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REMARKS ON THE QUARREL LEIBNIZ X NEWTON ON THE NATURE OF SPACE[1]

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Abstract: *The aim of the present article is to provide some aspects of an important quarrel on the nature of space, namely, the one between Leibniz and Newton. We'll argue here that there is a necessity in each one of the projects (i.e., the Leibnizian and the Newtonian) for both thinkers to conceive space as they did. On the one hand, Leibniz defended the concept of relative space, which was nothing more than the result of the relation between the positions of things in space; otherwise his thesis of ontological autonomy of the monads would simply fail. Newton, on the other hand, defended the concept of absolute space, which was nothing more than a previous condition enabling the existence of physical bodies; moreover it was an irrevocably prerequisite to the first law of movement.*

Keywords: *Leibniz. Newton. Space.*

OBSERVAÇÕES SOBRE A DISPUTA ENTRE LEIBNIZ E NEWTON SOBRE A NATUREZA DO ESPAÇO

Resumo: O objetivo do presente artigo é abordar alguns aspectos de uma discussão importante sobre a natureza do espaço, ou seja, a disputa entre Leibniz e Newton. Aqui, argumentaremos que havia um motivo, em cada um dos projetos (ou seja, o de Leibniz e o de Newton), para que esses dois pensadores concebessem o espaço como o fizeram. Por um lado, Leibniz defendeu o conceito de espaço relativo, que nada mais era do que o resultado da relação entre as posições dos objetos no espaço, pois, caso contrário, sua tese de autonomia ontológica das mônadas simplesmente cairia por terra. Newton, por sua vez, defendeu o conceito de espaço absoluto, que nada mais era do que uma condição prévia que permitiria a existência de corpos físicos; além disso, era pré-requisito irrevogável para a sua primeira lei do movimento.

Palavras-Chave: Leibniz. Newton. Espaço.

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[1] This paper represents an extended version of our communication presented during the *15th International Meeting on Pragmatism* in the Pontifical Catholic University of São Paulo (November, 4 to 7, 2013).

1. *Status quaestionis*

From history we have learned that the space theme was the object of investigation by many thinkers and was considered by several theories that addressed it. Given this fact, our task here consists in investigating a very specific clash between two different positions concerning the nature of space, which remained well-known: the quarrel Leibniz X Newton[2]. It must be kept in mind that the remarks of these two thinkers contributed a lot to the field of mathematics (and, above all, physics) of the time.

Initially, and even before we investigate the mentioned dispute, a basic but fundamental question to be asked and answered would be the following: what did they understand by space? In Leibniz's Newton's and some other thinkers' time, there were "two" spaces, namely, the physical space and the geometrical space. This distinction has a particular importance and will play an important role in our discussions, however let's leave it for one instant[3] and occupy ourselves now, specifically, with the physical space.

Basically, we could say that the physical space is that place where bodies move. At the time (i.e., seventeenth and eighteenth centuries) it was common opinion that space is something distinct from the spatial things that occupy it. However, there are two distinct positions concerning the nature of such distinction, which are:

(i) If the space is a consequence of the existence of bodies or;

(ii) contrarily, it is a prior condition for the existence of bodies.

It is precisely in this point that we find the conflicting positions regarding the nature of space: the relative, defended by Leibnizians (opinion i) and the absolute, defended by Newtonians (opinion ii).

However, although we know that the positions of Leibniz and Newton are different, there are some similarities between them which are worthwhile reviewing. Primarily, both Newtonians and Leibnizians understand the physical space as being that same space of our everyday life, i.e., from the more elementary, like for instance, the space in which we move, to the other where motion is governed by physics They are the same. Moreover, Newton and Leibniz agree that pure space – i.e., the one that distinguishes itself from the bodies, be it in a real or ideal manner – is the theme of the study of geometry (understood basically as the system of possible relations in space). Or, more precisely, that the points, the lines, the surfaces and the volumes whose relations of order and magnitude are the study of geometry, are determinations – parts or limits – of pure space.[4]

A final clarification to be made in this introduction, which makes an essential distinction between Newton and Leibniz in the context of their respective projects, would be that while the English scientist identifies physical space with geometrical space, the German philosopher does not. If he did his philosophical project would

[2] Notably, one of the most important documents in which we can find this discussion is situated in the *Leibniz-Clarke Correspondence* (initiated in 1715 and ceased in 1716 in virtue of Leibniz's death). In it, we find valuable reflections of the rival positions on the subject matter.

[3] Just adding something that we will discuss ahead concerning the geometrical and physical space, take into account that while Newton identified the physical space with the geometrical space, Leibniz did not, as it would cause real difficulties to his philosophical project.

