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The One or the Many?

Boscovich, Kant, and the Metaphysical Puzzle of Space

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Si nemo ex me quaerat, scio; si quaerenti explicare velim, nescio.

Augustinus, *Confessiones*, XIII, XI, 14

Summary

The supplement »De Spatio et Tempore« to Roger Boscovich's Theoria phlosophiae naturalis *(1763), together with some notes to Stay's* Philosophia recentioris*, contains the more comprehensive explanation he gave to the concept of space in itself (Suppl. I) and in its relationship to human knowledge (*Suppl. *II). As well known, Boscovich wanted to reach a compromise between Leibniz »relational« space conception and Newton's views about space as a sheer system of coordinates.*

Boscovich was not the only one in 18th century scientific and scholarly community to seek for such a via media between the two great masters of 17th and 18th–centuryscience. Another interesting, independent and — to some extent — opposite case was Immanuel Kant, who from an initial inclination to Leibniz' and Euler's relationalism developed in his Critique of Pure Reason *(1781, 1787) a space conception mostly due to Newton's idea of an absolute space (a conception in which, however, the Leibniz–Euler flavour is not completely unperceivable). In Kantian final idea, the plurality of the world is cancelled out by the uniqueness of an order superimposed to the things by the space–time intuition.*

On the other hand, Boscovich shapes in his Theoria *a general »pluralistic view« (but one in which Newton's influence is not entirely absent) where the order of things is an emergent property of their interactions (see for instance the »doctrine of modes« expressed in Suppl. I, 1–4). The broadness of this perspective is also shown by his rejection of the idea of the continuity of matter and space in the* Theoria *itself and in some important letters (mostly to his friend G. S. Conti) where he tried to give a complete and plain account of the philosophical underpinnings of his natural philosophy.*

Key words: *concept of space in the 18th century, relationalism, absolute space, Boscovichean »real models of existence«, Immanuel Kant*

1. *Introduction. Methodological remarks*

The metaphysical significance of the concept of space and the philosophical duty to use mathematics »in the genuine application of its propositions to the objects of philosophy« is articulated by Kant (1763, p. 167: 4-5; Kant 1992a, p. 207) in stating that »metaphysics seeks to discover the nature of space and establish the ultimate principles, in terms of which its possibility can be understood« (1763, p. 168: 3-4; Kant 1992a, p. 207). The »critical« position he advanced in *The Critique of Pure Reason*, where space and time are regarded as the two pure intuitions one has to possess before and in order to have any possible experience, is the clear result of a somewhat intricate path through the problem of space as it was posed — in conflicting ways — by Leibniz and Newton. To a certain extent, it is the final effect of Kant's early (so-called »pre-critical«) attempts to reconcile the Leibnizian conception of pure relational space with the Newtonian notion of absolute space.

In this paper I will try to compare Kant's search for a compromise between these two traditions with the (roughly contemporary) attempts by Roger Boscovich. I will not argue that their particular solutions to the problem of space in themselves prodded subsequent scientific or philosophical achievements; rather, I will maintain that they represent the emergence of space as a philosophical (»metaphysical« in their own words) subject.

The attempt to compare Boscovich's and Kant's works is not new; what is new in this paper, though, is the special subject (i.e. space) and the style of the comparison which I aim to advance. The analogies between their respective conceptions of force, usually dubbed altogether as dynamism, have often been emphasized with reference to Boscovich's 1763 *Theoria philosophiae naturalis* (first published with some differences in 1758) and Kant's 1786 *Metaphysical Foundations of Natural Science* (see e.g. Jammer 1957, pp. 170-183; McMullin 1979, pp. 116-126; Friedman 2004, p. x). Most studies devoted to Boscovich and Kant correctly recognize that their results were largely independent of one another. In fact, something like a *Wirkungsgeschichte* of Boscovich's work on Kant is a desperate attempt, given the lack of direct references to the former in the latter's works (and vice versa). We actually have clues that as early as 1759 Kant had read a review of Boscovich's*Theoria* by the

philosopher Moses Mendelssohn; nevertheless, Kant never mentioned Boscovich in his writings (Baldini 2006, p. 445).

