

# Ideas of space from Isaac Newton to Étienne-Louis Boullée

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This paper aims to prove that a fertile dialogue between architectural history and the history of ideas can open interesting perspectives for the understanding of the process of design. This dialogue, offering a reconstruction of the different mental contexts of each historical period, could prove to be essential for grasping the true meaning of design outcomes that belong to the same era. As a specific case-study, the present paper investigates the cultural interactions and the conceptual correspondences between the scientific spirit of the Enlightenment, philosophy and the architectural utopian projects of Étienne-Louis Boullée, based on the examination of various ideas of space. It is argued that after the Scientific Revolution of the seventeenth century and the major works of Isaac Newton and Gottfried Wilhelm Leibniz, the notion of space assumed an increasingly important role in the philosophical and architectural discourses of the Enlightenment. In this context, a general outline of the possible affinities and divergences between those distinct domains of eighteenth-century knowledge is traced, through the analysis of various interpretations of natural and urban space from Isaac Newton and Voltaire to Étienne-Louis Boullée. This analysis is a preliminary attempt to think the complex relations between the Humanities and the natural sciences in their Modern genealogical interdependences and tensions. Moreover, it can form the conditions for a better understanding of the intellectual environment that constitutes the meaningful ground of Boullée's design intentions.

**Key words:** space, mental context, history of ideas.

## Ιδέες του χώρου από τον Isaac Newton στον Étienne-Louis Boullée

Η παρούσα μελέτη στοχεύει να αποδείξει πως ένας γόνιμος διάλογος ανάμεσα στην ιστορία της αρχιτεκτονικής και την ιστορία των ιδεών μπορεί να διανοίξει ενδιαφέρουσες προοπτικές για την κατανόηση της διαδικασίας του σχεδιασμού. Αυτός ο διάλογος, καθώς προσφέρει μία ανασυγκρότηση των διαφορετικών νοητικών πλαισίων κάθε ιστορικής περιόδου, θα μπορούσε να αποδειχθεί ουσιώδης για την σύλληψη του αληθινού νοήματος των σχεδιαστικών αποτελεσμάτων που ανήκουν σε αυτήν. Ως μία συγκεκριμένη μελέτη περίπτωσης, το παρόν άρθρο εξετάζει τις πολιτισμικές αλληλεπιδράσεις και τις εννοιολογικές ανταποκρίσεις ανάμεσα στο επιστημονικό πνεύμα του Διαφωτισμού, την φιλοσοφία και τα αρχιτεκτονικά ουτοπικά σχέδια του Étienne-Louis Boullée, βασιζόμενο στην διερεύνηση διαφόρων ιδεών του χώρου. Υποστηρίζεται πως μετά την Επιστημονική Επανάσταση του 17<sup>ου</sup> αιώνα και τα μείζονα έργα του Isaac Newton και του Gottfried Wilhelm Leibniz, η έννοια του χώρου απέκτησε έναν ολοένα και πιο σημαντικό ρόλο στους φιλοσοφικούς και αρχιτεκτονικούς λόγους του Διαφωτισμού. Σε αυτό το πλαίσιο, σκιαγραφείται ένα γενικό περίγραμμα των πιθανών συγγενειών και αποκλίσεων ανάμεσα σε αυτές τις διακριτές περιοχές γνώσης του 18<sup>ου</sup> αιώνα, μέσα από την ανάλυση ποικίλων ερμηνειών του φυσικού και του αστικού χώρου από τον Isaac Newton και τον Βολταίρο έως τον Étienne-Louis Boullée. Αυτή η ανάλυση αποτελεί μία προκαταρκτική απόπειρα στοχασμού των πολύπλοκων σχέσεων ανάμεσα στις επιστήμες του ανθρώπου και τις φυσικές επιστήμες στις Νεωτερικές γενεαλογικές αλληλεπιδράσεις και εντάσεις τους. Επιπλέον, μπορεί να διαμορφώσει τις συνθήκες για μία καλύτερη κατανόηση του πνευματικού περιβάλλοντος που συγκροτεί το νοηματικό θεμέλιο των σχεδιαστικών προθέσεων του Boullée.

**Λέξεις-κλειδιά:** χώρος, νοητικό πλαίσιο, ιστορία των ιδεών.

## The importance of histories of architectural and philosophical ideas for the history of architecture

If we try to avoid a prevalent empiricism which still reigns in architectural design education, we should have to admit that architectural synthesis is immersed in a world of ideas. And this statement can and must have validity for every period of architectural creation. If we accept this interdependence and connection between theory and praxis, between concepts and

projects or buildings, then a history of architecture necessarily presupposes a history of ideas *about* architecture and architectural spaces. In order to fully understand, interpret and evaluate a design outcome we must reconstruct the intellectual environment, the ‘mental space’ from which it has grown.

