g. *Gulliver's Travels, Swift, 1726. Micromegas*, Voltaire, 1752). And they continue to be found right up to the present day....in more or less relevant calculations, which also make excellent exercises for young students.

We even see them turn up in the history of mathematics: first of all in French in the great epic poem *Le Roman de la Rose* (Guillaume de Loris et Jean de Meun (1237–1288), then in English in The *Book of the Duchess*, (circa 1370) by Geoffrey Chaucer, who also translated part of *Le Roman de la Rose*. Argus is the Latinized name of Al Khawarizmi.

Old French	*English translation of old French:*[7]	*Old english*
Se mestre Argus li bien **contens** I vo sist bien metre ses cures E venist o ses dix figures Par quoi tout certifie et nombre, Si ne péust-il pas le nombre De grans **contens** certefier Tant seust bien monteplier	If the Master Argus, who is so good at counting/ reckoning Would take care of it And come with his ten figures/ By which he can certify and count everything yet he can't certify the number of big conflicts/ pleasures So good were he at multiplying	That thogh Argus, the noble contour Sete to rekene in hys contour And rekene with his figure ten For by tho figures mowe al ken Yf they be crafty, rekene and noumbre And telle of every thing the noumbre Yet should he fayle to rekene even The **wonders** in my sweven

The French text plays on the word "contens" which can mean pleased, counting, recounting, reck-

[6] Cf Mira

[7] The English translation of all the French texts was made, unless otherwise mentioned, by my friends Stuart et Pam Laird.

oning as an adjective, and conflict, pleasures, happy people as a noun. The English translation must use more words "rekene/ contour", "rekene / noumbre". This property of being both metaphorical and polysemous plays an important role in literature, above all in poetry, but it is evidently closely linked to the language being used. Here we see all the problems posed by translation. I will not labour this point here. In an interdisciplinary study, students can additionally study language and rhetorical effects.

In the previously mentioned *Roman de la Rose*, the author in dealing with expressing countless quantities even introduces the idea of a potential infinity: "it is not wealth which equate to the value of a friend, for it could not attain a level so high that the value of a friend is not higher still."

As for the poets of the south of France, the troubadours, they enjoyed systematically exploring the configurations allowed by the constraints of different versifications. For example, Arnaut Daniel (end of the XII century), invented the "sextine". This poem of six stanzas of six lines uses six rhyming words. The order of their entrance in the stanza changes in a circular permutation from one stanza to the next. The poem is terminated by a stanza of three lines ending in three couplets of rhyming words.

So it is through poetry that combinatorics make its entry into western mathematics again. The use of *constraints of a mathematical type* in the structure of a literary work will be the foundation of the works of OuLiPo[8] in the twentieth century.

Jacques Roubaud' for instance, published a collection of poems with the rather enigmatic title: "$\in$" (this is the symbol of set membership but it is read *epsilon*). In the introduction we read: "This book is composed, on the principle of 361 texts which are the 180 white pieces and the 181 black pieces of a game of Go." Then: "The text or pieces belong to the following varieties: sonnets, short sonnets, interrupted sonnets, quotations, illustrations, grids, whites, blacks, poems, prose poems…" As the *Encyclopedia Universalis* explains: "Four modes of reading are possible for these generally brief texts (or pieces), which are always preceded by numbers, signs or symbols and which reflect the diverse systems of succession, of regroupings, of correspondences and of separation, focusing on the way symbols group or on their continued development, following the movement of a game of Go or taking each element in its singularity.

Hortense, a trilogy of novels by the same author, is based on essentially combinatorial rules which are more or less explicit. All the works of Jacques Roubaud are interlaced with Mathematics. *Mathématique : (récit)* occupies a special position. In it we find diverse mathematical recollections and reflections of the author as a student at the beginning of "modern mathematics" and an attempt at modelling memory through neighbourhoods topology. It is followed by *Impératif Catégorique* where the title and the content play on the words at several levels. 'Catégorique' refers at Category Theory and at its meaning as it relates to Kant (the categorical imperative). Roubaud also writes that it is related to a literary mode in the Japanese language.