[4] See: TORRETI, R. *Manuel Kant – Estudio*...., 1967. p. 71.

simply fail. Thus, in the face of Leibniz's failure and Newton's success, to understand what both projects intended is *sine qua non*.

2. On the projects of Leibniz and Newton

One of the most basic differences between the positions of Leibniz and Newton regarding the nature of space lies in the quite distinct core of their studies.

On the one hand, we have Leibniz, who, motivated by strongly metaphysical interests, defended his system in light of this science.[5] Hence, if the philosopher conceived in his theory a space as an absolute entity, then his metaphysical aims would be doomed to failure. To give just one example: this would imply the denial of his most fundamental thesis, namely, the ontological autonomy of substances, and this denial would be simply catastrophically to Leibniz, something that he never intended. This happens because if the space were, indeed, absolute, then these substances lacked something external to themselves for the constitution of their possibility.[6]

On the other hand, Newton's commitment, unlike Leibniz's, was not with metaphysics, but especially with physics. His project basically aimed at developing a science capable of translating in numerical terms the natural phenomena that are governed by the laws of physics. Consequently, and not by mere chance, the title of his most famous work was precisely: *Philosophiae naturalis principia matematica* (1686). Moreover, and now in relation to other scientists of his time, like, for instance: Descartes, Spinoza or even Leibniz, Newton was different in the following aspects:

(i) The English physicist did not attribute the exactness of mathematics to his own science because, to him, this discipline was only an instrument to explain the world together with his experimental method;

(ii) he does not share the rationalist ideal that science is a necessary universal knowledge, thus considering science as something subject to review;

(iii) Newton neither intended to ground physics in metaphysics, leaving each one of them in their respective places, that is, not mixing what belongs to the field of physics with what belongs to the field of metaphysics, and finally;

(iv) of no less importance was the method of investigation proposed by Newton: under it, both deduction and induction assume important roles.

Ultimately, the project of Newtonian physics was to "numerically translate the next and not the last, causal order that rules the natural phenomena".[7]

[5] Let us remember that Descartes also defended his Physics in light of this discipline (i.e., Metaphysics). However, although both had Metaphysics as a fundament and both had worked under the ideal of *Mathesis Universalis*, their projects were quite distinct. While the French Philosopher proposed to reduce physics to geometry, Leibniz had dynamics as grounds for his physics.

[6] See, for instance, the firsts' considerations of Leibniz in his *Monadology* (1714).

[7] PRADO, L. L. *Monadologia e espaço relativo*..., 2000, p. 18.

Concerning the identity of physical space and geometrical space within the Newtonian project, let us recall what we said in the beginning of our text: Newton identified the physical space with the geometrical [8]. And he does so precisely for one fundamental reason, namely: had he not done so, it would be impossible to resort to mathematics (that is, algebra and geometry) as instruments to translate physical phenomena. Moreover, this identity means more concretely that a determination that is considered valid in the physical space must be also valid in the case of geometrical space, and *vice versa*. Let us take for example the case of infinite divisibility of space: if this determination is valid in the case of geometrical space (and it is indeed valid, because geometrical space is infinitely divisible), consequently the same applies in the case of physical space.

In light of this analogy between both projects, also with regard to their understanding of the notion of space, if we compare both thinkers' aims we will see that Newton's was, effectively, more modest than Leibniz's, as the objects of study intended by his physics were solely natural phenomena. There is no doubt that Leibniz's interest was metaphysics and, furthermore, this discipline was the essence of all his theory.

3. Relative space in Leibniz

To Leibniz and his enterprise, the notion of relative space was an absolute necessity. We already know that, to him, metaphysics was the fundament of sciences (understood here as essentially physics), and thus the reasons that led Leibniz to adopt relative space had serious metaphysical consequences. We also know that the philosopher in his *Monadology* said that, given a substance, then noting can interfere with it. In other words, nothing at all, external to the Monad can interfere with its self-determination, since the Monad – as defined by Leibniz himself – is something: (i) indivisible (and, more importantly, not a physical entity, not possessing parts, extension or figure); (ii) that has neither a natural beginning nor a natural ending; and finally, (iii) that cannot be modified by any other substance. Concerning the self-determination of the Monad, we must bear in mind also that such a clause would apply even to God. Not even He would have that power. Nevertheless, God is decisive in His theory regarding the following aspect: He can decide the existence or not of substances; therefore, once created, as such it is and will remain perfectly throughout all eternity – and here we have a clear example of the role played by Leibniz's "Theory of pre-established harmony"[9]. Thus, not even God Himself can interfere with the ontological determination of substances, let alone space! The latter is absolutely out of the question, and plays no role in Leibniz's project, differently from Newton to whom space is something prior to spatial things. Hence, in the context of Leibniz's philosophy, a true requirement to be fulfilled regarding space would be that it were considered solely as the result "of places taken together"[10]. Or

[8] See the note 3 above.