The aim of a history of architectural ideas would then be to locate the conceptual ground which ascribes a precise meaning to acts of design that result in definitive functional, structural and aesthetic qualities of proposed or built spaces. Re-connecting the history of ideas and the history of architecture could raise the contemporary level of awareness regarding the inherent complexity of architecture. This epistemological attitude presupposes a belief in the interdisciplinary character of architectural creation. Namely, the belief that many levels and qualities of discourses (scientific, philosophical, literary) can influence the formation of architectural ideas and leave a decisive impact on the creative process of design. In the present paper we will try to supply a ‘proof’ of the above assertions through a specific case-study. We will attempt to show how the utopian designs of Étienne-Louis Boullée owe a great part of their ideological meaning and richness to a long European tradition of thinking about the idea of space. We claim that in order to fully evaluate those designs and their intentions and place them correctly within a history of Enlightenment or ‘Revolutionary’ architecture, we should have in mind the intellectual background of certain fundamental discourses on the idea of space. Thus, the paper<sup>1</sup> aims to strengthen the dialogue between architectural history and the history of architectural ideas, arguing that a reconstruction of the specific mental context (what we have named a “mental space”<sup>2</sup>) of each era is absolutely essential for understanding the true meaning of design outcomes that belong to this era.

In order to reveal the connections among architectural history and the history of ideas as they are codified in the case of Boullée, we have to focus on the various interactions between natural science, the Humanities and cultural mentalities during the seventeenth and eighteenth centuries, in relation to certain ideas of space. It is common knowledge that seventeenth and eighteenth-century thought has developed different ways of understanding the concept of space in the realms of science, philosophy, metaphysics and architecture. Nevertheless, especially during the period of the European Enlightenment, those different domains of human knowledge seem to present certain common properties and intellectual affinities, despite the obvious fact that serious controversies and conflicts often emerged inside the distinct ‘theoretical, mental and conceptual spaces’ of the above disciplines. A brief outline of those conceptual correspondences and divergences will be developed, through the comparative interpretation and reconstruction of texts written by important representatives of the spirit of the Enlightenment and their predecessors. A preliminary selection of certain basic characteristics of the various ideas of space, as they are expounded in those texts, apart from shedding some light on the mental context that could explain some of Boullée’s creations, could also contribute to a basic problem of contemporary interdisciplinary research in many academic institutions: the uneasy relationships and the frequent absence of dialogue between the natural sciences, social sciences and the Humanities. This problem is well known in the form codified by C.P. Snow in his book called “*The Two Cultures*”.<sup>3</sup>

### **The ‘Scientific Revolution’ of the seventeenth century and the concept of absolute space**

During the Scientific Revolution of the seventeenth century the seminal works of Galileo Galilei, René Descartes, Henry More, Blaise Pascal and Pierre Gassendi articulated a new scientific and humanistic worldview that culminated in the era of the Enlightenment. Those works paved

the way towards one of the most important contributions of seventeenth-century knowledge concerning the question of space: the conception of the idea of *absolute space* as formulated by Isaac Newton.<sup>4</sup>

Newton, contrary to Descartes, considered the existence of space independently from the physical matter of the bodies that occupy a certain part of it.<sup>5</sup> In his major work “*Philosophiae Naturalis Principia Mathematica*”, which was the first complete hypothetico-deductive system of mechanics,<sup>6</sup> Newton distinguished between *absolute space* and *relative space* and defined the first as *homogeneous, immovable*, completely independent from anything external, sensible or material.<sup>7</sup> As he writes characteristically:

Although time, space, place, and motion are very familiar to everyone, it must be noted that these quantities are popularly conceived solely with reference to the objects of sense perception. And this is the source of certain preconceptions; to eliminate them it is useful to distinguish these quantities into absolute and relative, true and apparent, mathematical and common. Absolute space, of its own nature without reference to anything external, always remains homogeneous and immovable.<sup>8</sup>

This new idea of space functioned as an absolute system of reference and measurement for the real properties of physical and sensible bodies.<sup>9</sup> It was a kind of uniform pedestal of natural bodies and their movements. Newton’s absolute space had a real existence and was connected with God, as one of his attributes or as his *sensorium*.<sup>10</sup> The concept of absolute space was gradually accepted -not without resistance- from the majority of natural philosophers and scientists during the era of the Enlightenment,<sup>11</sup> because it did not only serve as a foundation for the new natural science of modernity that placed man at the center of the world as a free, autonomous, independent and creative source of knowledge but also did not exclude certain theological and religious ideas concerning the existence of God.<sup>12</sup>

Consequently, the concept of absolute space, in reality a *mathematical and mechanical* concept that was developed within the framework of seventeenth-century natural science, acquired a new philosophical meaning in the beginning of the eighteenth century and was connected with wider cultural connotations, aided by the intervention of Newton himself (*General Scholium, Opticks*).<sup>13</sup>

### **The intellectual origins of the Enlightenment: John Locke and pure space**

John Locke took over Newton’s idea of absolute space and transformed it into the concept of *pure space*,<sup>14</sup> within the framework of his own epistemological research for the foundation of human understanding through the analysis of the ideas of the human mind.<sup>15</sup> According to Locke, pure space is an idea of the mind completely distinct from the idea of solidity that accompanies the materiality of bodies: pure space does not have solidity, nor presents any material resistance, confirming Newton’s thought, when transferred into the field of conceptual knowledge, into the internal structure of human thought.<sup>16</sup>