Fourth stop: in the Parisian salons of the 17th and 18th centuries

Euclid's *Geometry* is now studied by all the well educated boys. Charles Perrault (1628–1703), a writer latercelebrated for his Tales (*Contes*), found inspiration in it. At the age of thirteen, he wrote a poem

[8]Cf Audin

called *The Loves of the Ruler and the Compass*. In this poem, the ruler (female in french) "of serious bearing, full of majesty, unbending and observing of fairness above all" resists all efforts at seduction by the compass (male in French), up to the moment when :

> ⋯The compass immediately stood erect on one foot
> And, with the other, in turning a large circle traced.
> The ruler was overjoyed, and suddenly came and laid herself down
> In the middle of the circle, and formed the diameter.
> Her lover embraced her, having her at his mercy,
> Now extending and now contracting,
> And so came to be born from their learned postures
> Triangles, squares and a thousand other figures

The mathematicians of this period are also philosophers and talented writers. Above all they pursue research into methods, in mathematics, just as in philosophy. But, in the Parisian Salons, serious discussions would become freely gallant.

> "Madam⋯since we are inclined to always mingle the follies of gallantry with our most serious conversation, mathematical reasoning is made like love. You cannot permit the smallest thing to a lover that you have to allow more afterwards, and that ends up by going a long way. Similarly, grant the least principle to a mathematician; he will draw you a conclusion from it, that you will also have to grant and from this conclusion yet another, and in spite of yourself, he will lead you so far that you will scarcely be able to credit it."

In this extract we can see the application of a mathematical concept to something else. I will call this literary process "conceptual transfer" or "analogy".

This transfer of mathematical reasoning to amourous seduction is extracted from the *Entretiens sur la pluralité des Mondes*, 1686–1687, a work of *popularization* which is presented as a dialogue between the author, Fontenelle, and a marquioness. Fontenelle was a philosophe—mathematician, author for instance, of the "*Eléments de la géométrie de l'infini*".

Speaking about Pynchon, the literary critic John O. Stark, suggests that "by drawing nonmathematical conclusions from mathematics and by incorporating them into his literary works, he points out a feature that its technological applications might easily obscure: mathematics is metaphoric because it describes universals."

The infinitesimal calculus was doubtless still too new for non mathematicians to take up, but the infinite inspired awe and wonder in everyone. So much so that they dedicated poems to it in their mathematical works, like Jacques Bernoulli, in connection with the summation of infinite series (written in latin before 1689)[9]. We can notice the geometrical structure of the poem: parallelism and symmetry.

[9]Translated from latin in Struik D.J., A Source book in Mathematics, 1200–1800,Harvard University Press, 1969.

> Just as a finite little sum embraces the infinite series
> And a limit exists where there is no limit
> So the vestiges of the immense Mind cling to the modest body
> And there exists no limit within the narrow limit
> O say, what glory is to recognize the small in the immense!
> What glory to recognize in the small the immensity of God

We find commonly, at this time, the algebraic analogy between finite and infinite justified in mathematics by mean of Metaphysics. For example, Newton, in (*De Analysi per Aequationes Numero Terminorum Infinita*), published in 1711, but which circulated from 1669.)

> And whatever the common Analysis performs by Means of Equations of a finite number of Terms (provided that can be done) this new method can always perform the same by means of infinite Equations. So that I have not made any Question of giving this the name of *Analysis* likewise. For the Reasonings in this are no less certain than in the other, nor the Equations less exact; albeit we Mortals whose reasoning Powers are confined within narrow Limits, can neither express, nor so conceive the Terms of these Equations as to know exactly from thence the Quantities we want.

Conversely, the philosophical and apologetic work of Pascal (1623–1662) is often underpinned by mathematical concepts. For example, he transfers the notion of calculation of probabilities to religion, with his famous"Bet" (Pari) concerning the existence of God, and the calculus of the infinite to the place of man in the world :

> For, finally, what is man in nature? He is nothing in comparison with the infinite, and everything in comparison with nothingness, a middle term between all and nothing. He is infinitely severed from comprehending the extremes; the end of things and their principle are for him invincibly hidden in an impenetrable secret; he is equally incapable of seeing the nothingness from which he arises and the infinity into which he is engulfed.

