

SOURCES FOR THE HISTORY OF SPACE CONCEPTS IN PHYSICS: FROM 1845 TO 1995

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Dedicated to Prof. Juan José Giambiagi, *in Memoriam.*

*“Car là-haut, au ciel,
le paradis n’est-il pas
une immense bibliothèque?”*

— Gaston Bachelard

Brief Introduction

Space — as other fundamental concepts in Physics, like *time*, *causality* and *matter* — has been the object of reflection and discussion throughout the last twenty six centuries from many different points of view. Being one of the most fundamental concepts over which scientific knowledge has been constructed, the interest on the evolution of the ideas of *space* in Physics would *per se* justify a bibliography. However, space concepts extrapolate by far the scientific domain, and permeate many other branches of human knowledge. Schematically, we could mention Philosophy, Mathematics, Aesthetics, Theology, Psychology, Literature, Architecture, Art, Music, Geography, Sociology, *etc.* But actually one has to keep in mind Koyré’s lesson: scientific knowledge of a particular epoch can not be isolated from philosophical, religious and cultural context — to understand Copernican Revolution one has to focus Protestant Reformation. Therefore, a deeper understanding of this concept can be achieved only if one attempts to consider the complex interrelations of these different branches of knowledge. A straightforward consequence of this fact is that any bibliography on the History and Philosophy of *space* would result incomplete and grounded on arbitrary choices: we might thus specify ours.

From the beginning of our collaboration on the History and Philosophy of *Space* in *Physics* — born more than ten years ago — we have decided to build up a preliminary bibliography which should include just references available at our libraries concerning a very specific problem we were mainly interested in at that time, namely, the problem of space dimensionality. We realized soon

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that even making this sharp restriction on the subject we did not overcome the difficulty mentioned in the first paragraph: a bibliography aimed at providing a sound basis for the study of this problem should, indeed, also cover many other aspects of the Natural Philosophy of Space. On the other hand, from the recurrence of certain quotations, we also realized that there were many relevant references that could not be omitted owing to our difficulty in localizing them. In addition we have done an effort to include some very rare references. Therefore, our original plan followed a completely new direction; these are in a nutshell the main reasons for the significant time gap between thinking out the bibliography and rendering it available now. Let us in the sequel say some words about our choices in preparing this bibliography.

The most restrictive choice was to constrain the bibliography in time. The period covered here is of *circa* a hundred and fifty years; more precisely, the bibliography includes references from 1845 to 1995. The former is approximately a century after the publication of Kant's first work — *Gedanken von der wahren Schätzung der lebendigen Kräfte*, Königsberg, 1747, (English translation by J. Handyside, *Kant's inaugural dissertation and the early writings on space*, Chicago, Open Court, 1929) —, which can be considered a milestone in so far as the problem of space dimensionality is concerned. For treating this problem Kant had to consider the possibility of the existence of spaces with a different number of dimensions, prior to any formal theory for these types of space. In his own words: “A science of all [the] possible kinds of space would undoubtedly be the highest enterprise which a finite understanding could undertake in the field of geometry”. It was during the nineteenth century that this quote acquired its full sense and very remarkable generalizations in Geometry were done, leading to the conclusion that the space defined by Euclid's axioms is not the only possible non-contradictory construction. Non-Euclidean geometry and n -dimensional space not just contributed to change the *Weltanschauung* at that time, but also had a very impressive impact on the development of Physics in the twentieth century, from Relativity and Quantum Mechanics to Unified Field Theories.

One of the main consequences of such choice is that actually a very large number of well known primary sources of the western philosophy for the study of *space* — as the original contributions of the Pre-Socratics, Plato, Aristotle, Simplicius, Galileo, Newton, Leibniz, Kant, and many others — are not included in the present bibliography. Thus, for not introducing an asymmetry in the period covered here we decided to limit ourselves to quote what can be called secondary sources on the concept of *space* in Physics, which include: books, the majority of which are entirely dedicated to historical and/or philosophical aspects of this subject (presented as item **a.**); specialized articles and contributions to proceedings (item **b.**); chapters of books, dissertations, articles in encyclopaediae, entries of dictionaries, abstracts and other miscellaneous citations (item **c.**). It should be stressed that textbooks and technical Physics papers are excluded from the present bibliography.