For Locke, space is a transformation of simple ideas of the mind: it has a metric nature, it is connected with distance and it is characterized by *immensity*.<sup>17</sup> The parts of space, which can be conceived independently from the solidity of matter, are indivisible, thus pure space is immovable.<sup>18</sup> Locke held the view that if space was not separate from material bodies, then he would have to accept that the bodily matter of the world is infinite and thus deny from God the power to annihilate a part of materiality.<sup>19</sup> Thus, in Locke’s thought, as in Newton’s, this same possibility of the existence or *of the conception within the human mind* of the existence of an infinite, immense, void space, totally independent from material objects, was closely connected

with the existence of an omnipotent God.<sup>20</sup>

### **Enlightenment controversies: Berkeley, Clarke, Leibniz**

The idea of absolute space gradually assumed a wider cultural content and a deeper metaphysical meaning, and, through Locke and its transformation into pure space, acquired an important epistemological dimension in relation to the general conditions of human knowledge. The complex mathematical, metaphysical and epistemological implications of the concept of space were revealed with persistent clarity during the first two decades of the eighteenth century, not only through George Berkeley's attack on Newton's idea of absolute space and his relevant view that there can be no pure space without the existence of material bodies,<sup>21</sup> but mostly through the correspondence between Gottfried Wilhelm Leibniz and Samuel Clarke in 1715-1716.<sup>22</sup>

Clarke, a defender of Newton's absolute space, and Leibniz, opponent of Newton and advocate of the relational theory of space - namely the view that space is only the order of co-existence of material bodies<sup>23</sup> and does not have a real, independent existence - through their correspondence,<sup>24</sup> proved that those two distinct and different ideas of space<sup>25</sup> were not only connected with scientific and mechanical problems - such as the movement of bodies and the nature of physical forces - but referred to broader cosmological and humanistic issues and promulgated divergent interpretations concerning the idea of God and its relation to the world.<sup>26</sup> Leibniz's view of relative space proves the above assertions and is intimately connected with his

demonstrations against real absolute space, which is an idol of some modern Englishmen. I call it an idol, not in a theological sense, but in a philosophical one; as Chancellor Bacon says, that there are *idola tribus*, *idola specus*. These gentlemen maintain therefore, that space is a real absolute being. But this involves them in great difficulties; for such a being must needs be eternal and infinite. Hence some have believed it to be God himself, or, one of his attributes, his immensity. But since space consists of parts, it is not a thing which can belong to God. As for my own opinion, I have said more than once, that I hold space to be something merely relative, as time is; that I hold it to be an order of coexistences, as time is an order of successions.<sup>27</sup>

Leibniz's attack on Newton's absolute space, as it is developed in the Third Paper to Clarke, does not only show his theological reservations about the new 'idol of the tribe and the cave'. He codifies very precisely that Newton's absolute space was intimately connected with the categories of 'infinity' and 'immensity', which will play a crucial role in Boullée's architectural thought.

### **Voltaire and the public spaces of the city**

Voltaire, a major representative of the eighteenth century and the spirit of the French Enlightenment, had a thorough knowledge of the complex issues related to the different ideas of space propounded by Newton, Locke and Leibniz, and their multiple consequences for metaphysics, epistemology and cosmology, as can be confirmed by his "*Lettres Philosophiques*" (1734). In this work, and especially in the 13<sup>th</sup> Letter on Locke, Voltaire acknowledges that space belongs to the metaphysical concepts or the abstract ideas.<sup>28</sup> Moreover, Voltaire refers to the absolute power of God to influence matter and thus assumes the possibility of the existence of thought or feeling through matter, rejecting the Cartesian dualism between thought and matter as extension.<sup>29</sup> In this context, Voltaire accepts the independent existence of space and its difference from matter, contrary to Descartes. Consequently, in the 14<sup>th</sup> Letter, Voltaire identifies

the complete conceptual break between the full world of Descartes and the empty world of Newton.<sup>30</sup> Voltaire's ideas on space were further elaborated in the book called "*La Métaphysique de Neuton, ou Parallèle des Sentimens de Neuton et de Leibnitz*",<sup>31</sup> published in 1740, which articulated a new version of the first part of his "*Eléments de la Philosophie de Newton*", that had appeared two years earlier. In the first work, Voltaire attempts to reveal the metaphysical implications of Newton's natural science, accepting the existence of a *non-resistant space* (*Espace non-resistant*),<sup>32</sup> that is absolutely real and results necessarily from God's existence.<sup>33</sup> Voltaire's *pure space* (*espace pur*), the void, in direct analogy to John Locke's pure space, is immense and infinite, *immuable*, indivisible and constitutes an infinite mode and attribute of the infinite Being.<sup>34</sup>