Actually, analogy plays an important heuristic role at this epoch in all matters that touch mathematical infinity. Has all this been successfully swept away by modern, rigorous mathematics? Here is what the mathematician André Weil thinks (1960)[10]:

> There is nothing more profound, all mathematicians know it, than these obscure analogies, these murky reflections from one theory to another, these furtive caresses, these inescapable contretemps; nothing also gives more pleasure to the researcher. A day arrives when illusion is dissipated, premonition changes into certitude; twin theories reveal their common source before disappearing; as the *Gita* teaches knowledge and detachment are attained at the same time. Metaphysics has become mathematics, ready to form the material for a treatise whose cold beauty will no more know how to move us⋯.

[10] *Complete Works*, Volume 2, p.408:

In the same way still, we see analogies between the calculus of finite differences and the differential calculus serving as a guide to Leibniz, Taylor and Euler, during the course of the heroic period during which Berkeley could write, with as much humour as relevance, that "believers" in the infinitesimal calculus were little qualified to criticize the obscurity of the mysteries of the Christian religion, the former being at least as full of mysteries as the other. A little later, d'Alembert, enemy of all metaphysics in mathematics besides, upheld that the true metaphysics of the infinitesimal calculus were nothing else than the notion of a limit, in the entries of the Encyclopedia. If he did not himself, extract all that could be drawn from this, he would be justified by the developments of the following century; and nothing known to be clearer can be found today, nor, it must be said, more tedious, than a proper exposition of be elements of the differential and integral calculus.

Long after mathematicians had settled the problem, writers have continued to confront it. Here is a more recent example: *The Aleph*, Jorge Luis BORGES (1945)

"For the rest, the central problem is unsolvable: the enumeration, even if only partial, of an infinite set [⋯] What my eyes saw was simultaneous; what I shall transcribe is successive. Nevertheless I shall cull something of it all.

In the lower part of the step, towards the right, I saw a small iridescent sphere, of almost intolerable brilliance. A first I thought it rotary; then I understood that this movement was an illusion produced by the vertiginous sights it enclosed. The aleph's diameter must have been two or three centimeters, but cosmic space was in it, without diminution of size. Each object, (the mirror's glass, for instance) was infinite objects, for I clearly saw it from all points in the universe"[11]

In the same way that we can speak of analogy, we can speak here of a mental image, or more sketchily of the imagination. As wrote D'Alembert in the Preliminary Discourse to his *Encyclopédie*, (1751):

Imagination is not less active in a geometer who creates than in a Poet who invents

The developments in Algebra and in the infinitesimal calculus appear a little later in a curious work, worthy of a paper all to itself: *Le manuscrit trouvé à Saragosse* (The Manuscript found in Saragossa) of Comte Jan Potocki (1761—1815). This erudite, cosmopolitan, fervent admirer of the philosophers of the enlightenment would have learnt mathematics in order to teach one of his sons. A first (partial) edition of the novel (in French) comes from St. Petersburg in 1805. Partial manuscripts multiplied. They were lost, translated or plagiarized and the most complete version dates from 2006[12]. A crowd of characters appear within a sophisticated structure of interlocking histories. One of them, Velasquez, is a mathematician-philosopher. Here is a summary of his story, intertwined with lots of others:

The father of the hero, a mathematician, attributes his reverses of fortune to his love of mathematics. He swears that his son will not learn it, but rather learn to dance, which he judges to be more

[11] translated by Anthony Kerrigan in *A Personal Anthology by Jorge Luis Borges*, 1967 Grove Press

[12] If you want to read it, check that you find in your book at least 60 Journées (Days)

socially useful. But our hero cannot remember the simplest type of dance, as "there is neither generating rule nor formula to memorize the different figures"! To punish him, his father shuts him up in a storehouse. It is thus (I summarize in modern language) that by beginning counting the square panes in the windows, he discovers the usefulness of multiplication, and its commutativity (for the integers). Continuing with fractions of squares, he discovers the distributivity of addition and multiplication. Moved, his father allows him to continue and proposes different cases to him, even with the lines of the squares "infinitely small". In the end, his father exclaims to himself "Oh my god, look at it, he has discovered the binomial law, and if I let him, he will guess the differential calculus."

