"Sifted science will do your arts good": non-Euclidean Geometries in *Finnegans Wake*

Federico Sabatini, Università di Torino

In the light of his long-term and wide-ranging involvement with science, this essay intends to highlight Joyce's linguistic and conceptual treatment of geometry in *Finnegans Wake*. More specifically, it aims at uncovering, within several passages and expressions in the text, the constant interaction of Euclidean and non-Euclidean geometry. As I will show in the course of my analysis, non-Euclidean geometry attempts at describing a curved space that is not directly visible and needs thus to be imagined. In this regard, I will argue that Joyce refers to these new and radical theories (although he does not entirely dismiss the original ones by Euclid) and employs them in his all-encompassing scientific discourse, one that comprehends various and often divergent theories. As I will argue, science plays a crucial role in Joyce's aim at recreating the whole history of humanity, and it serves both as an essential instrument to describe and to understand natural phenomena, and as a source for the development and for the empowering of the human imagination and of the artistic inspiration. As my title suggests (deriving from Book III of *Finnegans Wake*), science needs to be sifted and combined with other discourses in order to positively influence the artistic mind as it seeks to record and recreate reality.

As Thomas Jackson Rice argued, "Joyce's notes for *Ulysses* and his allusions to geometry in 'Ithaca' demonstrate that he was familiar with the history and concepts of non-Euclidean geometry by the late 1910s" (Rice 1991: 400). In fact, Joyce's general interest in science, and in geometry and arithmetic in particular, does not only pertain to *Ulysses* and *Finnegans Wake* but is

traceable in his early works, starting from the very first page of *Dubliners*, where the Euclidean word "gnomon" is one of the three obscure words that he boy-protagonist does not understand.

Geometry plays thus a relevant role in all of Joyce's oeuvre up to *Finnegans Wake,* where he widely refers to four-dimensional geometry (Solomon 1969) and where he devotes an entire episode to a Geometry Lesson attended by the two children Shem and Shaun. Joyce's employment of scientific languages and methods is well-acknowledged and has provided critics with a fertile field of investigation able to shed light on Joyce's literary method and stylistic strategies. Nevertheless, as some critics convincingly show (Purdy 1982, Slote 2004), Joyce's attitude towards science proves constantly ambivalent if not mockingly ironical. We can think, as a key example, of the scene in "Ithaca" where the narrator describes with geometric precision the arcs of urine "sent simultaneously out into the world by Stephen and Bloom" (Purdy 1982: 195). As it is well-known, the art of the episode is science, and the narration revolves around two divergent yet complementary poles, the artistic mind (embodied by Stephen Dedalus) and the scientific mind (embodied by Leopold Bloom). As Sam Slote (2004) noted, in "Ithaca" scientific inaccuracy abounds, so do errors and misleading (or even paradoxical) scientific calculation and demonstration. In fact, the language of science always blends with a number of other languages and discourses, which, up to their very culmination in *Finnegans Wake*, are reunited in Joyce's oxymoronic construction of meaning and in the light of Giordano Bruno's philosophy of coincident contraries. In other words, science is a significant tool in the construction of the all-encompassing work he aimed to write, one of the several maps of orientation to follow the "the imaginable itinerary through the particular universal" (*FW* 260.36) within the "book of doublends jined" (*FW* 20.16) that is *Finnegans Wake*.

At the same time, to affirm that *Finnegans Wake* highly relies on geometry would also be misleading: inasmuch as Joyce recreated language he also recreated his own geometry as a branch of his own "omniscience". The tone of his letters, when they deal with science, ranges from enthusiasm to total dismissal, and thus witnesses the author's complex and ambivalent relationship with science. In 1921, he wrote to Alessandro Francini Bruni: "L'episodio di