Consequently, in Voltaire's thought, the distinction between infinite, pure space and matter, proves that matter does not exist with necessity, and thus shows the freedom of God to create it: pure space, in other words, confirms the freedom of God, which is the foundation of the freedom of man, a kind of freedom related to the spontaneity of human reason.<sup>35</sup> It is argued that Voltaire's approval of the independent existence of space connects the scientific concept of Newton's absolute space with Locke's epistemological concept of pure space, proving the free existence of God as an immaterial cause of matter<sup>36</sup> (*cause immatérielle*) and expounding the natural religion of men as bearers of a common reason. This common reason is the foundation of man's historical freedom, in direct analogy to the freedom of God, and relates to the community of the ethical principles that correspond to it.<sup>37</sup> According to our interpretation of Voltaire's thought, the common reason of men is related to their collective needs and concepts, revealing the importance of universally valid ethical principles for the foundation of political society.<sup>38</sup> In this way, Voltaire transforms the epistemological idea of Locke's pure space<sup>39</sup> and the metaphysical idea of Newton's absolute space into *a social and ethical dimension of space* as a foundation of the natural laws and principles that contribute to the common good of human society (*Bien commun*).<sup>40</sup> Voltaire's pure space reveals the common reference point and the universal rational basis of men, symbolizing the unitary nature of reason as a moral law of humanity that corresponds to the indivisible and unifying existence of an omnipotent God.<sup>41</sup> Consequently, Voltaire transposes the idea of space from the realms of metaphysics, natural science and epistemology to the social-ethical-political field, transforming it to a basis for the development of a civic-cultural science of man. In other words, Voltaire bridges the gap between the natural and the human sciences, through a new conception of symbolic space.<sup>42</sup>

Within the above context of an ethical, political and social conception of pure space, as propounded by Voltaire, it is not altogether irrelevant that in his text called *Des Embellissements de Paris* (1749), the French writer and philosopher argues for the need of creating *large open public spaces* in Paris, insisting on their importance for the ethical honour, the virtues and the quality of the common life of citizens in the urban environment.<sup>43</sup> We may indeed consider that public open spaces of the city are the *most direct symbolic representations of the ideas of absolute and pure space in the context of man's social, political and ethical everyday life*. Besides, Voltaire's ethical and social idea of pure space and its projection on the need for public spaces in the city, conceived as common fields of reference for the cultivation of social reason, public consciousness and civic virtue, had already been formulated, in another form, by the French architectural theorist Jean-Louis De Cordemoy, in 1706, in his text called *Nouveau Traité de toute l'Architecture*. Cordemoy lays stress on the need for spacious public places (*spacieuses*) and the importance of *vaste étenduë*, of a vast expanse, for the magnificence of the city,<sup>44</sup> blending the categories of the scientific and metaphysical ideas of space with the question concerning the architectural creation of public places in the city.

## **The *Encyclopédie*, D’Alembert and Montesquieu: science and aesthetics of pure space**

This constant interaction between different modes and disciplines of knowledge concerning the problem of space permeates the most important document of eighteenth-century French Enlightenment thought, namely the *Encyclopédie* edited by Diderot and D’Alembert. In the article of the *Encyclopédie* named “Espace”, the private and public spaces of the city are characterized as “entièrement immobiles”, as entirely immovable, a category which was used by Isaac Newton to identify his idea of absolute space.<sup>45</sup>

Besides this reference, D’Alembert himself, in his *Discours Préliminaire*, following Locke, distinguished the material bodies from the *indefinite space* in which they are placed (*espace indéfini*), whose parts he characterized as “immobiles” and “pénétrables”.<sup>46</sup> For D’Alembert, indefinite space is the general place of all the material bodies and has a separate existence from their material properties.<sup>47</sup> D’Alembert’s approach to space is the view of a mathematician and a geometer, a rationalist reading stemming from the culture of the natural sciences. The connection of absolute and infinite, unlimited space, considered as a vast expanse, with the public spaces of the city and the spaces of nature, can also be traced in the *Essai sur le Goût* (1754) written by Montesquieu, where it is argued that man’s soul and spirit wishes to constantly expand the horizon of its intuition, to cover more space and to guide man’s vision far away, without any obstacle from particular material objects.<sup>48</sup> According to Montesquieu, art can lead the way in this expanded, clear vision of pure space, natural or man-made, physical or urban.<sup>49</sup> Montesquieu transposes the idea of space into the field of the aesthetics of nature and the philosophy of art, deepening its epistemological and ethical consequences.

## **Immanuel Kant and space as an architectural framework of the mind**

Immanuel Kant, as a true representative of the Enlightenment, realized this new importance of space for the understanding of nature: in his Pre-Critical and important text called “*Concerning the Ultimate Ground of the Differentiation of Directions in Space*” (1768), Kant proved the distinct reality of the *absolute cosmic space of nature*<sup>50</sup> (*dem absoluten WeltRaum*), independently of matter, through the qualitative differentiations of the orientations of geographical and physical space, which are related to the physiological structure of the human body and especially to its distinctions between the left and the right hand.<sup>51</sup> Thus, Kant rejects the relational theory of space and accepts the existence of a *geometrical, universal, absolute and original space* that can only show and explain the physical differentiation of directions that we feel in geographical and physical space. This absolute space, according to Kant, is not an immediate object of external sensation: it is a *fundamental concept* (*Grundbegriff*) that allows for the possibility of every sensation.<sup>52</sup> This idea will be further developed by Kant in his *Critique of Pure Reason* (1781), in the section of the work entitled *Transcendental Aesthetic*, where space is defined as the pure order of sensibility, without any reference to sensible or material qualities of the objects, namely as a *pure intuition a priori* that forms the condition of the possibility of an outer experience of material objects.<sup>53</sup> Consequently, space is single, one and the same, has infinite magnitude and is characterized by objective validity, being a universal, common condition of the human capacity of representation of the sensible and material world.<sup>54</sup> In other words, Kant internalizes Newton’s concept of absolute space within the mind of the knowing subject. At the same time, Kant’s idea of space reminds Locke’s and Voltaire’s *pure space*. We claim that Kant transforms the ideas of pure and absolute space into a constitutional condition, a constructional *principle and type of knowledge* of the external world. In this respect, Kant attributes to space an organizational and architectural role in the shaping of man’s thought.<sup>55</sup>