The father then lets him have access to "The Universal Arithmetic of the Chevalier Don Isaac Newton". The study of mathematics continues in full swing, right up to the night when his aunt Antonia comes to see him "almost undressed" under the pretext of making him teach her geometry. Velasquez begins by docilely showing her the first two propositions of Euclid. Antonia is vexed and replies "So has geometry not taught you how babies are made." This launches Velasquez into a deep reflection on the way "to apply the calculation to the entire system of nature".

In order to refresh his spirits, he leaves on a journey, but lost in his thoughts and his writing materials, he finds himself surrounded by hostile nomads. He offers a ransom, but the sheik takes him for a madman, and so protected by God, and puts him back on his way. What consternation for our hero: "What's that? I say to myself, following the tracks of Locke and Newton, I would have arrived at the furtherest reaches of human intelligence, applying the principles of calculation one after another. I would have secured several steps into the abyss of metaphysics, and what comes back to me? To be numbered among the mad, to pass for a degraded being who no longer belongs to humankind. Perish the differential calculus and all the integrations to which I had attached my fame".

Reassure yourselves, the calculus remains alive in the novel, and the young man will learn how babies are made. In the course of these encounters, and with much humour, Velasquez will present many conceptual transfers to us. Here are several themes I have noted in the order of their appearance in the book (divided into days):

- 18^{th} day: The law of falling bodies on an inclined plane; the solution of a complicated arithmetical problem.
- 19^{th} day: "Women cannot understand the first elements of science"; quarrels (the Bernoulli brothers, the isoperimetric problem, Jean Bernouilli and the Marquis de l'Hopital, Newton and Leibniz).
- 20^{th} day: A selection of conceptual transfers: the increase in impatience is in inverse proportion to the square of the inertia of the person concerned; the pursuit of happiness compared to the solving of equations, some with imaginary roots; the question of love "goes back into maxima and minima and the problem can be represented by a curve".
- 22^{nd} day: The representation of human actions and passions by geometrical figures.
- 23^{rd} day: The story of our hero (the counting of panes); the hero discovers how to use the logarithmic tables of "Baron Napier"; Antonia's attempt at seduction and what follows from it.
- 25^{th} day: From the quadrature of the circle to the quadrature and rectification of curves. Isochrones; women's bodies and osculating curves.
- 29^{th} day: The analogy between the structure of a novel and of infinite series; the designation of unknowns by letters in algebra.
- 32^{th} Day: The analogy between the structure of a novel and recursive relations.

- 33^{rd} day: The analogy between love/hate, the rule for signs and the binomial formulae: "Yes, my dear, the binomial formula, invented by Chevalier Don Isaac Newton, must be our guide in the study of the human heart as in all calculations."
- 37^{th} day: Velasquez's ideas on religion, the infinitely small and the infinitely large.
- 39^{th} day: Abstraction and deduction; ideas and the senses; "the difference between minds is in the quantity of images and in the facility of combining them; effective calculation of combinations.
- 41^{st} day: A proof by calculus that a lake is a crater lake.
- 45^{th} day: The curve of human life.

This type of work is really exhilarating, above all for a historian of mathematics. The author had learned mathematics in order to teach it to his son. He does not explain mathematics, but causes us to reflect on this subject (among lots of other subjects), while mixing up the transfer of concepts with much humour. Finally, the construction itself refers back to the mathematics involved, and more generally to the multiplicity of points of view, which is a useful tool in mathematics.

I would like to mention two novels of the 20^{th} century, *Ratner's Star* by Don Delillo (1976), where mathematics operates simultaneously in the structure and in the themes, and Brazzaville Beach (1990) by William Boyd, with a lot of recent mathematical subjects and analogies.[13]

Fifth stop : From the old to the new world, the XIXth century

The teaching of mathematics has spread more widely. The literary fashion is to express oneself, and the authors willingly recount how they are inspired by mathematics (or their teachers). This brings new elements onto the trail of *the image of mathematics and mathematicians in society*.

