BASIS FOR A MATERIALIST AND DIALECTICAL APPROACH TO SPATIAL INTERACTIONS

[1]Márcio Rogério Silveira
[2]Rodrigo Giraldi Cocco

[1]Department of Geosciences, UFSC. marcioourinhos@gmail.com
[2]Master of Science UNESP, Presidente Prudente.rodrigogiraldi83@yahoo.com.br

Abstract *The current scientific literature in geography reflects a growing concern with phenomena involving transport, a fact demonstrated by the use of concepts and expressions derived from the movement of goods and people comprising geographic space. This is the case of concepts such as flow, mobility, accessibility, spatial interactions and networks. However, reinforcing the use of the notion of spatial interactions, without updating it on the basis of a critical view, reduces it to the concepts of flow and displacement. In doing so, the extent of the concept of spatial interactions and its adherence to the ideas of space as a social dimension is also reduced. Such space cannot exist without the connections between material formations, i.e., between the socially produced geographic objects that are involved in these processes. In the light of categories of dialectical materialism, the notion of spatial interactions can be reconstructed and connected to the dialectical conception of geographical space. It also provides an understanding not only of the transformation of phenomena, but also of the internal essence of the objects that make up geographic space.*

Keywords *Transports, Spatial Interactions, Mobility, Accessibility, Development.*

Introduction

The quantitative notion of spatial interactions, although very important in the development of scientific knowledge, met its limits (and was found lacking) in the face of the new dynamics manifested in the production of geographical space. Thus, an effort to rethink this concept is necessary. The limitation refers to a consideration of interaction as a mere shift, as can be seen in the writings of authors such as Reilly (1931), Zipf (1949), and Watson (1974), all representatives of quantitativism.

The growing coordination established between flows and fixed elements, as well as the dizzying speed of changes in space, has led to a reopening of discussions about urban, regional, and national territorial spaces, even though these changes are at times "slowed down" when they come into contradiction with the spatial heritage traditionally associated with former Socio-Spatial Formations. The result has been an incessant search for "fluidity" (improved transport and circulation) as a paradigm for the different scales of power that organize geographic space. When related to the network of regional urban transport, the result is an increasingly intense fragmentation of the city on one hand and a complex territorial division of labor on the other, a fact that challenges urban and regional planning, as well as policies of economic development.

These and other problems related to Geography show the inadequacy of approaches that concentrate either on the isolated treatment of transport (ignoring the inherent contradictions between fixed elements and flows) or on the isolated treatment of the problem of uneven spatial development and socio-spatial inequality (reducing the importance of the movement of matter, i.e., of the flows of capital, labor force, and money as commodities, and its relation to fixed spatial elements).

This scenario shows the limitations of the traditional concept of *spatial interactions* for the treatment of problems involving flows, fixed elements, and spatial transformations, since the concept has been considered to be a mere displacement in space, thus demonstrating the need for an overhaul on historical, materialistic and dialectical grounds.

The materialist dialectic as a set of laws and of explanatory categories of objective reality must be the *thread of Ariadne* which leads specific sciences to an adequate development of concepts to explain their objects. Some categories, such as "cause and effect", are quite clearly related to the idea of spatial interaction. In this case, the categories of "cause and effect" - where the *cause* of general transformations in the material world is the *interaction* of different material formations - correspond necessarily to the notion of *spatial interaction,* which will be illustrated here using the example of transport and its flows. The history of the geographical concept of spatial interaction and its practical applications will thus be reviewed, as well as its *interface* with other concepts and categories, as we seek to lay the groundwork for a possible materialist and dialectical approach to spatial interactions.

Materials and methods

The preparation of this paper required, above all, a coherent theoretical account to cover the main elements that constitute the history of spatial interactions. To attain this, we were guided in part by the research agenda suggested by Corrêa (1997), which lays the foundation for further study on the subject, initially highlighting the fact that spatial interactions cannot be reduced to "mere displacement," but rather that they are "an integral part of existence (and reproduction) in the process of social change (p. 280)". In this case, we studied the ideas of Ullman (1972), Harvey (1982), and especially Cheptulin (1982), whose study was suggested by Corrêa (1997) as a model for a materialist analysis of spatial interactions. A consideration of the approach of Cheptulin led to a more philosophical and conceptual discussion about the relationship between the notion of *spatial interactions* and the idea of development as *transformation* of the various aspects and configurations of matter targeting more complex and higher levels of analysis (Cheptulin, 1982). To this end, we have sought to present empirical cases, such as those involving the transport of passengers and the transformation of land use by transport. Parallel to the evolution of the category and concept of spatial interactions is the evolution of the concept of geographical space, which makes use of the ideas of Santos (2001, 2008).