## Étienne-Louis Boullée and pure architectural spaces of an ideal city

It is argued that the visionary architect Étienne-Louis Boullée,<sup>56</sup> in his text *Architecture. Essai sur l'art*<sup>57</sup> (1781-1793) develops a 'Kantian' *philosophy of architecture* that is trying to be commensurate with the spirit of the Enlightenment and the ideas of absolute and pure space, as we have already analyzed them.<sup>58</sup> Boullée's emphasis on the foundation principles of architectonic art, on the moral and social ideas that are created by architecture within the mind of men, on their relation to an intuition of God through nature that is ordered architecturally, along with his insistence on the priority of conceiving certain notions and ideas within the human mind before their physical realization into architectural works, remind relative thoughts formulated by Voltaire and Kant. Boullée, Kant and Voltaire seem to share very similar ideas concerning the metaphysics of Deism, the critical power of the human mind and the importance of moral principles and a priori concepts of reason for the structure of the sensible and social experience of man.<sup>59</sup>

In his numerous utopian designs, Boullée attempts to combine those ideas with the principles of pure geometry, in order to create the foundation of an ideal city which consists of large, exterior and interior public spaces and monumental buildings that express a symbolic, artistic, political and ethical content. The ideal city of Boullée's utopian drawings puts in mind of certain relevant ideas expressed by Voltaire, Montesquieu and Cordemoy.<sup>60</sup> In the context of Boullée's transcendental aesthetic theories and designs of pure architectural spaces and shapes, and in complete line with Montesquieu's thought, it is ascertained that perfect and regular geometrical figures, such as the sphere, create the ideas of harmony, perfection and symmetry within the human mind, thus urging the soul to expand its intuitions and embrace the whole universe.<sup>61</sup>

The written presentation of Boullée's utopian designs in his *Essai* leaves few doubts as to the idea of space that his ideal city and its monumental buildings delimit and embody: *immensity*, *grand tout* and *vast* are some of the categories that he uses to characterize his seemingly 'Newtonian' or 'Voltairean' concept of space. For example, describing his project for a 'public library', he writes:

Ce projet consiste à transformer la cour...en une *immense* basilique éclairée par le haut...J'ai donc voulu que nos richesses littéraires fussent présentées dans le plus bel ensemble possible. C'est pourquoi j'ai pensé que rien ne serait plus *grand*, plus noble, plus extraordinaire et d'un plus magnifique aspect, qu'un *vaste* amphithéâtre de livres.<sup>62</sup>

We claim that Boullée conceives space as a *pure expanse (étendue)* that functions as an independent, unitary base, containing completely abstract, geometrical shapes of architectural forms.<sup>63</sup> The cosmological, Newtonian ground of this conception of space is clearly formulated by the French architect, when he presents his design for a basilica:

Si avec de grandes images on est sûr de présenter aux hommes un tableau imposant, certes un temple érigé en l'honneur de la divinité doit toujours être vaste. Ce temple doit offrir l'image la plus frappante et la plus grande des choses existantes; il faudrait, si cela était possible, qu'il nous parût l'univers... (il doit) offrir le tableau de l'espace par le nombre d'objets que doit naturellement contenir une grande étendue.<sup>64</sup>

Moreover, we assert that Boullée understands architectural space as a geometrical measure, a human intuition and a delimitation of Newton's absolute space of nature, which is called by the French architect "*espace inconcevable*" – a very similar expression to the *espace indéfini* of D'Alembert – namely as a definition of natural, cosmological space within the context of distinct, pure, exterior or interior public spaces of the city.<sup>65</sup> In that way, according to our interpretation of

Boullée's thought, nature is activated, delimited and enclosed through architecture, and absolute, cosmic space is absorbed and related to pure, civic, public exterior places and to 'infinite', seemingly unlimited interior architectural spaces, which try to unite the universal, immense space of nature with the finite spaces of human life and civilization.<sup>66</sup> Boullée is quite conscious of this intention, when he describes the effects of perspective in his basilica:

Les objets sont alors dans une disposition telle que tout contribue à nous procurer des jouissances. Leur multiplicité nous offre l'image de la richesse. La plus grande magnificence et la symétrie la plus parfaite, voilà ce qui résulte de l'ordre qui les établit dans tous les sens et les développe à nos regards de manière que nous ne puissions pas les nombrer. En prolongeant l'étendue des allées de sorte que leur fin échappe à nos regards, les lois de l'optique et les effets de la perspective nous offrent le tableau de l'immensité.<sup>67</sup>