Therefore, it is impossible to prove or disprove any »influence«, although there are of course resemblances. The circumstance that they did not know the works of each other excludes the possibility of a history of source reconstruction, where evidence of localized and non-generic »influence« is produced in a precise and measureable way. Indeed, source reconstruction implies that it is always possible to specify the »channels« and manner through which the relevant information has been broadcasted (a successful »Boscovichian history of effect« in the Jesuitic context is provided e.g. by Baldini 1992), but there is a patent lack of information regarding Boscovich and Kant. So what is the historical significance of such comparisons? Is a reference to a broad concept of influence —which seems to be implied in McMullin (1979) and Friedman (2004), not to speak of Jammer (1957) and the »classical« history of ideas — really justifiable? To take an example, in which sense exactly was the dynamical theories of matter in Boscovich's and Kant's way so »influential« in the natural philosophy of the 18th–19th centuries, as argued by McMullin (1979) and Friedman (2004)? And what kind of influence was this? How could we measure this fact? What kind of evidence do we have? We could obviously count the quotes and calculate a sort of »h-index«, »impact factor« or so; but do quotes provide a reliable measure of the influence of a theory? In fact, there could be more than one reason behind a quote or a statement of favour, and the aims of dedicatory letters, which were usually premised to poems and philosophical and scientific treatises, provide a good example of this.[1]

This shows that critical reflection on such historical categories as influence should be of some importance for the history of sciences. To begin with, because objective and measurable things, like quotes, references and statements of favour, are largely unsatisfactory and polysemic in any historical investigation, one is often compelled to invoke some other unspecified but more profound and wide-ranging influence, which remains tacit and only implicitly asserted by a kind of unconscious discourse, possibly capable of being revealed by something like hermeneutics. So, the perspective of historical influence finally lacks

1 For an analysis of a historical case involving Boscovich, see Guzzardi (2012).

all the objectivity it had promised. The problem is that the category of influence is frankly abused: it only bears paradoxes.

Once influences are left aside, how can we account for the synchronic emergence of analogous but non-homologous (scientific) themes? That is to say, cases in which we observe the nearly simultaneous emergence of the same or similar patterns of concepts, which have been developed largely independently. This is precisely the question – which can of course be extended to the diachronic level – we have to face with Boscovich and Kant speaking of the concept of space. Irrespective of any possible material contact between them (such as quotes or declared sympathies), what Boscovich and Kant share is reference to what I term a »common field of discourses« regarding space, originating from reflections on Leibniz and Newton. Such a field of discourses is qualified with reference to a second field, which I dub a »field of dispersion of concepts«: this is a shared ground where words – regardless of their origin in science or philosophy or perhaps literature or theology – are defined, discussed, manipulated in many ways, so that this field is characterized through mutual differences among concepts more than similarities.[2] This is the reason why mutual quotes are much less important than they might appear at first sight. We simply do not need them; we simply do not need something like historical influence.

2. *Boscovich's pluralistic »via media«*

In article number 2 of the first part of his *Theoria philosophiae naturalis*, titled »Expositio, analytical derivation and proof of the theory«, Boscovich points out the analogies between his system and the ideas of both Newton and Leibniz. He maintains that his system »holds to those simple & perfectly non-extended primary elements upon which is founded the theory of Leibniz; and also to the mutual forces, which vary as the distances of the points from one another vary, the characteristic of the theory of Newton« (Boscovich 1763, p. 2: n. 2; Boscovich 1922, p. 35). The analogies go in couples: Leibniz-Boscovich on one side, Newton-Boscovich on the other; but there is also a more general

2 The somehow metaphysical counterpart of this sketch of a historical methodology can be found in Wittgenstein (1969). The application of this point of view to the historical disciplines was advanced by Foucault (1977).

»common point between either of the theories of Newton and Leibniz and my own; namely, that any particle of matter is connected with every other particle, no matter how great is the distance between them«. That is, Boscovich argues for universal, holistic interconnections of all the particles of matter, so that any change in the position of one particle causes a change in the entire system.Then, he indicates what he regards as major differences between his own system and the views of Leibniz and Newton respectively. In particular, the former is blamed for his standpoint in favour of »the continuous extension that arises from the idea of consecutive, non extended points touching one another« (Boscovich 1763, p. 2: n. 3; see also Suppl. I,1; Boscovich 1922, pp. 35 & 393), and the latter for the introduction in *Opticks* of »the three principles of gravity, cohesion and fermentation« instead of »a single law of forces« (Boscovich 1763, p. 2: n. 4; Boscovich 1922, p. 35). This can be done, Boscovich maintains, by describing a force which at very small distances becomes repulsive, thus accounting for the cohesion of bodies as well as for universal gravitation.