Spatial interactions and space in the development of philosophical and scientific knowledge

An understanding of the evolution of the concept of *interaction,* requires the identification of the categories of "cause and effect", which date back to the early philosophers, such as Thales, for whom the cause of the appearance of things came from air, and Heraclitus, who attributed the rise and transformation of matter to fire. For Aristotle, the cause of the emergence of new material formations resided in other material formations (Cheptulin, 1982), i.e., it was located in the framework of *formal logic*[1]. In this same context, Aristotle viewed space as a "place" occupied by things[2].

The first to confront formal thought was Hegel, who stated that cause and effect are *interacting,* conceiving the cause as an "active substance" acting on a "passive substance", thus generating dialectic transformations (Cheptulin, 1982). Due to interaction, cause and effect feed and transform each other. This concept overcomes the *perpetual error* of metaphysics, according to which every phenomenon originates from another phenomenon to which it corresponds.

Despite having advanced towards the Marxist theory of causality (of interaction as the cause of things), the objective idealism of Hegel (1962) led to a view of space as the predicate of the "absolute Idea", rather than its subject. This approach also influenced the view of space of Ratzel and Ritter. Similarly, in the formulations of philosophers such as Berkeley and Bergson, both believers in subjective idealism[3], there is no room for space outside of

1 In this regard, Aristotle mentions four types of cause: material, formal, productive (efficient) and final. An example of the first would be the foundation of a house; the second would be the plan for that house; the mason's work would be the productive cause and the purpose of the construction would be the final cause (Cheptulin, 1982). In this case, it is clear that the causes are attributed to things.

2 Similar views are expressed by ancient Greek philosophers, such as Democritus and Archytas of Tarentum, for whom space was a "huge box" in which things were set.

3 Subjective idealism believes that all existence is a function of human consciousness, i.e., things do not exist outside of consciousness. On the other hand, objective idealism (Hegel) conceives of the objective existence

human consciousness, since things are a creation of our spirit (Santos, 2001).

Kantianism, by developing the idea of *space--container*, moves in that direction, proclaiming that space is a form of intuition that individuals use to address the phenomenal world, an a priori representation, a mere reflection[4]. It is worthy of note that the thoughts of Kant, together with those of Hegel (despite their differences) would profoundly influence the concept of space for the founders of Geography, such as Ritter[5], Ratzel and even Hettner, for whom "space was a form of perception, an approach to reality" (Santos, 2001). Moreover, although Kant's theories were aimed at combating determinism, they ended up endorsing possibilism, as well as determinism itself, due to the proximity of the Kantian *space-container* to the Newtonian *void* (Santos, 2001).

With the advent of "New Geography", which sought to overcome the issues of Classical Geography, space maintains and strengthens its attribute as a mere "container", originating from the uncritical acceptance of the Newtonian view. In the context of the New Geography, spatial interactions become more like a reaction to the "static" notion of space, rather than a conscious intent to overcome epistemological emptiness. In this approach, spatial interactions are represented by models of gravitation, by analogy to models of Newtonian physics, as mere shifts *in* space. They are rendered as a two-way relationship between economic activities, involving "force fields" that determine attraction, repulsion, irradiation and cooperation (Camagni, 2005).

These assumptions have been used to justify the production of *models of gravitation,* which would make it possible to express synthetically the "principle" of spatial interactions by empirical measurement of flows[6]. However, it is worthy of note that the derivation of these models from the simple *analogy* of the Newtonian model of universal gravitation leads to serious doubts about the reliability of the models when applied to geographical space (Camagni, 2005). We find, for example, that the application of these assumptions to transportation problems, especially urban transport, involves the formulation of models for the allocation of traffic, projection of future demands, etc., thus treating the problem of circulation as a merely "technical" issue which should be solved with supposedly politically "neutral" tools.