In other words, Boullée seems to internalize within his vast public buildings the absolute, immense space of the natural sciences of his times, transforming it to a pure, internal space. Boullée transposes and applies Locke and Voltaire's 'pure space' into the field of architectural creation, inaugurating a utopian city of the Enlightenment. At the same time, this transposition or translation of an idea of space from the realm of natural and mathematical science to the field of architecture as a civic, social and human science, creates tensions, ambiguities and contradictions. Absolute and infinite space must be delimited and enclosed, in order to become habitable, meaningful and human. This geometric and social limitation produces a "relative", finite space, a distinct public place, which "*makes nature work*", as Boullée says ('mettre la nature en oeuvre').<sup>68</sup> We argue that an antinomy in Boullée's thought arises from his will to convey the idea or the intuition of absolute Newtonian natural space through a cultural, enclosed, relative, delimited human space. Helen Rosenau codifies this tension through the conceptual dualisms of finite/infinite and static/dynamic.<sup>69</sup>

The tension in Boullée's thinking and projects arises from the inherent nature of architecture as a discipline. Since architecture uses material and sensible bodies for the articulation and arrangement of habitable space, it is bound to the relative space of Leibniz. We could say that architectural spaces are always Leibnizian in a sense, since what they offer are orders of coexistences between material elements and bodies. The means of architectural expression are material articulations of relations among sensible elements. Thus, architectural space is always relative and finite. The real importance of Boullée's architectural ideas and creations is that he is trying to overcome the inherent limit of his discipline. Using finite arrangements of material relations among bodies, he is trying to suggest or to convey the idea, the image or the intuition (in a Kantian sense) of absolute, pure, infinite space, as it was articulated by Newton, Voltaire and Locke. This impossible limit is what gives meaning to Boullée's utopian designs. And his tools for suggesting those ideas are purely architectural: perspective, relations and alternations between light and shade, creative use of the void, absence of "functional" traces concerning the "use" of the buildings. Boullée thus arrives at an idea of pure or absolute architecture, an architecture with no functional objects inside its vast spaces. We claim that ignoring this essential intention of Boullée, namely the fact that through Leibnizian space<sup>70</sup> he approaches the impossible task of depicting absolute Newtonian space through architecture, we lose all the importance of his work. And we could not arrive at this conclusion if we did not reconstruct the intentional horizon of the world of ideas that informed his era and which reveals the true meaning of his designs. We claim that the dialectical tensions of Boullée's projects and thoughts stem from his attempt to reconcile Newton's and Leibniz's ideas of space through the language of architecture. A similar argument, but based on entirely different grounds, is put forward by Martin Bressani, in his important study "Étienne-Louis Boullée. Empiricism and the Cenotaph for Newton", where he writes:

Boullée's purified spectacle encapsulates a vision of the infinite. He attempts to represent the inconceivable not through convention, but in a natural way. In this sense, his project reflects the anxiety generated by modern science. On the one hand the successes of Newtonian science made it possible to think of oneself as able to grasp the infinite and therefore as being at the center of all things. On the other hand, one realized with uneasiness that this (empirical) science depended necessarily upon a relative point of view.<sup>71</sup>

Those dialectical tensions between the “infinite” or “absolute” and the “relative”, between the Newtonian and Leibnizian concepts of spatiality, are best revealed in the more characteristic and well-known architectural project of Boullée: his monument dedicated to Isaac Newton, in the form of a gigantic sphere that delimits an empty, public interior space, symbolizing the vast cosmos.<sup>72</sup> Boullée expressly states that through this utopian design he wanted to guide the citizens to a *determined* intuition of the “immensity of space”,<sup>73</sup> which Newton himself had proposed with the concept of absolute space, thus closing a full circle of ideas of space during the Age of the Enlightenment.<sup>74</sup> As he writes:

C'était dans le séjour de l'immortalité, c'était dans le ciel que je voulais placer Newton. Avec le dessin sous les yeux, *on verra ce qu'on aurait regardé comme impossible*. On verra un monument dans lequel le spectateur se trouverait, comme par enchantement, transporté dans les airs et porté sur des vapeurs de nuages dans *l'immensité de l'espace*.<sup>75</sup>

Étienne-Louis Boullée conceives the urban spaces of his ideal city as a transference of the absolute, geometrical and mathematical space of Newton and the mental, social and ethical spaces of Locke, Voltaire and Kant into symbolic, Leibnizian architectural spaces. Those spaces communicate a public sphere of collective ideals and values which aims to unify the Humanities and the natural sciences.

This interpretation can shed new light on the place of Boullée's contributions and thoughts within the history of western architecture. Emil Kaufmann was right in his assertion that the so-called ‘Revolutionary architects’ paved the way to the inauguration of the Modern Movement of the 20<sup>th</sup> century.<sup>76</sup> But he misses the real reason behind this statement. Kaufmann believes that Boullée's importance lies in a new conception of architectural forms. He writes:

Boullée is significant as marking the first conscious employment of the new forms.<sup>77</sup> Of the three (revolutionary architects), Boullée represents primarily the struggle for new forms.<sup>78</sup>

We argue that Boullée is a harbinger of Modernity not because he inaugurated a new, “autonomous” vocabulary and syntax of forms,<sup>79</sup> but because he displaced architectural discourse from a focus on the category of ‘form’ to a focus on the category of ‘space’. And that was ‘revolutionary’ indeed. Moreover, it is revolutionary because space is understood, maybe for the first time, as an a priori construction or structure of the human mind, in a Kantian perspective. This idea has immense consequences for the conception of architecture as a discipline, providing a fatal blow to the empiricism associated with Vitruvius. Moreover, Boullée tried to suggest through finite, material means, an absolute, pure, public space. And that is exactly what the Modern Movement of the 20<sup>th</sup> century tried to achieve.

