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GEOGRAPHICAL STUDIES OF CIRCULATION, TRANSPORT, AND LOGISTICS

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GEOGRAPHICAL STUDIES OF CIRCULATION, TRANSPORT, AND LOGISTICS

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Abstract

This paper presents the epistemological trajectory of the Geography of Circulation, Transport, and Logistics, contextualizing the theme within the current historical period, which is characterized by the technical-scientific-informational milieu and contemporary acceleration. The methodology consists of exploratory, descriptive, and bibliographic research, based on a narrative review which – unlike a systematic review with explicit inclusion and exclusion criteria – relied on influential works and key authors identified in the literature. The conceptual evolution is divided into four major theoretical groups: the traditional classical formulations (German and French schools); the post-World War II neopositivist and quantitative approach; a hybrid perspective focused on territorial planning; and contemporary critical analyses formulated under the aegis of the critical current in geographical science. Finally, the study concisely presents the contributions, seminal works, and development of these theoretical and empirical studies within the Brazilian scientific context of Geography.

Keywords: Circulation; Transport; Logistics; Epistemology of Geography; Geographical Thought.

Resumo / Resumen

ESTUDOS GEOGRÁFICOS SOBRE CIRCULAÇÃO, TRANSPORTES E LOGÍSTICA

Este artigo apresenta a trajetória epistemológica da Geografia da circulação, transportes e logística e contextualiza o tema no atual período histórico, marcado pelo meio técnico-científico-informacional e a aceleração contemporânea. A metodologia consiste em uma pesquisa exploratória com finalidade descritiva e natureza bibliográfica, baseada em revisão narrativa que, diferentemente de uma revisão sistemática com critérios explícitos de inclusão e exclusão, apoiou-se em obras influentes e autores de referência identificados na literatura. A evolução conceitual é dividida em quatro grandes blocos teóricos: a gênese clássica tradicional (escolas alemã e francesa); a abordagem neopositivista e quantitativista pós-Segunda Guerra Mundial; uma perspectiva híbrida voltada ao planejamento territorial; e as análises críticas contemporâneas formuladas sob a égide da corrente crítica na ciência geográfica. Por fim, o trabalho expõe de maneira sintética as contribuições, obras seminais e o desenvolvimento desses estudos teóricos e empíricos no cenário científico brasileiro.

Palavras-chave: Circulação; Transportes; Logística; Epistemologia da Geografia; Pensamento Geográfico.

ESTUDIOS EN GEOGRAFÍA DE LA CIRCULACIÓN, TRANSPORTES Y LOGÍSTICA

Este artículo presenta la trayectoria epistemológica de la Geografía de la circulación, transportes y logística, contextualizando el tema dentro del período histórico actual, marcado por el medio técnico, científico e informacional y la aceleración contemporánea. La metodología consiste en una investigación exploratoria con finalidad descriptiva y de naturaleza bibliográfica, basada en una revisión narrativa que, a diferencia de una revisión sistemática con criterios explícitos de inclusión y exclusión, se apoyó en obras influyentes y autores de referencia identificados en la literatura. La evolución conceptual se divide en cuatro grandes bloques teóricos: la génesis clásica tradicional (escuelas alemana y francesa); el enfoque neopositivista y cuantitativo posterior a la Segunda Guerra Mundial; una perspectiva híbrida centrada en la planificación territorial; y análisis críticos contemporáneos formulados bajo el amparo de la corriente crítica en la ciencia geográfica. Finalmente, el trabajo presenta de forma sintética las contribuciones, las obras seminales y el desarrollo de estos estudios teóricos y empíricos dentro del panorama científico brasileño de esta disciplina.

Palabras-clave: Circulación; Transportes; Logística; Epistemología de la Geografía; Pensamiento Geográfico.

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INTRODUCTION

Concepts and notions such as spatial interactions, transportation networks, fixed elements and flows, accessibility and mobility, infrastructure, routes, corridors, and storage, among others, constitute the Geography of Circulation, Transport, and Logistics, a field of specialization within Economic Geography that studies dynamic processes contributing to the production and reproduction of geographical space. Accordingly, this paper aims to examine the epistemological trajectory of studies on circulation, transport, and logistics in Geography. While examining classical works and the development of research conducted within different paradigms, such as the neopositivist and critical paradigms, we also consider selected case studies and how they have been approached over the decades, in accordance with different theoretical currents and the methods on which they are based. The paper also provides a concise overview of recent advances in research conducted in Brazil.

In terms of their defining content, geographical studies of circulation, transport, and logistics encompass three fundamental dimensions. Circulation can be understood as a comprehensive and dynamic process, represented by the continuous, cyclical movement of people, goods, information, capital, and so forth, which, under the capitalist mode of production, becomes identified with the circuit of capital. Transport has a more specific character, shaped by the technical paradigm within which the analysis is situated, and is defined as the act, effect, or operation of moving people or objects from one place to another through interventions that rely primarily on infrastructure and vehicles. Logistics, in turn, comprises a set of strategies for transport planning and management and for storage, from either a public and state-oriented or a private and corporate perspective. It also encompasses planning, efficiency and effectiveness, the fluidity of flows, and other issues associated with production chains at different scales (Silveira, 2011b; 2017).