Here is the young Stendhal in his autobiography *The life of Henry Brulard*, 1836

> "In my opinion, dishonesty was impossible in mathematics [$\cdots$]. I worked that out when I became aware that no-one could explain to me how it happened that $(- \times - = +)$? . My teacher replied '.. my son, you will understand that later'"

And the young Daniel Deronda in *Daniel Deronda*, by George ELIOT, 1876 :

> "[Daniel] applied himself vigorously to mathematics, and the favourable opinion of his tutor determined him to try for a mathematical scholarship in his second year. But he felt a heightening discontent with the wearing futility and enfeebling strain of a demand for excessive retention and dexterity without any insight into the principles which form the vital connection of knowledge."

Poets speak of it with greater exultation!

[13] Cf Michel-Pajus A. & Spiesser M. , HPM 2004

Victor HUGO, *Contemplations*, 1831	Isidore DUCASSE(Comte de Lautréamont)
[⋯] I was then tortured by mathematics. I was wrung from wingtip to beak , On the frightful rack of X and Y ; Alas, I was whacked under the maxillary bones. By the theorem adorned with all its corollaries. Geometry! Algebra! Arithmetic! Zone Where the invisible plane cuts the indistinct cone, Where the asymptote searches, where the hyperbola flees! Crystallization of the night Sea where the polyhedron is the frightful madrepore ; Where the universe evaporates in calculations Where the vast and sparse fluid filling all Is no more than an hypothesis, and trembles and dissolves [⋯]	*The songs of Maldoror*, 1869 « O austere mathematics, I have not forgotten you, since your learned lessons, sweeter than honey, filtered into my heart, like a refreshing wave. [⋯] Arithmetic! Algebra! Geometry! Grand Trinity! Luminous triangle! Who does not know you is insensible. ! He deserves to undergo the ordeal of the greatest tortures; for there is blind contempt in his ignorant carelessness; but one who knows and appreciates you is worth no less than the goods of the earth; satisfied with your joyful magic; and carried on your dark wings, desiring nothing more that to ascend, in weightless flight, in constructing an ascending helix, towards the spherical vault of heaven.[⋯]

A particular discovery shook writer's minds: that of non-Euclidean geometries. Reversing the argument of the infinitesimal calculus, Ivan Karamazov concludes that, since he cannot comprehend a non-Euclidean universe where parallel lines can meet, he cannot comprehend that which concerns God. (*The Brothers Karamazov*, Fyodor Dostoevsky)

> "But you must note this: if God exists and if He really did create the world, then, as we all know, He created it according to the geometry of Euclid and the human mind with the conception of only three dimensions in space. Yet there have been and still are geometricians and philosophers, and even some of the most distinguished, who doubt whether the whole universe, or to speak more widely, the whole of being, was only created in Euclid's geometry; they even dare to dream that two parallel lines, which according to Euclid can never meet on earth, may meet somewhere in infinity. I have come to the conclusion that, since I can't understand even that, I can't expect to understand about God."[14]

In the works of Edgar Allen Poe, the mechanics of thought are a fundamental theme. The faculty of analysis is carried to its highest point in Detective Dupin. For him it surpasses that which is called mathematical analysis, since this one functions solely by calculation: "to calculate is not in itself to analyze."[15] While human analysis takes into account a multitude of balanced facts through a *calculation of probabilities* (the more improbable a fact is, the more important it is) and, above all through the possibility of "entering into the mind of an adversary", a "pure machine" is not able to do this. In Maelzel's *Chess Player* (1836), he deduces *mathematically* that an automaton supposed to be playing chess is, in fact, a hidden human being, from the fact that it is impossible for a machine to be able

[14]Translation from the website : `http://fyodordostoevsky.com/etexts/the_brothers_karamazov.txt`
[15]The Murders in the Rue Morgue, *Poetry and tales*, New York, Library of America, 1984, p.39

to play chess. "It is quite certain that the operations of the automaton are regulated by *mind*, and by nothing else. Indeed this matter is susceptible of a mathematical demonstration, *a priori*."