There are, however, some differences in these discussions, as is the case of the proposal of E. Ullman (1974), who anchors the notion of spatial interactions to three basic principles: *complementarity, distance (transferability)* and *intervening opportunity.* He bases his arguments a bit more on geographic reality, as well as historical conditions, and considers spatial interactions as flows mobilized from the *differentiation of areas;* this, in turn, reflects the productive differentiation generated by different spaces due to a certain isolation, arising from geographical barriers[7]. The essence of this concept of differentiation of areas, which was developed and used by Hartshorne (1978), comes from studies of Karl Richthofen on the views of Humboldt and Ritter (Hartshorne, 1978).

Interestingly, despite little contact with Marxism, Ullman discussed to some extent the transforming nature of spatial interactions. However, the content of the notion of spatial interactions was still identified with movement, the flow of matter, which is still visible today in texts that use this expression. In order to overcome the confusion between interaction and flows (as they are apparent synonyms), it is necessary to overcome the formal logic from which they developed, seeking a more dialectical approach to both spatial interactions and geographic space.

Spatial interactions, geographical space and categories of materialist dialectic

Given the failure of the formulations presented, the materialistic and dialectic view seems

of things, since they come from the deployments of the absolute idea (Cheptulin, 1982).

4 Also for W.E. Moore (1963 p. 8), "space is passive regarding human behavior. It is a mere reflection of society." For this author as well as for Kant, space is not considered a social instance endowed with relative autonomy, but is a function of other instances (of economy, politics, etc.). This view is a legacy of Kant, Newton and positivism in general, which has influenced even Marxist theoreticians (Santos, 2001).

5 Mehedini (1901), quoted by Santos (2001), states that while Ritter was influenced by the Kantian view, Humboldt would have been influenced by the principles of Auguste Comte. Both of them would subsequently have influenced the view of space of La Blache and Jean Brunhes, among others.

6 This discussion is carried out by Roberto Camagni (2005) in his Economia Urbana, exploring this interpretation of spatial interactions, dating back to authors such as E. G. Ravenstein (1885-1889), Zipf (1949), Reilly (1931), Wilson (1969) and Stouffer (1940), among others. In this work, the author expresses the fragility of the notion of spatial interactions, but does not suggest an alternative for successfully overcoming that view.

7 The term was originally coined by Carl Sauer in 1925, as a "paraphrase" of the concept of Geography given by Alfred Hettner (Hartshorne, 1978). Subsequently, many British and American geographers would use the expression areal differentiation, since this fits better the requirements of the English language.

to be a more realistic alternative for the concept of spatial interactions, which is inseparable from the concept of geographical space[8]. In dialectical materialism, the *interaction* between two or more bodies, or between aspects of the same body (an element of the categories of "cause and effect") is the *cause* of the changes in the bodies and the emergence of new material formations, while the "effect" corresponds precisely to these new transformations and new formations of matter arising from the interactions (Cheptulin, 1982). The category of "cause and effect" and its associated interactions are inseparable from matter, since matter is transformed through interactions established between material formations, interactions which depend on *time* to realize these transformations. Herein lies the inseparability of space[9] and time in the categories of dialectical materialism, because such *development* can only occur through the *interaction* of aspects or formations that contradict each other[10] after the extrapolation of *quantitative* aspects. This gives rise to new *qualitative* features, a new phenomenon, higher and more complex.

Under the dialectical concept of geographical space, the category of space can be understood as a second reality *(natura naturata)* that cannot be realized without the conditions offered by the previous objective reality *(natura naturans),* which, in turn, is incomplete and is only fully realized with the manifestation of the second reality, in accordance with the categories explored by Spinoza and presented by Santos (2001). Thus, there is a first nature, with the vocation to become a second nature, and this, in turn, cannot come into realization without the first nature, which is always incomplete (Santos, 2001). This definition of geographical space is aligned with the category of space of dialectical materialism, showing the immanent nature of space, time and the movement of matter.

Indeed, when we approach *geographical space,* these philosophical categories are transposed to another plane, because the material formations of which we speak are socially produced geographic objects, which undergo dialectical relationships with already produced objects, and even with those who produce it (the workforce), under the aegis of another mode of production, or another time in the same mode of production (Santos, 2001). Q*ualitative* and *quantitative* changes in this case refer to the accumulation of quantitative information from *spatial interactions* (and its flows) that give rise to a new quality for geographic space and the people who produce it, by means of transformation of the essence or forms of spatial objects (qualitative leap).