Ithaca, adesso tutto geometria, algebra e matematica" (*SL* 280; "The episode of Ithaca, now it's all about geometry, algebra and mathematics"). In the same period, he described "Ithaca" as a "mathematico-astronomico-physico-mechanico-geometrico-chemico sublimation of Bloom and Stephen" and he also noted that the episode "should be read by some person who is a physicist, mathematician and astronomer and a number of other things" (Friedman 1982: 198). Quite differently, he also wrote to Harriet Shaw Weaver: "I could never learn chemistry or understand in the least what is about" and then, to Tom Kristensen: "I don't believe in any science but *my imagination grows* when I read Vico as it doesn't when I read Freud and Jung" (*JJII* 693). Finally, when he was writing *Work in Progress*, he revealed to Eugene Jolas that the work involved a search for a "*pansymbolic panlinguistic synthesis* in the conception of a 4D universe" (Purdy 1982: 214). Moreover, Joyce also claimed both a mathematical basis and a geometrical form for the book. As Ellmann points out, "he wished also for Ogden to comment, as a mathematician upon the structure of *Finnegans Wake*, which he insisted was mathematical" (*JJII* 627).

All these apparently contradictory documents reveal two significant concepts: firstly, an advocated combination of several disciplines of research (such as, among others, mathematics, geometry, chemistry, to be interpreted by someone who is not only a scientist but "a number of other things") and, secondly, a mutual relationship between science and imagination, which, by extension, we could easily call a relationship between science and art. Inasmuch as "Ithaca" deals with scientific language in a symbolic way, as it has been deftly and thoroughly argued by Sam Slote, *Finnegans Wake* takes a step further, aiming at a "pansymbolic and panlinguistic" recreation of the world, a recreation made possible by the interaction of different, if not divergent, branches of learning. In addition, just as *Ulysses* skilfully combines science with magic and occultism, as noted by Purdy, in *Finnegans Wake* "for every science there is a pseudo-science, for every astronomy an astrology, often jostling it in the same paragraph" (Purdy 1982: 208).

Such a method of "Bimutualism" (*FW* 308.36) is often discernible not only in a single paragraph, but also in a single word or *mot-valise*. There are two key examples of this kind which I would like to point out. The first is

"arthroposophia"(*FW* 394.19): it combines "arthro" ("arm", which hints to a study of the body), art, anthropology, arithmetic, philosophy and even the pseudo sciences of antroposophy and theosophy. The second term, is "aristmystic" (*FW* 293.33), which combines Aristotle (and so philosophy), art, mysticism and arithmetic. The two *mots-valise* underline the abovementioned combination of disciplines that had to cooperate with science in order to achieve a universal system of knowledge and a "panlinguistic" recreation of all spaces and of all times. Science is thus a tool to be *sifted* (as in my title, which derives from book III of *Finnegans Wake*) in order to serve the artistic mind in its attempts at recording reality and, above all, science is an instrument able to fuel the imagination as it tries to comprehend the universe. Such a universe, as I have argued elsewhere (Sabatini 2007, 2008), is defined an "immarginable" universe (*FW* 4.19; with a clear derivation from the cosmology and philosophy of Giordano Bruno), namely a universe whose margins, though real and physical, are not to be imagined and, analogously, a boundless universe whose margins depend on our position, so as to be continuously expanding (or, as Joyce has it in another passage, "a more and more almightily expanding universe" (*FW* 263.29). It has been extensively demonstrated, in the linguistic construction of such a space, Joyce often refers to scientific advancements and incorporates numerous theories such as Bohr's complementarity, Einstein's relativity, quantum mechanics, "herzian waves" (*FW* 232.12), Heisenberg's uncertaint principle and so forth (Duszenko 1994, Fleishman 1967, Morrisson 2009, Salvadori and Schwartzman 1992, Rice 1991, Slote 2004). Similarly, he refers, more or less explicitly, to non-Eulidean geometries, and he quotes Lobačevskij in his *Ulysses* note-sheets (Rice 1991). For this reason, one is tempted to consider the geometrical form he advocated for *Finnegans Wake* as non-Euclidean, given the numerous references to the curvature of space and to a four-dimensional reality. A careful reading would reveal that, as in all of Joyce's oxymoronic and chiasmatic poetics, even non-Euclidean geometries are treated in the same way: on one hand they represent a privileged method that relies on abstract speculation and imagination but, on the other hand, they must seem limited in a total comprehension and apprehension of reality, as I hereby intend to suggest. In addition, non-Euclidean geometries need to be constantly set in

direct connection with Euclid's elements, which, as I'll suggest, represent their originating nucleus.