So the first issue emphasized by Boscovich in displaying differences and analogies with Leibniz and Newton is not the notion of space, but that of force.[3] However, it is easy to recognize that Boscovich's own conception of force is instrumental for his reflection on space conceptions. As anticipated above, according to him forces acting in physical nature depend only on the distances (therefore, they are of the Newtonian kind) and can be described by means of a unique curve (the so-called *curva boscovichiana*). Its significance can be summarized as follows: every force in nature behaves repulsively at very small distances and attractively at great distances; repulsion grows as distances decrease, so it becomes infinitely great at infinitely small distances; attraction decreases as distances grow, so it becomes infinitely small at infinitely great distances (hence, at great distances it approximates Newton's law). Therefore, at »intermediate« distances the force is alternatively repulsive and attractive, going through points where attraction and repulsion balance one another, resulting in an intensity equal to zero (Fig. 1 provides a geometrical illustration of the law from Boscovich's *Theoria*).

3 For a comparison between Boscovich's and Newton's conception of force, see also McMullin (1979), pp. 116-118.

As is evident from the trend of the curve, Boscovich denies the continuous extension of matter, for an infinitely repulsive force acts between particles at infinitely small distances. Thus, there must always be some distance left between the particles, and Boscovich is right in claiming that his system is based on something very similar to the »primary elements upon which is founded the theory of Leibniz«. Moreover, »points of indifference« where the curve cuts the *x*-axis, meaning that repulsion is perfectly counterbalanced by attraction, are instrumental to Boscovich's conception, since they provide the reason of the cohesion of bodies: »For if two points are at the distance that corresponds to that of any of the limit-points of this kind, & the forces that arise when the distances are changed are great enough […], then the points will maintain this distance apart with a very great force« (Boscovich 1763, p. 76: n. 165; Boscovich 1922, p. 131). In other words, a system formed by two points at a distance like AI (or AG, AL, and so on) remains unchanged, »with a very great force« of cohesion, in any translation.

To reject the continuous extension of *matter* is not equivalent to refusing the continuity of *space*. However, Boscovich expresses this 'empirical' force-based argument at the very beginning of his somewhat philosophical account »Of space and time« in the first Supplement to the *Theoria*:

> I do not admit perfectly continuous extension of matter; I consider it to be made up of perfectly indivisible points, which are non-extended, set apart from one another by a certain interval, & connected together by certain forces […]. Here it is to be seen, with this theory, what is my idea of space, & of time, how each of them may be said to be continuous, infinitely divisible, eternal, immense, immovable, necessary, although neither of them, as I have shown in a note, have a real nature of their own that is possessed of these properties (Boscovich 1763, p. 264: Suppl. I,1; Boscovich 1922, p. 393).

Here, Boscovich refers to his own footnote to verse 625 in the first book of Stay's »Newtonian« poem *Philosophiae recentioris versibus traditae libri X* (Stay 1755). As is known from his correspondence with Stay, Boscovich had provided him with a comprehensive account of Newton's »natural philosophy« which served as a basis for Stay's poem (see Tacconi 1994a, pp. 337-338). Boscovich extensively commented on the verses too: the first two volumes of the poem – respectively encompassing books I-III and books IV-VI – were printed together with supplements and footnotes of his own, while the third volume, con-

taining books VII-X, would only appear in 1792 without Boscovich's observations. Even Supplements I and II to the *Theoria* — »Of Space & Time« and »Of Space & Time, as we know them« respectively — were first published as Supplements VI and VII to the first volume of Stay's poem (Stay 1755, pp. 285-294, with some variations).

Verses 607-653 of the first book (Stay 1755, p. pp. 25-27) are devoted to Newton's theory of space and time, which Boscovich critically comments on in the footnotes. After having described the problem of space and time as »the most difficult among the metaphysical problems« (»difficillimam omnium metaphysicarum quaestionem«, Stay 1755, p. 25: footnotesa to v 607), he explains in the subsequent note b that Newton »ascribes to the absolute space a nature of its own, which is different from the nature of the bodies […]. Unlike bodies, it is not impenetrable; like bodies, it has parts; but these parts, unlike in bodies, cannot be separated so that an interval [*hiatum*] remains between them. Hence, space is everywhere the same, is immovable, continuous; like bodies, it has extension, but no limits […], and is infinite in every direction«.