This statement is astonishing for us. It arises from the fact that Poe takes for his model Babbage's Machine. (These one was never constructed, however, it was described in The *Southern Literary Messenger*, in July 1834). Here is his proof:

> "Arithmetical or algebraic calculations are, from teir very nature, fixed and determinate. Certain data being given, certain results necessarily and inevitably follow. These results have dependence upon nothing, and are influenced by nothing but the data originally given. And the question to be solved proceeds, or should proceed, to its final determination, by a succession of unerring steps liable to no change, and subject to no modification. This being the case, we can without difficulty conceive the *possibility* of so arranging a piece of mechanism, that upon starting it in accordance with the *data* of the question to be solved, it should continue its movements regularly, progressively, and undeviatingly towards the required solution, since these movements, however complex, are never imagined to be otherwise than finite and determinate. But the case is widely different with the Chess-Player. With him there is no determinate progression. No one move in chess necessarily follows upon any one other. From no particular disposition of the men at one period of a game can we predicate their disposition at a different period. "[16]

If Edgar Allen Poe could not imagine that a machine could be programmed to incorporate new data, such as the position of pieces on a chessboard, as they arose, it is because he is a prisoner to the image of a machine as envisaged by the state of science of his time. This vision of a machine, tied blindly to strictly deterministic acts, is found again in his Essay *The Philosophy of Composition* (1846), where he explains that his celebrated poem, *The Raven* "emerged from a deliberate and conscious process that progressed with the precision and rigid consequence of a mathematical problem".[17]

The end of the voyage

Our voyage is going to come to an end at the threshold of the XXth century. It seems to me that mathematics is more and more fashionable in literature, cinema, and in TV series. This shows that mathematics play a role in the culture and the real life. One may like or not like the image of mathematics or of mathematicians which is portrayed. If these fictions lead the young to do mathematics, so much the better! If a coating of honey lets them take it up with more pleasure or creativity, so much the better! But the essence and the beauty of mathematics remains enclosed in mathematics itself and I do believe that a firm and competent hand will always remain indispensible to guide and encourage learners on the paths leading to it.

REFERENCES

– Barbin E., Itard G., 1993, Le courbe et le droit, in *Histoires de problèmes. Histoire des mathématiques*. p. 113–137. Ellipses, Paris.

[16] Edgar Allan Poe, "Maelzel's Chess-Player" [Text-02], Southern Literary Messenger, April 1836, 2:318–326. On line : `www.eapoe.org/works/essays/maelzel.htm`

[17] cfCassou-Noguès and Levy

– Audin M., *L'oulipo et les mathématiques, une description*, http://www-irma.u-strasbg.fr/~maudin/ExposeRennes.pdf

– Cassou-Noguès P., 2010, Poe Descartes et la cybernétique, http://www.epistemocritique.org/spip.php?article118

– Deledicq A., Deledicq J.C., Casiro F.,1996, *Les maths et la plume*, ACL éditions, Paris.

– Koehler D.0., 1982, Mathematics provides writers with a rich source of themes, images and metaphors, in *Mathematics and Literature*, vol 5, No2. http://www.jstor.org/discover/

– Lévy S., 2008, *Poe Expérience de pensée, la pensée comme expérience*, http://www.epistemocritique.org/spip.php?article45

– Lipsey S.I.,Pasternack S.B.,Mathematics in Literature, http://math.unipa.it/_

– Michel-Pajus A.,Spiesser M., Mathematics And Mathematicians Under The Writer's Pen, *Universitetstyckeiet*, Uppsala, 2004

– Mira C.,2000, L'usage du nombre dans la Littérature médiévale (XIIème et XIIIème siècles), in *Si le nombre m'était conté*.. p. 144–172. Collection : IREM—Epistémologie et Histoire des Mathématiques. Ellipses Paris.

– Paquin J.,2008, *L'intertexte scientifique en poésie*, http://www.epistemocritique.org/spip.php?article66

– Preece D.A., 2009, *Mathematics in Literature*, http://www.kent.ac.uk/smsas/staff/dap/70thtalk.pdf

– Sriraman B., Beckmann A., 2007, Mathematics and Literature :Perspectives for interdisciplinary classroom pedagogy http://www.ucalgary.ca/ihpst07/proceedings/IHPST07%20papers/125%20Sriraman.pdf

– Wilburne J.M., Napoli M., *Connecting Mathematics and Literature : an analysis of Pre-sevice Elementary School Teacher's Changing Beliefs and Knowledge, IUMPST : The Journal*. Vol2, 2008

– Zalmanski A. (dir.), 2006, *Mathématiques et littérature, une fascination réciproque*, Editions POLE, Paris.