In this light, Heisenberg's words seem very akin to Joyce's belief:

> In art as in science we can discern a striving for universality. In the sciences we are endeavouring to interpret the physical phenomena in a unified way, to understand all organisms in terms of a single point of view [...]. In art we are seeking to present a basis for life common to all men on earth. (quoted in Hassan 1982: 187)

Advanced scientific work, as Hassan underlines, is conceived as "an imaginative act" and "the axiomatic basis of scientific theories cannot be extracted from sensory data; it must be freely invented" (*ibid.).* In addition to this, Heisenberg, to whose "uncertainty principle" Joyce refers in the pun "onecertain allsecure" (*FW* 22.19), affirmed that "what we observe is not nature in itself but nature exposed to our method of questioning [...] in the drama of existence *we are both players and spectators*" (Hassan 1982: 189). Such a statement dramatically reveals how these new theories by Heisenberg rejected Newton's absolute theories of space, by claiming a new role for the subject. Quite the reverse, Newton, in his *Principia,* claimed that "we must consider things themselves, distinct from what are really only sensible measures of them" (Perlis 1982: 191).

As for Joyce, it is pertinent to say that he indubitably criticizes Newtonian absolutism, although evidence proves that he doesn't entirely dismiss him either, as the passage containing "aristmystic" may suggest:

> Given now ann linch you take enn all. Allow me! And, heaving *alljawbreakical* expressions out of Sare Isaac's universal of *specious aristmystic* unsaid, A is for Anna like L is for liv (*FW* 293.18-23).

The passage reveals that "all geometrical" discoveries overcome Sir Isaac: "jawbreakical" combines "jaw" (hinting at breaking and chewing but also to "idle talk"), "break", and "all" while, in addition, it also reads as "all geometrical", meaning that all the new geometries have contributed to the overcoming of Isaac Newton. Yet, at the same time, "jawbreaking" also suggests difficulty in uttering, and so in understanding, the new geometries. In another passage

("Let's hear what science has to say, pundit-thenext-best-king. Splanck! Upfellbowm", *FW* 505.27-29), Newton's tree, after the exploding reference to Planck, is upside down: in the *mot-valise* "upfellbowm", as carefully noted by Sam Slote (2004), the verb "to fall" is preceded by "up" and followed by "baum", the German word for "tree", while "upfel" (pronounced as "apfel") is the German for "apple", meaning, therefore, that the apple paradoxically falls up.

Although Joyce often challenges Newton, he simultaneously embraces a kind of absolutism that can be noticed in his treatment of other philosophers such as Hume or Descartes. His relationship with Descartes is ambivalent: he confutes his idea of an only rational space-measurement (in favour of a combination of thought and perception) and at the same time he feels the need for a Cartesian framework, as it is observable in the precise spatial coordinates he provided for his more traditional works (Sabatini 2007; chapters I and II). In other words, Joyce's aim at an "omniscience" takes into account both a rejection and a simultaneous approval of Descartes, as well as of Newton and, finally, of Euclid. Similarly to Newton, in the works of other enlightenment and empiricist philosophers such as "Hartley, Hume and Locke...there is an implicit recognition of an unchanging mechanically presence called "nature", which the act of perceiving inevitably fails to record with verisimilitude" (Perlis 1982, 195).

In his constant attempt at such perceptual recording of reality, it might be thought that Joyce refutes such rational theories. However, in *Finnegans Wake* there is a significant reference that (again) proves his approval of Hume's philosophy derived from Newton's absolutism. In the expression "hume sweet hume" (*FW* 80.18), in fact, the ironical connection between "hume" to the idiomatic "home sweet home" reveals the need, for the artist, of a sheltered frame of reference, of a fixed and absolute reality upon which we can address our thought and perception, although in a sceptical hume-like manner. Perception, in its turn, is never exhaustive for Joyce but rather performs its activity "immarginably" upon an "immarginable" universe of a brunonian nature.