Objectively, this can be evidenced, for example, by the effect of the formation of high quality public transportation systems, which contribute by conferring mobility to the population to other parts of the city, providing access to employment opportunities, leisure facilities, personal improvement, and the collective equipment essential to the social reproduction of the population, making a positive contribution to the breakdown of the intergenerational reproduction of poverty (DRAIBE, 1993). In this case, it is the value of the work force which is enhanced, and thus *transformed* (CARCANHOLO, 2007). There is, however, resistance to these spatial interactions. This resistance takes the form of denial by "old" structures (wrinkles) remaining in the space, as well as by capitalist relations aimed at maximizing the profitability of a collective transportation *business.*

For example, the difficulties in implementing exclusive bus lanes to increase the efficiency of public transport arise from the costs of the expropriations necessary for this expansion, as well as from the "counter- purposes" crystallized in the space (the narrowness of the existing road system, dating back to other eras of the mode of production, and the morphology of urban space and its buildings, etc.). They also result from the hegemonic social and political structure and the strength of the middle and upper social classes, involved in a struggle for the control of circulation which exerts pressure on the government to increase the fluidity of individual cars rather than that of collective bus transportation. In this case, the process and its flows may be forced to adapt to the old forms, or the new ones required for the

8 It is only formally that we can separate the concept of spatial interactions from the concept of geographical space, just as is the case with respect to the categories of matter, space and interaction. In a schizophrenic way, many authors were using an expression of quantitative content juxtaposed to the dialectical conception of geographical space without any reformulation.

9 The *category* space in dialectical materialism, which involves the category of "cause and effect", is defined as "the extent of particular material formations and the relationship between each of them and other material formations." Time - immanent to space - is "the duration of the existence of material formations and the relationship of each one of them with previous and posterior formations" (Cheptulin, 1982).

10 The *law of unity and struggle of opposites,* which corresponds to the interaction of elements in a relative unit, where the direction of development is contrary and which, when it becomes equivalent, determines transformations that disrupt the essence of material formations.

realization of the process may be created.

Even in mid-sized cities with a modest extension of the urban fabric, like Marília and Presidente Prudente, the absence of exclusive bus lanes leads to inefficiency in the movement of public transport, as seen in displacements times required to travel between sub-centers, industrial areas and the residential quarters of workers (home-work course), which often takes up to one and a half to two hours due to the lack of synchronization of the systems of integration and frequent delays of buses in transit, a situation that "devalues" the labor force.

Finally, the definition of space as a concept carries with it not only the wider *category* of *space*, but also the categories and basic laws of dialectical movement of matter; this makes it possible to show there is both a "relative unit" and an "absolute conflict" between the new and old forms, since each needs the other for its realization, but, at the same time, they must overcome each other. Thus, the new tends to deny the old in its quest for realization, while the dynamic inertia of the old leads to the resistence of the new flows and the new spatial forms (law of negation of negation). S*patial interactions* are then manifested as the expression of this contradictory combination of old and new, creating the connection between fixed elements and flows. This process reflects the *law of unity and the struggle of opposites* in geographic space, with interaction being the *causa finalis*.

Spatil interactions, development and transformations in the value of space

To reflect the *changes* resulting from interactions, changes which drive material formations to a higher level, dialectical historical materialism makes use of the *category* of development, which should not be confused with the various *concepts* of development[11]. In economy, for example, Celso Furtado (1965) distinguishes the concept of development from the concept of growth, while Ignacio Rangel (2005) makes no such distinction, claiming that the very concept of development contains within itself the inherent contradictions of the capitalist mode of production[12].

The interaction between production and consumption, for example, which are contrary aspects in a capitalist society, conditions constant transformations in these elements, thus developing them. In the very production of goods – where the *interaction* between workers and capital takes place – men are perfected, making their needs more complex, for which – dialectically – production should be developed and further modified (Cheptulin, 1982)[13]. It is worthy of note that the exploitation of the labor force by capitalists requires an interaction that is *spatial,* through the daily transportation of the workforce to the means of production; without this spatial movements, there can be no extraction of surplus value or production of value.