### **Architectural space as a field of dialogue between human sciences and natural sciences**

Ernst Cassirer, in the Introduction to his classic work titled *The Philosophy of the Enlightenment*, acknowledges that, during the eighteenth century, the social role of philosophy was greatly transformed. He writes:

Instead of confining philosophy within the limits of a...doctrinal structure, the Enlightenment wants philosophy to move freely and in this immanent activity to discover the fundamental form of reality, the form of all natural and spiritual being.. Philosophy is no longer to be separated from science, history, jurisprudence and politics; it is rather to be the atmosphere in which they can exist and be effective.<sup>80</sup>

This ideal of the unity of human knowledge, which can be attested from the new role of philosophy during the eighteenth century, was also confirmed through our examination of the various ideas of space from Newton and Voltaire to Boullée. Our analysis has attempted to show that the *multiple metamorphoses of the ideas of absolute, pure and relative space*, in mathematics, epistemology, metaphysics, geometry, natural science, aesthetics, ethics and civic architecture, despite their internal disciplinary controversies, maintained family resemblances, analogies and correspondences that affirmed a dynamic conceptual unity of the category of ‘space’ in the various dimensions, mentalities, discourses and functions of human knowledge during the Enlightenment. Consequently, the “unity” of the Enlightenment stems from a series of “metamorphoses” and adjustments of a general cultural atmosphere and mentality concerning the idea of space into the specific “languages”, the peculiar aims and the distinct conceptual tools of different disciplines. This movement of transpositions creates tensions and divergences that naturally arise but does not exclude the possibility of a fertile dialogue between the natural and the social and human sciences. The examples of the *Encyclopédie*, Voltaire and Boullée show that the *idea of space* was a central axis of reference and coherence for the humanistic thinking and the universal values of the Enlightenment, building the possible foundations of a unified science of man’s social existence within the public, open architectural spaces of the city, whether real or ideal.

Today, the Humanities and the natural sciences are usually considered as totally independent and distinct disciplines, without any horizons of a mutual dialogue. It is argued that the case of Boullée has disclosed one interesting possibility: architecture could function as the creative environment of those “*open spaces of thought*” of whom Goethe speaks,<sup>81</sup> namely as a plane of interaction between the human sciences and the natural sciences, combining their inherent tensions into a communicative space that could contribute to a new science of human culture. Thus, we have seen how the strengthening of the connection between architectural history and the history of ideas not only reveals a different way of understanding Boullée’s historical position within dominant traditions of Enlightenment and Modern thinking but opens the way for an enrichment of contemporary architectural education with valuable epistemological principles. In other words, the history of philosophical and architectural ideas can procure new meaningful interpretations of design outcomes and even enrich contemporary design methodologies with useful conceptual tools.

## Notes

1 This study is an enlarged English version of the introductory part of a Post-Doctoral Research titled *Ideas of Space in the Twentieth Century*, which was elaborated at the Department of Humanities, Social Sciences and Law of the National Technical University of Athens from February 2007 to September 2008. I would like to thank Professor *Aristides Baltas*, the supervisor of this research, for his important comments and constant support during the project, and also for his decisive

contribution to its publication in Greek (Nissos Publications, Athens, 2009), in the form of a book bearing the same title. A much shorter version of this study was read as a paper at the *12<sup>th</sup> International Enlightenment Congress*, which took place in Montpellier from 8 to 15 July 2007. The theme of the Congress was *Sciences, Techniques et Cultures au XVIII<sup>e</sup> Siècle*, and was organised jointly by the *International Society for Eighteenth-Century Studies* (ISECS) and the *Société*