Such reversible dualities and double chiasmatic connections in Joyce's theory of "interpenetrativeness" (*FW* 308.44) and "interchangeability" (*FW* 308.39) also apply to the role of Euclidean and non-Euclidean geometries. As Rice has

illustrated, Joyce became acquainted with the new revolutionary theories during his sojourn in Rome from 1906 to 1907, when Roberto Bonola's book *La geometria non-euclidea: esposizione storico-critica del suo sviluppo.*(*Non-Euclideaan Geometry. A Critical and Historical Study of its Development)* was highly celebrated. A review of 1912 opens with a passage which connects non-Euclidean geometries to the imagination:

> Few, if any, of the modern developments of mathematics have struck the popular imagination in so profound a fashion as non-Euclidean geometry and, perhaps, we may say, deservedly so (Rice 1991: 400).

The book provides an account of the works by the most influential non-Euclidean thinkers, such as Bolyai, Lobačevskij, Riemann and Poincaré. Although their conclusions were different, all of them refused the Euclidean method of deduction and, especially, they rejected the fifth axiom of Euclid's *Elements*, i.e. the postulate of parallel lines. This implies "through a point next to a straight line only one line can be drawn that is parallel to it, both of them intersecting only at infinity" (Holton 2001: 128). By rejecting this, as it was only applied to two-dimensional surfaces, two main geometries developed: the Hyperbolic and the Elliptical. In the former, there are infinite parallel lines through the given point, while in the latter, there is none. In other words, both considered the curvature of a *n-dimensional* space rather than the flat surface of Euclidean geometry, so as to allow a violation of Euclid and to dramatically rethink the nature of space and the method of describing it. While Euclidean postulates were created by deduction (from existing data), non-Euclidean geometries relied on intuition (of something unknown, abstract, non directly visible).

The very term "non-Euclidean", as argued by Rice, "came to be employed in non-mathematical fields as a label for unconventional, non-traditional, radical thinking" (Rice 1991: 402). Both scientists and artists have shared the profound impact of the new theories which demonstrated that "man's judgement and conclusions about space are purely of his own making" (Kline 1953: 429). As noted above in term "alljawbreackical", an accurate reading of some passages of *Finnegans Wake* reveals how, in his attempt at a "literary omni-science", Joyce directly refers to a breaking with Euclid's theories, so as to suggest

implications with the new geometries which would explain his continuous references to the work as a four-dimensional sphere. More precisely, one ought to speak about an alteration of Euclid, which, similarly to what happens in Joyce's treatment of absolutism and relativity, reveals that the new scientific outcome still preserves the nucleus of the theories that generated it and thus must be taken into account within the abovementioned "all-encompassing science".

In *Finnegans Wake,* Joyce creates two highly significant *mot-valises*, namely "Neuclidius" and " elementator joyclid":

> to the extinction of Niklaus altogether (Niklaus Alopysius having been the once Gripes's popwilled nimbum) by *Neuclidius* and Inexagoras and Mumfsen and Thumpsem, by Orasmus and by Amenius, by Anacletus the Jew and by Malachy the Augurer and by the Cappon's collection and after that, with Cheekee's gelatine and Alldaybrandy's formolon… (*FW*, 155.30-36).

> Now, (peel your eyes, my gins, and brush your saton hat, me *elementator joyclid*, son of a Butt ! (*FW* 302. 11-13, my emphasis).

The first passage presents a list of scientists and thinkers including Anaxagoras, the pre-Socratic philosopher who gave a scientific account of natural phenomena such as eclipses and meteors and who was exiled because he contravened religious principles by. conceiving matter as an infinite mass of indestructible basic elements. Although this all seems very akin to Joyce's poetics, the pun mixes the philosopher's name with the adjective "inexact", so as to ironically hint at the limitation of his theories as all other universal theories. More importantly for this analysis is the term "neuclidus" which combines the German "neu" with Euclid, namely a "new Euclid", coming out of his own theories, but also something that is "neucloid", namely that resembles a nucleus, so as to declare the importance of Euclid from which all mathematics and geometry stem. The second expression, "Joyclid", is an ironical fusion of Joyce and Euclid which entails both Joyce's identification with Euclid and his refusal of his theories in favour of the above-mentioned "omni-science". "Joyclid" advocates a symbolic combination of literature and science, a combination that is enacted in the very style of *Finnegans Wake*, raising issues of imagination and literature in accord with scientific analysis. At the same time,