Boscovich's criticism is partly a theological one, based on the impossibility to think of an absolute, eternal and necessary space which is different from God (*»a Deo distinctum«*); the problem is, he argues, that God does not have parts, while space has (see Tacconi 1994b, p. 399): a fine-grained description would show that it is composed of a plurality of non-extended elements (i.e. points) which cannot be contiguous. Indeed, the title of Suppl. I, n. 6 reads: »Contiguity of points of space is impossible« (Boscovich 1763, p. 265; Boscovich 1922, p. 393), although Boscovich seems to confuse here space with the *res extensa*, or matter. In fact, he maintains that the discrete nature of matter demonstrates the discrete nature of space: in n. 371 of the *Theoria* (Part III: »Application of the theory to physics«, see Boscovich 1763 p. 164; Boscovich 1922, p. 273) he states that »extension necessarily aris[es] from repulsive forces« which act between points of matter, so that »from impenetrability [which is a consequence of the *curva boscovichiana*] there arises extension. It is involved in the fact that some parts are outside other parts; & this of necessity must be the case, if several points cannot at the same time occupy the same point of space«.

Thus – contra Leibniz – »continuity does not really exist«, as Boscovich states in n. 158 of the *Theoria* (Boscovich 1763, p. 72; Bos-

covich 1922, p. 127). As evidence that bodies are composed of a huge number of tiny particles, separated from each other by »little empty spaces, or pores«, Boscovich produces absorption, transparency to the light, and the fact that different bodies have different specific weights because of »the numbers of the empty spaces«. Hence, the continuous extension of matter is only due to sense deception: »We obtain the idea of bodies through the senses; and the senses cannot in any way judge on a matter of accurate continuity; for very small intervals do not fall within the scope of the senses«. This applies, though, only to the physical world we perceive, as he clarifies in n. 372. Things get worse if a mathematical continuum is assumed in describing physical phenomena. In claiming that the arguments raised against Leibniz's idea of extension from non-extended monads do not hold against his own theory, he explains:

> I assume non-extended points that are separated from one another […]. According to my theory, [extension] is founded not on points simply, but on points having distance relations with one another; these relations […] are not founded upon an intermediate space; for this space has no actual existence. It is only something that is possible, indefinitely imagined by us; that is to say, it is the possibility of *real local modes of existence*, pictured by us after we have mentally excluded every gap. […] The extension which I admit is of such nature that it has some points of matter that lie outside of others, & the points have some distances between them, nor do they all lie on the same straight line, nor all of them in the same plane; but many of them are so close to one another that the intervals between them are quite beyond the scope of the senses. In that is involved the extension which I admit; & it is something real, not imaginary, & it will be physically continuous (Boscovich 1763, pp. 169-170; Boscovich 1922, p. 273; emphasis added).

The key point is that distance relations are not »within space«; they are *prior* to space: they are its metaphysical fundament. There is obviously something like a continuous space, but according to Boscovich this is only due to our faculty of abstraction. In n. 142 of the *Theoria* and in Suppl. I,4, he terms this kind of continuous space »spatium imaginarium« (Boscovich 1763, pp. 63-64 & 265; Boscovich 1922, pp. 117 & 393). Note that in n. 142 »imaginary space« is qualified as »indefinitely imagined by us […] after we have excluded every gap«. Thus, Boscovich's phrase »the possibility of real local modes of existence« must not be understood as a condition of possibility in Kant's sense. Rather, possibility means here that it is possible to imagine that a thing could oc-

cupy any point of space in a given instant of time, or — in Boscovich's terms — that one could ascribe to something a certain real spatial and temporal mode of existence. So, in stating that imaginary space is »indefinitely imagined by us«, Boscovich meant that this is something like empty space, only defined by the unlimited possibility of positioning and displacing things:[4] in other words, imaginary space is the whole of all possible positions (Boscovich 1763, p. 267: Suppl. I,11; Boscovich 1922, p. 397). Thus, to think of intervals or gaps amongst things in this context obviously makes no sense, because imaginary space is what remains after the things with their mutual distances have been mentally removed.

This is the reason — Boscovich maintains — for which we tend to think of space as a continuum. Actually, we tend to abstract from the real (i.e. to mentally remove all things) and think of it as imaginary space alone. And yet, at the very foundation of this abstraction lies real space in which things are.[5] It results that Newton's so-to-speak platonic view is completely overturned: in the Scholium to the eight Definitions which open the 1687 *Principia*, he stated that »in philosophical disquisitions, we ought to abstract from our senses, and consider things themselves, distinct from what are only sensible measures of them« (Newton 1960, p. 8). However, in Suppl. I,2, Boscovich declares that both Leibniz's and Newton's followers — i.e. the relationalists as well as the absolutists about space — »must admit some mode of existence that is real & not purely imaginary« (Boscovich 1763, p. 264; Boscovich 1922, p. 393). On the one hand, the only tenable notion of absolute space is that of imaginary space, for which, though, a consistent notion of real space is necessary; on the other hand, the relationalists, who according to the quoted definition from *Theoria* (Suppl. I,2) »consider space itself to be the relative arrangement which exists amongst things that exist«, need the foundation of the concept of relation of distance. Boscovich's claim, in which his *via media* consists, is that the idea