The effects of extension of bus lines for passenger transport provide an example of the transformation of geographical space. This extension offers accessibility to more distant places to which there has traditionally been little access, such as rural areas for recreational use, but by providing this access, the transformation of this space is encouraged in relation to modification of land use. Regular daily bus service leads to the use of the space for permanent housing. Thus, the interaction in question leads to a new state, qualitatively more complex, which manifests itself as part of the geographical space. This example was particularly evident in the city of Presidente Prudente (Brazil), where the extension of transportation lines to the "Chácaras Arilenas" led to the development of new neighborhoods, resulting in an even greater need for services and infrastructure. In other words, there was a transformation of space, but its *value* was also transformed through the work of transport.

Thus, *spatial interactions* cannot be reduced simply to flows, since they constitute a broader phenomenon, one which involves flows, but

11 As a category of dialectical materialism, development refers to the process in which matter is conducted from a lower stage to a higher and more complex one, as a progressive movement, even though it manifests, at times, a circular movement (a return to the initial stage of development of the matter) or regressive movements (breakdown of the social formation), i.e., as conditions for general progressive movement (Cheptulin, 1982); it reflects the *continuity of discontinuity* in the historical process. It is worthy of note that in the materialist and dialectic interpretation of reality, movement is absolute, in other words, the processes of transformation of the material formations are a constant in the material world, while rest is relative.

12 On this subject, Rangel comments (2005) that "People can create a somewhat romantic idea of economic development, as if it were a haven of stability, welfare and peace," when in fact "A booming economy does not solve a problem without creating an even bigger one. It jumps continuously (dialectically) from one imbalance to another."

13 Citing Cheptulin (1982, p. 231): "The interaction leads to the modification of the bodies or aspects in interaction, as well as to the emergence of new phenomena and to the transition from one qualitative state to another. For example, the interaction of antagonistic classes affects the appearance of the State, changes in the social and state system, and the transition of society from one socio-economic formation to another."

that promotes the transformation of the spaces in which they interact. In the movement of this transformation towards development, flows and fixed elements become more complex, with the interactions between material transformations diversifying themselves in dialectical movement[14]. Spatial interactions are the expression of this dialectic, which corresponds to the fact that the fixed elements "fixed in each place, allow actions that modify this place; new or renovated flows recreate environmental and social conditions, and redefine each place" (Santos, 2008 p. 62), changing not only the phenomenon, but the very *essence* of that material formation.

For example, the mere announcement of the creation of the Expresso Tiradentes in São Paulo, a more efficient bus line, was enough to increase in 40% the value of the surroundings property. This is a classic case in which transport "creates" the "point", since it has created new standards of quality for accessibility, thus modifying the *value* of the space. The paradoxical fact is that by doing so, it has had the effect of "expelling" exactly those residents who most need this type of transportation infrastructure; they now live in more peripheral areas and depend on public transport routes providing lower levels of service.

This case makes it clear the fact that the path to a less "generic" use of spatial interactions, one that is able to get to the essence of the phenomenon, is related to an understanding of the concepts of *mobility*[15] and *accessibility*[16], moreover, it requires an understanding of the fact that transformations resulting from changes in these two conditions are those leading to variations in land *value* and the *value* of the material formations being transported. Accessibility and mobility are the factors that allow the concrete spatial interactions.

Milton Santos (2008) provides a hint of this discussion, when he says that "flows are a direct or indirect result of actions, and they cross or are installed in the fixed elements, changing their meaning and their *value*". The evolution of the *quality* and *quantity* of these flows stimulates a shift, a *leap* (the category of leaps, i.e., abrupt qualitative changes) in the fixed elements and in the flows themselves, which by the act of combining, trigger development; this development depends both on the conditions for *mobility* of entities that mobilize themselves and favorable *accessibility* offered by the space as a result of the infrastructure that comprises it.

Indeed, it is the transport that ensures *mobility*, i.e., that makes up spatial interactions, as well as their creation and transformation and the transfer of value that are part of the movement towards development. For Marx (1983), transport work creates value and surplus value, as it creates a transformation (even if intangible) in the commodity-service of transport[17]. Marx (1983) provides

14 Given these assumptions, the idea of an indissoluble link between space and time with matter (the whole) in motion is clear, since this can only be set in motion when embodied in its individual material formations (the parts). This movement is not without contradictions: indeed, it is only by resolving contradictions between material formations, or internal aspects of a material formation in *interaction,* in which there is negation of the old, the statement of the new (first negation), reaffirming the old under new foundations and denial of the pre-existing new (negation of the negation) (Cheptulin, 1982). This movement is also spatial, as it can express the production of space and, more broadly, the Social-Spatial Formation as a meta-concept of Geography.