8

this hybrid figure is said to be "elementator" which creates at least three meanings: "elementator" as the creator of the *Elements*, "elementator" as "elementary" (and so unreliable) and finally, by assonance, "elementator" as "emendator", the one who emends and corrects mistakes.

Non-Euclidean geometries play a crucial role in *Finnegans Wake* especially in regard to the role of the imagination and subjectivity in scientific research. By referring to Lobačevskij's emphasis on mathematical abstraction, Poincaré (which Joyce carefully renders as "Pointcarried" (*FW* 304.5), in a passage devoted to Newton, argued that mathematical truths are always subjected to modifications as they could only be approximations or conventions created by the human mind. In this respect, the role of the imagination becomes crucial in understanding the curved "other world" expressed by Poincaré, a theory which must have indubitably fascinated Joyce and which was crucial for his style's transition from the phenomenological cosmic space of *Ulysses* to the abstract, linguistic and imaginative space of *Finnegans Wake*. Before Poincaré, Lobačevskij highlighted the interdependence of empirical and imaginative reality, between abstract analysis and practical measurements:

> Surfaces, lines and points, such as Geometry defines them, *exist only in our imagination*; while we make our measurements of surfaces and lines by using bodies.....hereby we will stick to those very concepts that are *immediately united in our mind* with the representation of bodies, to which *our imagination is familiar*. (Lobačevskij 1994: 55, my translation)

Poincaré outlined such theories in the highly influential *Science and Hypothesis* (1902), asking the reader "to imagine" another world, a different world, a non-Euclidean world. He made a statement about geometry being "no more than a conventional conception of space, a convenient but nonetheless subjective vision of reality": "geometry is not true, it is advantageous" (Rice 1991: 401).

In this light, it can be argued that Joyce took advantage of geometry or, more precisely, of all geometrical, or "alljawbrekical" traditions, and he made them melt with a number of other sciences and methods of inquiry, in order to understand and recreate reality. In his construction of a spherical world, namely a "fourth-dimension" (*FW* 467.35) or "too dimensional" world (*FW* 154.28), but also in his attempt of "circling the square" (*FW* 186.13), Joyce employed the

languages of mathematics and geometry in an artistic way, in order to fuel and feed the imagination that tries to grasp and interiorize the world. Hence, a number of puns and *mots-valise* which is worth mentioning. Starting with the paradoxical "multhimathematical immaterialities" (*FW* 394.34), which reinforces the infinite and never-exhausting possibilities of calculations even of incalculable essences, we may also refer to the term "erithmatic" (*FW* 537.36). This connects to all the issues above and offers a linguistic interpretation and explanation of "what science has to say" (*FW* 505.29) in order to increase recreation of the world in artistic terms. "Erythmatic" refers to "enigmatic" but, by reversing the vowels' position, it also inverts and rearranges "arithmetic" itself, so as to suggest possible connection with "earth", namely with earth-calculations and so with "geometry". In addition, the term also refers to "erratic" and the verb "to err" which, deriving from the Latin "errare" means both "to be in error" and "to go astray". "Errare", in Italian, connects to the verb to "wander", whose derived noun, "wanderer", is expressed in Greek as "planétes", which has obviously become. "planet", as Sam Slote has argued (2004). Therefore, the "erithmatic" concept also includes astronomy and it create a complex web of horizontal and simultaneously vertical (attempts at) calculations, as well as a complex web of references which informs Joyce's attempt at omniscience.