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- 2 Terzoglou (2008: 74).
  - 3 Snow 1998.
  - 4 For a general account of the development of the ideas of space during the Scientific Revolution of the seventeenth century, see Čapek (1976: 73-95, 273-288).
  - 5 Huggett (1990: 126-130).
  - 6 Jammer (1954: 95).
  - 7 Newton (1999: 408-409) and Einstein (1954: xv-xvii).
  - 8 Newton (1999: 408).
  - 9 Jammer (1954: 99-104) and Newton (1999: 409-415 and Earman (1989: 6-15).
  - 10 Jammer (1954: 110-117).
  - 11 See Leonard Euler, *Theoria Motus Corporum Solidorum*, in Čapek (1976: 113-119) and Jammer (1954: 110-139).
  - 12 Jammer (1954: 2-3, 127-132). In this respect, see the works of Jacob Raphson, John Jackson, Joseph Clarke and Isaac Watts in Jammer (1954: 129). Also see the ideas of William Whiston in Israel (2001: 515-516, 518-520).
  - 13 Newton (1999: 939-944) and Newton (1952: 403-404).
  - 14 Locke (1959: 151-158).
  - 15 Locke (1959: 27-32).
  - 16 Locke (1959: 153-158).
  - 17 Locke (1959: 218-224).
  - 18 Locke (1959: 225-228, 231-232).
  - 19 Locke (1959: 231-233).
  - 20 Locke (1959: 232-237).
  - 21 Berkeley (1982: 67-69).
  - 22 Huggett (1999: 159-160). And Meli (2002: 455-464).
  - 23 Huggett (1999: 146-147) and Israel (2001: 521-522) and Leibniz (1772: 337-339). For an examination of Leibniz's philosophical thought in relation to our subject see Russell (1900: 118-130).
  - 24 Alexander (1956: 5-125).
  - 25 For an elaboration and examination of this old debate from a contemporary perspective of the natural sciences see Earman (1989: 1-5, 12-26, 154-208).
  - 26 Huggett (1999: 143-168) and Čapek (1976: 277-286).
  - 27 Alexander (1956: 25-26).
  - 28 Voltaire (1734 : 124).
  - 29 Voltaire (1734: 128-137).
  - 30 Voltaire (1734: 139-141).
  - 31 For an examination of the metaphysical dimensions of Newton's thought see Stein (2002: 256-307).
  - 32 Voltaire (1740: 1-8, 12).
  - 33 Voltaire (1740: 9-12).
  - 34 Voltaire (1740: 12-15).
  - 35 Voltaire (1740: 12-27).
  - 36 Voltaire (1740: 64).
  - 37 For the relation of Voltaire's ideas on God with the ethical and rational values of man's social and historical existence see Deprun (1973 : 687-689), Copleston (1960: 20-23), Rosenthal (1955: 166-167) and Hazard (1963: 117-132, 391-403).
  - 38 Voltaire (1740: 22-29).
  - 39 For a general account of the influence of Locke's philosophical system on the era of the Enlightenment see Aarsleff (1994: 252-289) and Israel (2001: 522-527).
  - 40 Voltaire (1740: 30-32).
  - 41 Voltaire (1740: 32-35).
  - 42 Etlin (1994: 3-4, 24-25).
  - 43 Voltaire (1749: 99-111). For an analysis of the idea of the city as virtue and human progress in Voltaire's thought, see Schorske (1998: 6-7, 37-39).

- 44 De Cordemoy (1706: 130-131, 193-194).
- 45 Article "Espace" (Droit Civil) (1755: 956).
- 46 D'Alembert (1751: v).
- 47 D'Alembert (1758: v-vii). See also the Article Lieu (1765: 495-496).
- 48 Montesquieu (1993: 37).
- 49 Montesquieu (1993: 37-38).
- 50 Kant (1992b: 365-366).
- 51 Kant (1992b: 366-370). See also Walford, Meerbote (eds.) (1992: xv-xxxvii, lxxx, lxi, 458-459, note 4) and Huggett (1999: 203-212).
- 52 Kant (1992b: 371).
- 53 Kant (1998: 155-158) and Parsons (1992: 62-100). For the importance of the *Transcendental Aesthetic* for the foundation of public space and *espace laïque* see Porset (2003: 30, n. 12).
- 54 Kant (1998: 158-161, 192).
- 55 Kant (2006: 112, 674-675) and Kant (1992a: 395-400). For the relation of the transcendental aesthetic to the transcendental analytic and the problem of space in general, see Gardner (1999: 70-85). For the relation of Kant's thought to Newton's ideas see Clavier et al. (2003: 42-68).
- 56 Kaufmann (1939: 212-227).
- 57 Montclos (1994: 111-177).
- 58 Boullée (1993: 19-23, 28-31).
- 59 Boullée (1993: 34-36, 45-47, 52, 60-62).
- 60 Boullée (1993: 115, 117, 120) and Montclos (1994: 177-181). See also Etlin 1994: 13-24).
- 61 Boullée (1993: 61-62).
- 62 Boullée (1993: 133).
- 63 Boullée (1993: 70, 76, 81-82, 84, 91-93, 109, 143-144).
- 64 Boullée (1993: 81).
- 65 Boullée (1993: 84, 168).
- 66 Boullée (1993: 67-69, 71, 81) and Madec (1986: 80).
- 67 Boullée (1993: 82).
- 68 Boullée (1993: 30-31).
- 69 Rosenau (1953: 13).
- 70 Boullée (1993: 168).
- 71 Bressani (1993: 39).
- 72 For an analysis of the relations between Boullée's Monument to Newton and the scientific thought of his era see Stafford (1982: 241-278). For an exhaustive interpretation of Boullée's project see Vogt (1969). For an extremely interesting philosophical-epistemological interpretation of Boullée's Cenotaph for Newton, see Bressani (1993: 47-53).
- 73 Boullée (1993: 143).
- 74 For an examination of the concept of space during the Enlightenment, see Vidler (1995).
- 75 Boullée (1993: 142-143).
- 76 Kaufmann (1952: 434) and Kaufmann (2002: 17-25, 84-85).
- 77 Kaufmann (1939: 213).
- 78 Kaufmann (1952: 435).
- 79 Kaufmann (2002: 27-39, 61-63).
- 80 Cassirer (1951: vii).
- 81 Cassirer (1951: 360).

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