[9] We could say that the "Theory of pre-established harmony" and the two principles – (i) identity and (ii) sufficient reason – were the fundamental stones of Leibniz's Philosophy.

[10] See the *fifth letter of Leibniz to Clarke* (especially the § 47).

in other words – and as a Leibniz motto – "*Spatium est ordo coexistendi*" [11], that is, a phenomenon of the order of situations, derived from the simultaneous existence of several substances.

In light of Leibniz's substance theory that held that bodies were composed of simple parts and, as such, indivisible[12], one of his major problems vis-à-vis the identity of geometrical and physical space was precisely the infinite divisibility of space. The philosopher said several times[13] that space is something indivisible. Among other considerations, the infinite divisibility would be a problem to Leibniz because if we take this consideration through to its lasts instances, this would imply in the divisibility of God Himself.[14]

4. Absolute space in Newton

For our purposes here it is important to remember that Newton in his *Principia Mathematica* aimed, among other considerations of course, to defend two important theses, namely: (i) that of absolute motion and; (ii) that of absolute space. Despite the importance that this work achieved in its time and the fact that it is still considered nowadays a classic in the field of exact sciences, in it we cannot find even one definition of space by Newton. To him, this is due to a simple fact: he believed that such concept (i.e. space) would be all too familiar to those who investigated the subject – likewise the other fundamental concepts of physics, like for instance: mass, force, motion; thus, because they are so "basic and well known", a work so tiring like this one to define them would be simply dispensable, and he says unequivocally that he does not define them[15]. Despite this,, Newton, in the scholium of definition VIII of the *Principia* – "The motive quantity of a centripetal force *is the measure of the same, proportional to the motion which it generates in a given time*" – provides some characteristics of what he understands by space. The relevant notes to our objectives are:

1st space is something real;

2nd it is where all physical phenomena occur;

3rd it is distinct from the things that exist in it (or, in other words, space is distinct from spatial things) and further: it is a prior condition to spatial things.

[11] LEIBNIZ, G. W. *Initium Rerum Mathematicarum metaphysica*, I. In: GERHARDT, K. I. (ed.): *Leibnizens mathematische Schriften.*Vol. 5. Halle. Druck und Verlag von H. W. Schimidt. 1858. Page 18.

[12] Leibniz sometimes uses the term "atom" in order to design the Greek term of "indivisible", and not the sense given by modern physicists. See again the initial considerations of the philosopher in his *Monadology*.

[13] For instance, in the *Nouveaux Essais* (Book II, Chapters XIV and XV); and in the *fifth letter of Leibniz to Clarke* (now in § 27).

[14] See the fourth *letter of Leibniz to Clarke* (especially §§ 7,8,9); and in the *Nouveaux Essais* (Book II, Chapter XXIII).

[15] "I do not define time, space, place and movement because they are well known by all" (NEWTON, I. *Principia*…, 2008, p. 44).

Now, if we take into account the requirements above, we will find that, for Newton, the existence of an empty space is totally possible. In other words, space can exist independently of spatial things (3rd feature above), since it is not the things that occupy it that determine it, but, on the contrary, it is prior to the things themselves. Finally, to Newton, absolute space was "a logical and ontological necessity. It was a prerequisite for the first law of motion"[16]; this law being, undoubtedly, one of the fundamental pillars of Newtonian physics.

5. Consequences of absolute space in Newton and relative space in Leibniz

Let us compare both concepts of space. In the face of Newton's considerations on the nature of space and Leibniz's metaphysical project the 3rd feature mentioned above, proposed by the English physicist, would be too problematical to the philosopher's system, for the reasons we have seen when we referred to Leibniz's project. [17] Nevertheless, whether or not the designation of an absolute character to space offends metaphysical interests, this is not of great relevance to Newton's program for the simple reason that this discipline (i.e., metaphysics) is not *prima facie* in the plans of his project[18], as we mentioned[19] before. So much so, that his expression became famous: "*Hypotesis non fingo*" ("I do not build hypothesis")[20]. That is, Newton, going against the flow of his time, did not wish to explain what exceeded the field of natural phenomena, which required just that: hypothesis. Therefore, in the face of metaphysical explanations of many thinkers of his time, which sought to clarify certain principles governing natural laws, such as the causal principle – which was a presupposed principle, and furthermore, irrevocable within the system of the English scientist – Newton, albeit presupposing such a principle, never wished to explain it because, if this principle duly fulfills its role and the system works, then there would be nothing else to do.[21]