Mathematics and geometries must include imagination in their methods, they must be employed imaginatively in art and, finally, by following non-Euclidean theories, they must feed the imagination, as expressed in another key expression: "the aliments of jumeantry" (*FW* 286.42), where Euclid's *Elements* have become the "aliments of jumeantry". The term "jumeantry" ironically qualifies geometry as a "jument", a beast for burden. In addition, once geometry and art have fed one another and have found their meaning (as in ju-*mean*-try), we can finally speak of "*aletheometry*" (*FW* 370.15), a concept which I'd like to see as the artistic combination of Euclidean and non-Euclidean geometries. "Aletheia" is the Greek for truth so, at first sight it should be read as a kind of geometry which provides a truthful interpretation of space, also in connection with "alethiology", namely the branch of logic dealing with truth. On the other hand, "aleteo" is also the first singular present of the Spanish verb "aleteo", which means "to flutter one's wings" and, similarly, "alethes" are also small

African birds. The image of flying, and of winds fluttering, brings us back to the combination of art and science, as well as of geometry and imagination. A combination that proves apt to describe *Finnegans Wake*'s recreation of all times and all spaces in "all flores of speech" (*FW* 143.6): a recreation that is both unconscious and tangible, both nocturnal and enlightened, both imaginative and concrete and, ultimately, both artistic and scientific.

Works Cited

Bonola, Roberto (1906) *La geometria non-euclidea: esposizione storico-critica del suo sviluppo*, Bologna: Zanichelli.

Duszenko, Andrzej (1994) "The Joyce of Science: Quantum Physics in *Finnegans Wake*", *Irish University Review* 24(2): 272-282.

Fleishman, Avrom (Summer 1967) "Science in 'Ithaca'", *Wisconsin Studies in Contemporary Literature* 8(3): 377-391.

Friedman, Alan J. (1982), "*Ulysses* and Modern Science", in Bernard Benstock (ed) *The Seventh of Joyce*, Bloomington: Indiana University Press, 198-206.

Hassan, Ihab (1982) "Joyce and the Gnosis of Modern Science", in Bernard Benstock (ed) *The Seventh of Joyce*, Bloomington: Indiana University Press, 185-190.

Holton, Gerald (2001) "Henri Poincaré, Marcel Duchamp and Innovation in Science and Art", *Leonardo* 34(2): 127-134.

Kline, Morris (1953) *Mathematics in Culture*, Oxford: Oxford University Press.

Lobačevskij, Nikolaj (1994) *Nuovi principi della geometria*, Italian translation by Lucio Lombardo Radice, Torino: Bollati Boringhieri.

Morrisson, Mark S. (2009) "Science", in John McCourt (ed) *James Joyce in Context*, Cambridge: Cambridge University Press, 343-354.

Perlis, Alan David (1982) "The Newtonian Nightmare of *Ulysses"*, in Bernard Benstock (ed) *The Seventh of Joyce,* Bloomington: Indiana University Press, 191-197.

Purdy, S.B. (1982) "Let's Hear What Science Has to Say: *Finnegans Wake* and the Gnosis of Science", in Bernard Benstock (ed) *The Seventh of Joyce,* Bloomington: Indiana University Press, 207-218.

Rice, Thomas Jackson (1991) "The Geometry of Meaning in *Dubliners*: A Euclidian Approach", *Style* 25(3): 393-404.

Sabatini, Federico (2007) *Im-marginable: Lo spazio di Joyce, Beckett e Genet.* Rome: Aracne.

Sabatini, Federico (2008) "Im-marginable Langscape: Re-creation and De-creation in Joyce and Beckett", *The AnaChronisT, A Journal of Engish and American Studies*, 13: 89-98.

Salvadori, Mario and Myron Schwartzman (1992) "Musemathematics: The Literary Use of Science and Mathematics in Joyce's *Ulysses*", *James Joyce Quarterly* 29(2): 339-355.

Slote, Sam (2004) "Joyce and Science", in Jean-Michel Rabaté (ed), *Palgrave Advances in James Joyce Studies*, Houndmills and New York: Palgrave Macmillan, 162-182.

Solomon, Margaret C. (1969) *Eternal Geomater: The Sexual Universe of Finnegans Wake*, London and Amsterdam: Feffer & Simons.