4 Indeed, Suppl. I,4 of the *Theoria* reads: »The possibility of these modes […] is, to my mind, empty space & again empty time, so to speak; in other words, imaginary space & imaginary time«.

5 Note that this is not identical to physical space, because geometrical space is also a kind of real space in the Boscovichian sense, where geometrical figures occur. In other words, real space is space taken with its content, i.e. space which is not endowed with independent existence.

of the real modes of existence provides a sound notion of real space through the founding of the concept of distance relation.

Indeed, space and time as the real modes of existence are qualified as follows: »any point has a real mode of existence, through which it is where it is; & another, due to which it exists at the time when it does exist. These real modes of existence *are to me* real time & space« (Boscovich 1763, p. 265: Suppl. I,4; Boscovich 1922, p. 393; emphasis added). In other words, the expression »mode of existence«, which was deep-rooted in the Jesuits' philosophic tradition (see Baldini 1992, pp. 35-39), means something like a *principium individuationis* in order to distinguish the different positions of the points; therefore, the modes of existence must be discrete, non-contiguous. And given that real space and time are made up of them, real space and time are not continuous either.

Local modes of existence and temporal modes of existence are sorts of indexes which indicate that something is there (exists), e.g. by marking off its boundaries. Indeed, Boscovich maintains that things »are where they are«, i.e. have a position, through real modes of existence; but if things are temporally or spatially displaced, the related index/mode of existence is »switched off«, so that »this mode exists when they are there, & perishes when they cease to be where they were« (Boscovich 1763, p. 264: Suppl. I,2; Boscovich 1922, p. 393). On the one hand, with some concession to Newton's views, absolute space and time, revisited as imaginary space and time, arise when we imagine that the modes of existence could be anywhere in a real space or time interval, and therefore we abstract from the content of that space or time and indefinitely extend it.[6] On the other hand, conceding something to

6 Note that the original theological imprint of the Jesuit philosophical tradition is still present in Boscovich's discourse. Only human minds do not have a »clear and distinct« idea of imaginary space and time, whose possibility »is easily [*indefinitely*] apprehended by us«, because we come to them through abstraction, but God possesses this idea clearly and distinctly. Suppl. I,11 points out that such a possibility is nothing but a system of the possible histories of an aggregate – something similar to what we would nowadays call a *phase space*, the space in which all possible states of a system are represented. God knows this for the entire space, because He is eternal and for Him past and future are like an eternal present: the present of all possible configurations. So for Him, imaginary space and time and real space and time coincide, because He possesses »intellectual intuition« which is precluded to human minds. This conception of Deity as the all-contemplating mind (νοῦς), to which all things are present in their mutual relationships, seems to be profoundly rooted in Western civilization. Remember Homer's *Iliad* (xv, 461), where Zeus's »wise mind« is described as »πυκινὸν νόον«, before which the deeds of mortals are revealed and are impossible to hide (ἀλλ'οὐ λῆθε), since it is like a mirror in which everything is mirrored with all possible consequences. As pointed out by Kerényi (1971, p. 107), »πυκινὸν« originally means the »thick

Leibniz, space is not purely the mutual arrangement amongst things, but is a texture of a plurality of discrete, non-contiguous local modes of existence, which provide a basis for the concept of distance relations, and ultimately for the Leibnizian notion of space as the »relative arrangement amongst things«.[7]