Another important restriction is imposed by language: only texts written in English, French, German, Italian, Spanish, Portuguese and Latin were considered.

Two other simple but nevertheless restrictive criteria were followed and should be mentioned. Although we recognize the impact of the Theory of Relativity on modern Physics epistemology, neither papers devoted exclusively to *time* nor technical papers on *spacetime* are brought into the bibliography, which, of course, excludes any reference to the fundamental (and well known) papers of the scientist-philosopher A. Einstein. We are convinced that Relativity, by itself, deserves an independent bibliography. However, some basic references on the philosophy of spacetime were occasionally included. Both choices were mainly motivated by our will to render the bibliography manageable.

It should also be stressed that *special attention was given to the modern literature concerning the very old problem of space dimensionality*, biased by our interest on this subject. Only in this case the authors made a particular effort to be complete, even knowing *a priori* that this is an impossible task. Clearly, due to the interrelations of Physics with the aforementioned areas, we could not resist the temptation of including a small number of references on *infinity*, *aether*, *foundations of geometry*, and some references belonging to the domain of other areas, although, in this case, completeness was absolutely not our goal: our intention was just to offer to the reader the possibility of starting by himself the search for new references on those areas.

We hope the reader will forgive us if sometimes the apparent rigidity of the aforementioned criteria is found slightly broken. Finally, we must confess that being two bibliophiles the authors gave a special emphasis to the research of books.

All the 1075 references are given in chronological order and for each year in alphabetical order of authors' name. This includes 414 books entirely devoted to *space*, 380 articles in periodical journals and proceedings and 281 miscellaneous citations. A small number of references that could not be accessed and were quoted by more than one author with discrepancies, or in an incomplete way, is included, but the reader will find a question mark whenever information is uncertain or confuse.

Although we are very conscious of the incompleteness of the present bibliography, we are convinced that it puts together an expressive amount of basic references and we hope it will be useful for anyone interested in the history (and philosophy) of the space concepts in *Physics*.

Let us close this Introduction by trying to express in words our guiding aspiration. When the last reference was written down we have imagined how many times our feelings in that very moment would be magnified in the soul of a lexicographer. Being absolutely unable to grasp what could be experienced during the endless and patient compilation of a dictionary, we have found comfort in the words of Andrieux: "*Tous les auteurs peuvent aspirer à la louange; les lexicographes ne peuvent aspirer qu'à échapper aux reproches*": the latter is our aspiration.

The authors will welcome any corrections, suggestions and additional references.

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b.

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- WOLTER, F.: *De spatio et tempore, quam praecipua Aristotelis ratione habita*, Bonn.

1850

a.

- ULE, B.: *Untersuchung über den Raum und die Raumtheorie des Aristoteles und Kant*, Halle.

1855

a.

- LEWIS, T.: *The six days of creation: or the scryptural cosmology with the ancient idea of time worlds, in distinction from worlds in space*, Schenectady, N.Y. van Debogert / London, John Chapman.

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a.

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1865

a.

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1868-9

a.

- BAUMANN, Julius: *Die Lehren von Raum, Zeit und Mathematik in der neueren Philosophie nach ihrem ganzen Einfluss dargestellt und beurteilt*, Berlin, G. Reimer, vol. 1-2. Reprinted by Minerva Verlag GmbH, Frankfurt/Main, 1981.
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1891

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1893

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- DEICHMANN, Carl: *Das Problem des Raumes in der griechischen Philosophie bis Aristoteles*, Leipzig, G. Fock.
- c.**
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“... Così tra questa
immensità s’annega il pensier mio:
e il naufragar m’è dolce in questo mare. ”

— Leopardi

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ADDENDUM

This addendum contains 36 new references added in proof, following the format adopted throughout the bibliography.

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