As we have seen, to Leibniz, as opposed to Newton, space would be only a system of relations devoid of any existence; thus, it is not necessary to delegate an absolute character to space, as Newton did. That means that space is, as we have said, the result of a relationship of the external objects that occupy it. Thus, a chimerical existence of space would not be possible. A positional relationship would suffice.[22]

[16] JAMMER, M. *CONCEITOS DE ESPAÇO...* 2010. Página 137.

[17] In our item 3 above.

[18] Although Metaphysics was not in Newton's plans, this does not mean that this subject was simply ignored by the physicist. He has written on the subject; for example, his comments on the prophecies of the *Bible*.

[19] In our item 2 above.

[20] See this expression in the "general scholium" in the end of the *Principia*, when Newton talks about the hypothesis of vortex.

[21] See about Newton's "*Hypotesis non fingo*", his 'general scholium" in the end of his *Principia*.

[22] See the *fifth letter of Leibniz to Clarke* (especially the § 29).

6. Concluding remarks: one example of the importance of the Leibniz X Newton quarrel to the space problem in Kant's philosophy

The Leibniz X Newton quarrel was of major importance to the debates that evolved in philosophy. One classic case occurred in Kant's Epistemology. It is well known, and is not the case of comment right now, that Kant in the beginning of his career as a philosopher was influenced by the rationalist school of Leibniz and Wolff and the innovative mechanics of Newton. Moreover, the space theme was one of the most important subjects in the context of his theoretical philosophy.[23] However, something not as well known is the fact that Kant's theory of space did not come to light in a unified way, but it suffered some important changes during its development.[24] However it is common sense to consider the "Transcendental Aesthetic"[25] of the *Critique of Pure Reason,* the *locus classicus* of his mature theory of space – time as well – when finally it is conceived as our pure intuition, and where the philosopher explains the role played by it in his system.

On the importance of the Leibniz X Newton debate in the development of the space theme in Kant, we must consider the following: according to a strong interpretative school[26], the philosopher of Königsberg in 1769 – i.e., one year before his *Inaugural Dissertation of 1770* (on the sensitive and intelligible world) – had read the *Correspondence between Clarke and Leibniz*, and the debate contributed to his change of opinion, giving him valuable insights[27], and even more important, placed him on the way to his critical position. Now, if indeed it was so, now is not the time to evaluate it in a proper manner. It is a task to be undertaken on a future occasion.

* * *

[23] We can find in almost all of Kant's epistemology writes the philosopher treating the space theme, since the beginning of his career to his *Critique of Pure Reason* and also in the writes after the *Critique* itself.

[24] In our master's degree we tried to investigate one period considered of major importance on this thematic, namely, the years of 1768 and 1769. It finds this bibliography in our references bellow.

[25] Of course that the space theme appears during all the *Critique*, and it plays decisive roles in the other important parts of this book, like in the "Transcendental Logique", and booth in the "Analytic" and "Dialectics".

[26] Comprising names such as: Benno Erdmann, Hans Vaihinger, Max Wundt, Erich Adickes, Ernst Cassirer, W. Windelband, and others.

[27] To give just one example, take into account that some scholars had related some of Kant's *Reflexions* of 1769 with some passages of the *Correspondences of Leibniz and Clarke*. See for instance what Cassirer says: "Las *Reflexiones* contienen referencias profundas e inequívocas que demuestram cuán detenidamente se ocupó Kant de los problemas planteados en la correpondencia entre Leibniz e Clarke. Cf. por exemplo refl. 1416, 1417 y 1426 (problema del comienzo del mundo em el tiempo) con la quinta carta de Leibniz, § 55; refl. 1557 (sobre el movimiento del cosmos) con Leibniz, V, 52; refl. 1423 (las dificuldades relacionadas com el lugar del mundo y del tiempo antes del mundo) con la tercera carta de Leibniz, § 5 y con la carta cuarta, §§ 13 ss.; refl. 1458 (sobre la divisibilidad 'lógica' e no 'real' del espacio absoluto) con la cuarta réplica de Clarke, §§ 11 y 12. Todas estas reflexiones giran claramente dentro da la órbita general de pensamientos del problema de las antinomias;" (CASSIRER, E. *El problema del conocimiento...*, tomo II, 1956, p. 577).

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