3. *Kant's option for the One*

The idea underlying Boscovich's doctrine of modes is that space (and time) is (are) essentially a plurality of things, and we obtain the notion of space (and time) as a unity (i.e. as something »continuous, infinitely divisible, eternal, immense, immovable, necessary«) only through abstraction. As we have seen, he holds that such a pluralistic doctrine could function as a *via media* between Newtonian absolutism and Leibnizian relationalism regarding space. In the same years in which Boscovich extensively expounded his views on space and time, mainly in his observations to Stay's »Newtonian« poem (1755), in the *Theoria* (1758, 1763), and in a long 1762 letter to his former pupil Giovan Stefano Conti (Boscovich 2008, pp. 61-90),[8] Immanuel Kant made his own attempts to reconcile Newton's conception of space with that of Leibniz, mostly in the wake of Euler's works (see Walford 1999, pp. 306-312), starting with the *Gedanken von der wahren Schätzung der lebendigen Kräfte* (1747) and the *Monadologia physica* (1756). Nevertheless, this led him to develop an alternative view in his 1768 essay »Von dem ersten Grunde des Unterschiedes der Gegen den im Raume«

connection« of »a thing with reference to the close union of its parts, *close, firm, solid«* (see e.g. Liddel & Scott 1940, *ad vocem* πυκνὸς, p. 1552; in the previous 1897 edition the word was also qualified »in opposition to what is loose and porous«, p. 1344). Zeus is the daylight (Kerényi 1971, p. 198) to which all things in all possible connections are immediately revealed and present, so to speak without pores.

7 Note that distance relation is not *defined*, but *founded*. The local and temporal modes of existence are a general schema which tells us how we spatially and temporally distinguish things; but this does not tell us how we gain a measure once we have distinguished things. In other words, Boscovich's space, though in any case three-dimensional (while time is monodimensional (Boscovich 1763, p. 266: Suppl. I,10; Boscovich 1922, pp. 395, 397)), could potentially be subject to a multiplicity of metrics.

8 In this important piece of correspondence (Boscovich to Conti, Pera di Costantinopoli, 26 February 1762), Boscovich tries to give a comprehensive explanation of his system in plainer terms and without technicalities. For further details regarding this letter and the rejection of the concept of continuity and actual infinity which is involved, see Guzzardi (2009), in particular p. 143.

— a view which, in its commitment to the notion of space as a unity – foreshadows the critical conception of space as a pure form of intuition.

As pointed out by Walford (1997, 2001), it would be mistaken to understand the German term *Gegend* as »region«, as in the most usual cases; in this context and taking into account a number of Kant's own statements, it should be rendered as »direction«, meaning a »form of directionality« (Walford 2001, pp. 413-418). So, Walford has proposed a new translation of Kant's 1768 essay as »Concerning the Ultimate Ground of the Differentiation of Directions in Space« (Kant 1992b).

Kant's main argument is based on what he terms the »so-to-speak [*gleichsam*] *a posteriori*« method of the »incongruent counterparts« (*inkongruente Gegenstücke*), in order to show the inconsistency of Leibnizian relationalism. The qualification »so-to-speak« is essential in understanding Kant's line of thought: the existence of incongruent counterparts serves as a counter-example, so that an originally *a posteriori* argument, as such based on a fact of experience, is used in order to construct an *a priori* argument, that is, a counterfactual inference which as such is modelled after a purely hypothetical-deductive inference, the *modus tollens*.[9]

This *gleichsam a posteriori* argument can be summarized as follows: a very common experience is the superposition of the right with the left hand. Both can be assumed symmetrically to have the same shape because of the symmetry of the human body, so that they can be termed »incongruent counterparts«, that is, each of them is »a body which is exactly equal [in size] and similar [in form] to another, but which cannot be enclosed in the same limits as that other« (Kant 1768, p. 382: 1-3; Kant 1992b, p. 370). The peculiarity of the incongruent counterparts is that the superposition does not occur in the same straight way it does with, for example, a pair of symmetrical equilateral triangles or other polygons which are similar in form and equal in size. One person's hands are also equal in size and similar in form, but in order to superpose them, one has to oppose them one to another: they are mutually endowed with a property we usually call reflection symmetry.

It does seem that triangles have a property beyond equality in size and similarity in form, which is not possessed by the hands, that is, con-

9 For further details about the apagogic and non-apagogic methods (i.e. involving or not involving the *modus tollendo ponens* in order to prove a thesis by disproving the opposite one) employed by Kant, see Walford 2001, pp. 325-327.

gruency; and, in turn, that some other things like our hands possess the property of mutual reflection symmetry. But are they really properties *of things*? In Leibniz's perspective, the answer should be *yes they are*; but from Leibniz's perspective, space (to use Boscovich's pithy description) is »the relative arrangement which exists amongst things that exist«. And this implies that it should always be possible to superpose things equal in size and similar in form, since their relative arrangement is the same. So, a strictly observant relationalist should be able to superpose his hands in the same way he does with triangles and without invoking symmetries as properties of things; but since such a superposition is clearly impossible, the incongruent counterparts function as a counterfactual, proving that relationalism is ontologically untenable. Hence, the possibility to superpose one's own hands as by using a mirror, if not a property of things, must be a property of space itself.