15 Mobility is an attribute of things or people that are mobile, and have the power to move differently according to the material conditions available. In the Marxist genealogy, Rosa Luxemburgo (1985), Jean Paul de Gaudemar (1977) and Lenin (1982) use this expression to refer to migrations motivated by work that are mobilized by the "drag" promoted by *the mobility of capital.* There are, however, other approaches. In sociology, it is common to talk, for example, about *social mobility* when we want to refer to the circulation or the movement of ideas, of social values or of individuals from one segment or social group to another (Bourdieu, 1984), while disciplines studying urban space, and delving into the scale of the city refer to *urban mobility* as the differential ability of individuals to move within the city space, i.e., it is the ability of movement of individuals and social groups in the space of the city in various contexts, at different frequencies and with different objectives (Sousa, 2003). People confined to wheelchairs, the elderly, low income groups, and the unemployed are urban people considered to suffer reduced mobility.

16 *Accessibility* is an attribute of the *space* produced which reflects the ease of reaching desired destinations'. This can be measured by the *number* and *nature* of the destinations that can be reached within a given urban context,;also by the *costs* incurred in time of travel and waiting, walking, and even transshipment, which can reflect the lack of investment in infrastructure unique to public transport, whose feasibility is constrained by the *externalities* of traffic or by the anarchic growth of urban space (Vasconcellos , 2000).

17 In this case, Marx (1983) makes clear the unproductive nature of the activities of buying and selling, since in these there are no new products created by the work, neither tangible nor intangible. In commercial activity, there is merely a transfer of ownership of a product from the seller to the buyer, with the profits coming from the surplus value extracted from the

various examples of "intangible" products in his work, i.e., he explains that work does not necessarily have to produce a tangible commodity[18] to be productive. Therefore, transport activities increase the wealth-value of the society by transferring the value of the constant consumed capital (vehicles etc.) in the transport of goods, as well as added value for the work of transport, i.e., for the transport service[19] (Marx 1970).

In the case of urban land, the dispute for the value of use of *accessibility* (the relationship between supply, demand and the ability to pay for location) generates different *exchange values,* producing more dynamic *spatial interactions* between certain spaces, while others remain somewhat segregated, more isolated in terms of access to the space of the city as a whole. Therefore, the provision of new *mobility* and *accessibilities* provides the reinforcement of *spatial interactions* and the transformation of the value of spaces that participate in it, thus changing their uses[20]. For example, when the state endows a given space with an efficient infrastructure for accessibility, it creates *general conditions of production* for capital and confers *expanded social reproduction* to the labor force (Topalov, 1979) by enabling mobility in different modes of transport.

productive sectors (Marx, 1983). Abstractly it is possible to separate, in formal terms, the capital of industrial production, productive services and the unproductive trade of goods and interests; however, categorical formalism and a formal interpretation by a reader is one thing, and the objective reality of strictly commercial companies (framed within the commercial sector) performing the unproductive activity of transferring ownership (buying and selling), as well as the productive activities of storage, transport, packaging, etc., is another. Thus, many activities that commercial traders realize are not commercial, though a large part of their profits arise from unproductive commercial activity, and from the reduction of the mass of surplus values of the productive sectors (Carcanholo, 2007). Marx (1983, p. 325, L. III) states that "Commercial capital, stripped of all heterogeneous functions related to it, such as storage, shipping, transport (...) and limited to its true function of buying and selling does not create value, nor surplus value "(Carcanholo, 2007).

18 However, there are two moments in Marx's work that must be distinguished: 1) productive work in general, i.e., the one that produces use value and 2) productive work under capitalist relations of production.

19 In time, clarification is required: transport activity can be unproductive if the freight does not refer to the transport of goods to the place of consumption, but rather being determined by speculative interests, since in this case it can reduce the wealth-value of the society. One example is the transportation of a commodity from space "A" to "B" and later, once the prices at "A" become favorable, its re-transportation back to area "A" (Carcanholo, 2007).

20 Moreover, it is not a «deterministic» relationship, but bonds that develop from *multiple determinations,* since in dialectic materialism the categories of *necessity* and *contingency* are involved. For example, the provision of mobility and accessibility is *contingent* because it depends on the outcome of the relationship of social forces, with agents more or less interested in these investments. If the state is involved, there will *necessarily be* transformation of space due to the interactions that occur therein.