Thus, space is »a unity« (»Raum als eine Einheit«, Kant 1768, p. 378: 3; Kant 1992b, p. 365) which is endowed with the property to be oriented (i.e. it has directions, *Gegende*), allowing for such operations as reflection symmetries; it can be described as objectively existing absolute space »independently of the existence of all matter and as itself the ultimate foundation of the possibility of the compound character of matter« (»daß der absolute Raum unabhängig von dem Dasein aller Materie und selbst als der erste Grund der Möglichkeit ihrer Zusammensetzung eine eigene Realität habe«, Kant 1768, p. 378: 9-11; Kant 1992b, p. 366). Kant, though, does not forget what Newton had recognized in the Scholium to the eight Definitions: differences between absolute space and time and »relative« (i.e. relational) space and time only affect our »philosophical disquisitions«, while in the scientific practice of measuring distances and motions there is no incompatibility (see Newton 1960, p. 8). So, Leibnizian relationalism is epistemologically incomplete rather than mistaken, and can be incorporated in a broader view, recognizing the *a priori* directionality of space.

Is this concept of absolute, directional space truly the same as the Newtonian notion of absolute space? Walford (1999, pp. 329-330) has shown that Kant prefigures here his later »intuitionistic« solution, essentially based on the idea, which occurs in the 1768 essay, that »absolute space is not an object of outer sensation; it is rather a fundamental *concept* [*Grundbegriff*] which first of all makes possible all such outer sensation« (Kant 1768, p. 383: 27-29; Kant 1992b, p. 371; emphasis

added). In concluding this brief work, Kant mentions that »the concept [of absolute space] is not without its difficulties. Such difficulties reveal themselves when the attempt is made, employing the ideas of reason, to understand the reality of space, which is intuitive [*anschauend*] enough for inner sense« (Kant 1768, p. 383: 27-29; Kant 1992b, p. 372). These difficulties would be eliminated in the *Critique of Pure Reason*, by recognizing that »space as a unity« is not a concept but an intuition which is to be taken »all at once«. Hence, Kant's 1768 essay »signals […] the beginning of the end of his commitment to Newtonian absolutism« (Walford 1999, p. 309). However, Kant's 1768 essay seems to advance a conception which in itself is not less problematic for a pure Newtonian absolutist. Newton's absolute space was only defined through a kinematic property: its state of rest (it »remains always similar and immovable«, Newton 1760, p. 6), which makes it the absolute, or preferential, frame of reference. However, directionality is a far more demanding property than a kinematic one, for if directionality is a property of space, absolute rest is not sufficient to define the preferential frame of reference. What Newton termed absolute space needs, in Kant's understanding, a further »topological« specification, therefore missing its absolute character; conversely, if this specification is not provided, there could be more spaces at absolute rest but with different orientations. So, Newton's notion of absolute space lacks that fundamental character of essential unity which Kant assumed as the basis of his own notion of absolute space.

4. *Reprise. First the One or the Many?*

Both Boscovich and Kant openly declare that the problem of space, through the role it plays in science, is a metaphysical problem (Stay 1755, I, 607, footnote a; Kant 1763, p. 168). But their solutions radically diverge: according to the former, space in itself is a texture of a plurality of discrete »modes of existence«, while the latter worked out a concept of »space as a unity«. The most intriguing aspect is that both developed their diverging ideas as an answer to the same urge, i.e. in order to find a way to reconcile Leibniz's and Newton's conception of space. And in both cases, the promised *via media* has led to alternative views more than to a compromise: on the one hand, Boscovich has reduced Newton's absolute space to an imaginary space through

his concept of an underlying plurality of modes of existence, which also functions as a foundation of Leibnizian relationalism; on the other hand, Kant's »option for the One« means the rejection of relationalism as ontology and its epistemological incompleteness, but also anticipates his doubts about any notion of space (including that of Newton) as a concept instead of a singular intuition.