Conclusion

This paper has demonstrated the immanence between the geographical notion of *spatial interaction* and interaction as a link between materialism and dialectical categories of "cause and effect", i.e., it is the primary cause of the emergence of new material formations through the establishment of links between them. The importance of the notion of spatial interactions was revealed in the treatment of discussions on transportation, as well as its relationships with the dialectical view of geographical space; we thus sought to apply it to overcome the *mainstream* tradition in which it originated, in other words, the ruling view that defines the notion as a mere displacement mobilized by centripetal economic forces. These conclusions lead to the overthrow of *formal logic*, which was initially used to conceptualize spatial interactions, and its replacement with a *dialectical logic* which advocates the existence of contradictions and a continuous leap from one contradiction to another (Rangel, 2005) in the process of development of the material world. We also conclude that spatial interactions do not promote transformation and emergence of the new only as *phenomena*, but also as part of the *essence* of these phenomena; in the context of the capitalist mode of production, they refer to transformations of the *value* of the spatial objects produced, as well as of the very space produced.

REFERENCES

Bourdieu P. 1984. *La distinción*. Madrid: Taurus.

Camagni R. 2005. *Economia Urbana.* Barcelona: Antoni Bosch.

Carcanholo R. 2007. A categoria marxista de trabalho produtivo. In: Anais do Encontro Nacional da Sociedade Brasileira de Economia Política. SEP, São Paulo. URL: <http://www.sep.org.br>. Last accessed: dec 15th,2009.

Cheptulin A. 1982. *A dialética materialista:* leis e categorias da dialética. São Paulo: Alfa-Ômega.

Corrêa R. L. 1997. Interações Espaciais. In: Castro I. E., Gomes P. C. da C., Corrêa R. L. (eds.). *Explorações geográficas.* Rio de Janeiro: Bertrand Brasil. p. 279-314.

Furtado C. 1965. *Desenvolvimento e subdesenvolvimento*. Lisboa: Fundo de Cultura.

Gaudemar J. P. 1977. *Mobilidade do trabalho e acumulação do capital*. Lisboa: Editorial Estampa.

Hagget P. 1970. *Locational analysis em human Geography*. Londres: Edward Arnold. p. 31-61

Hartshorne R. 1978. *Propósitos e natureza da Geografia*. São Paulo: Hucitec.

Luxemburgo R. 1985. *A acumulação do capital:* contribuição ao estudo econômico do imperialismo. São Paulo: Nova Cultural.

Marx K. 2005. *O Capital*: crítica da economia política. 10. Ed. Rio de Janeiro: Civilização Brasileira.

Marx K. 1983. O Capital: crítica da economia política. São Paulo: Difel.

Rangel I. 2005 *Obras reunidas*. Rio de Janeiro: Contraponto.

Santos M. 2008. *A natureza do espaço*: técnica e tempo, razão e emoção. São Paulo: Edusp.

Santos M. 2001. *Por uma Geografia nova*. São Paulo: Edusp.

Santos M. 1982. Sociedade e espaço: a formação social como teoria e como método. In: *Espaço e sociedade*. Petrópolis: Vozes. p. 9-27.

Sousa M. T. R. 2003. *Uma abordagem sobre o problema da mobilidade e acessibilidade do transporte coletivo, o caso do bairro Jardim São João no município de Guarulhos-SP*. Campinas: Univ. Est. de Campinas/ Unicamp. (Msc. Dissertation).

Topalov C. 1979. La urbanización capitalista*:* algunos elementos para su análisis. México: Edicol.

Ullman E. 1974. Geography as spatial interaction. In: Hurst M. E. (eds.). *Transportation Geography***.** London: Macgraw Hill. p. 29-39.

Vasconcellos E. A. 2000. *Transporte público urbano nos países em desenvolvimento:* reflexões e propostas. São Paulo: Annablume, 2000.

Villaça F. 2001. *Espaço intra-urbano no Brasil*. São Paulo: Studio Nobel, 2001.

Santos M. 2000. *Por uma outra globalização*. Do pensamento único à consciência universal. São Paulo; Rio de Janeiro: Record.

Weber A. 2005. *Excelência em beneficiamento e armazenagem de grãos*. Canoas/RS: Salles Editora.