Moreover, it seems that each standpoint is in itself tenable and cannot be invalidated by the other one. There is a kind of complementarity between both. On the one hand, Kant's criticism of relationalism does not apply to Boscovich's pluralism, for things which are equal in size and similar in form and yet incongruent — i.e. they are incongruent counterparts — may have different real local modes of existence (in other words, they have different »indexes«), thus explaining reflection symmetries. On the other hand, Boscovich's criticism of Newton's absolute space is not applicable to the far more articulated Kantian view of space as possessing in itself directionality. But these standpoints cannot be taken together, for each position accounts for the same fact in a peculiar way, which has sense only within that particular schema and no sense outside. So the dichotomy appears to be insolvable and may serve in further research as an indication of the two extremes in which space could be understood throughout the 18th and 19th centuries. It plays the role of what I term, on a more general level, a field of dispersion of concepts, which in this case qualifies space and time, in so far as they are recognized as subjects of metaphysics, as a common field of discourses.

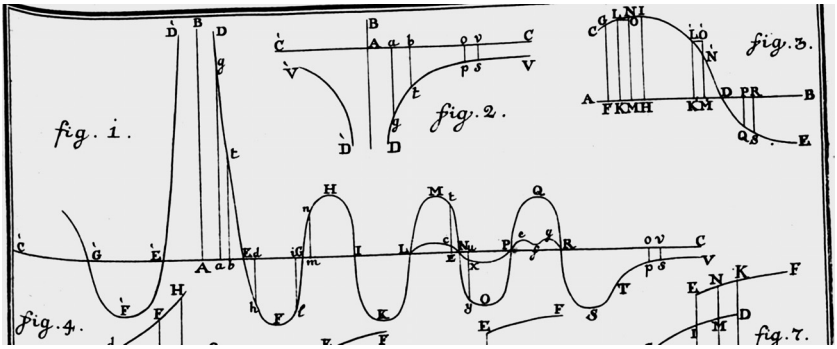

Figure 1 The *curva boscovichiana* as depicted in the first table (Fig. 1) of the *Theoria*. The distances are represented on the *x*-axis, while the intensity of the force is given by the ordinates (n. 13). The force is attractive when the curve is below the *x*-axis and repulsive when above, so that there are 'points of indifference' on the *x*-axis —such as

E, G, I, L, etc. — in which the resultant force is equal to 0 (n. 14). Thus, the *curva* also explains why bodies and aggregates hold together: »For if two points are at the distance that corresponds to that of any of the limit-points of this kind, & the forces that arise when the distances are changed are great enough […], then the points will maintain this distance apart with a very great force« (n. 165).

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Jedno ili mnoštvo? Bošković, Kant i metafizička zagonetka prostora

Si nemo ex me quaerat, scio; si quaerenti explicare velim, nescio.

Augustinus, *Confessiones*, XIII, XI, 14

Sažetak

»De Spatio et Tempore«, dodatak *Boškovićevu djelu* Theoria philosophiae naturalis *(1763), zajedno s nekoliko napomena Stayeva djela* Philosophia recentioris*, sadržava sveobuhvatno obrazloženje pojma prostora (Suplement 1) i njegova odnosa s ljudskom spoznajom (Suplement 2). Kao* što je dobro *znano, Bošković je želio postići kompromis između Leibnizove »relacijske« koncepcije prostora i Newtonove ideje o prostoru kao pukom koordinatnom sustavu.*

Bošković nije bio jedini koji je u okviru znanstveno–istraživačkog konteksta 18. stoljeća tražio srednji put (via media) između ova dva velikana 17. i 18. stoljeća. Još jedan zanimljiv, neovisan i posve oprečan primjer bio je Immanuel Kant, koji, pošavši od relativizma Leibniza i Eulera, razvija u svojoj Kritici čistog uma *(1781, 1787) koncepciju prostora koju duguje Newtonovoj ideji apsolutnog prostora (koncepcija u kojoj se dade naslutiti utjecaj Leibniza i Eulera). U kantovskoj završnoj ideji jedinstvenošću reda, koji stvarima nameće intuicija prostora i vremena, poništava se pluralitet svijeta.*

S druge strane, Bošković u svom djelu Theoria *oblikuje opći »pluralistički stav« (u kojem u potpunosti nije odsutan Newtonov utjecaj), gdje red stvari biva značajkom njihovih interakcija (vidi npr. nauk o modusima izražen u* Suplementu *I, 1–4). Širina ove perspektive također se očituje u njegovu odbijanju ideje neprekidnosti materije i prostora u djelu* Theoria *i nekim važnim pismima (svom prijatelju G. S. Contiju), gdje pokušava dati cjelovito i jednostavno obrazloženje filozofskog utemeljenja svoje prirodne filozofije.*

Ključne riječi: *pojam prostora u 18. stoljeću, relacionalizam, apsolutni prostor, Boškovićevi »stvarni način postojanja«, Immanuel Kant*