We live in a period characterized by the near-instantaneous transmission of intangible flows and an increasing demand for the acceleration of material flows. Geopolitical instability, economic and financial interdependence among nation-states, the centrality of international trade, expanding consumption, and global production chains, among other factors, direct our attention to circulation, transport, and logistics. However, the issue concerns more than flows of people, goods, information, and capital, and extends beyond an exclusive focus on infrastructure. The normative dimension – that is, the relationship between territory and norms – is also central to this field of inquiry, particularly in the current historical context, in which digital platforms for intermediation, commerce, and the transformation of work are emerging. Contrary to the claims made since the 1980s, globalization has entailed an increase in the production of norms and intensifying competition among states, rather than the greater cooperation suggested by the globalization narrative.

The current historical period is characterized by the inseparable triad of technique, science, and information, fundamental spatial elements for understanding the worldwide expansion of relations and, consequently, of flows and fixed elements, together with their linkages and interactions, in the sense proposed by Santos (2014). In this context, territory becomes selectively fluid, places are integrated into worldwide networks through the mediation of socio-spatial formation, and production, circulation, exchange, and consumption – the classical categories of Marxist Political Economy – become increasingly extroverted. The normative dimension suggests studies such as those by Arroyo (2015; 2018), which address the porosity of territories in relation to the interests of corporations operating across multiple locations. This leads us to problematize the digital world, the clash between flows and inflows, and socio-spatial formations, which “filter” relationships and modulate attempts to “flatten” the world, particularly in finance and commodity markets (Silveira, 2020; 2022). This is also evident when we recognize the information technology and telecommunications paradigm as a defining component of the present (Perez, 2004).

Our purpose is not to provide an extensive literature review or an exhaustive analysis of studies on circulation and transport in geographical science, but rather to identify and discuss works that illustrate both the historical trajectory of this field and recent research efforts. Certainly, some works have not been included, since we did not conduct a systematic survey using bibliometric methodologies or exhaustive searches of thesis and dissertation repositories, scientific journal databases, or conference proceedings. To establish the state of the art, our methodology consisted of exploratory research with a descriptive purpose and a bibliographic approach (Gil, 2017). Unlike a systematic review, which applies

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explicit criteria for including or excluding studies, we prioritized the theoretical and methodological relevance of authors and works; in other words, we conducted a narrative review (Rother, 2007). The selection criteria favored reference works, authors whose contributions were significant to each theoretical current, and studies representative of recent research in Brazil.

On this basis, we developed the classification presented in this theoretical and bibliographic essay, which examines the theoretical currents encompassing the thematic geographical studies under consideration. We discuss authors and works that express the theoretical and methodological paradigms underlying these studies. The discussion begins with a traditional perspective inherited from Geography's modern origins, proceeds to regional studies and the quantitative current, and then addresses critical developments over the past three decades. Our approach builds on previous studies examining the evolution of research on circulation and transport in Geography, including Giménez i Capdevila (1986), Pini (1995), Olivier (2001), Pacheco (2004), Silva Júnior (2009), and Silveira (2011b). This essay updates the overview of recent contributions in Brazil and works published in other countries over the past decade, while also proposing a periodization of the epistemological trajectory of the field.

The studies discussed below can initially be classified into the following groups according to their theoretical and methodological affinities. (1) First, we consider the classics and the origins of the "Geography of Circulation" or "Transport Geography". In addition to early contributions, this group includes works produced contemporaneously with the first studies or drawing on those pioneering contributions. (2) Next, we examine an approach that emerged after the Second World War, namely New Geography, grounded in neopositivist and the quantitative turn. (3) A third group comprises a hybrid approach combining classical German and French geographical traditions with a limited turn toward quantification, emphasizing graphical modeling, generalizing syntheses, and some degree of statistical analysis, also shaped by territorial planning – the French concept of aménagement. This hybridization is particularly evident in transport studies, where models, diagrams, and statistical methods were employed less extensively. (4) A fourth group of studies indicates that contemporary acceleration, arising from financial globalization, has prompted a reassessment of the field's thematic concerns. This reassessment has introduced contributions focused on international trade, the intensification of tangible flows of goods and passengers, and the relationship between these processes and technological progress. It constitutes a more critical general framework developed over the past three decades.

THE FOUNDATIONAL CLASSICS: THE "GEOGRAPHY OF CIRCULATION"

From this point onward, we examine the trajectory of geographical studies on circulation and transport. Attention to this phenomenon dates to the early development of Geography as a modern science, whose origins were also connected to the question of territorial integration during German unification in the late nineteenth century. Friedrich Ratzel, an important precursor of the German school of Geography, played a fundamental role in the study of circulation. This is evident in what is perhaps his best-known work, Anthropogeographie, published in two parts, in 1882 and 1891, respectively.

Ratzel's thinking on circulation and its role in spatial organization was subsequently systematized by G. A. Hückel in two contributions to the Annales de géographie, published in 1906 and 1907. The origins of these thematic studies are intrinsically linked to the nineteenth century "transport revolution", whose early milestones included Karl Ritter's observations on the role of technique in partially overcoming the forces of nature. In this context, Alfred Hettner played an important role by comparing the system of flows to the blood circulation of a body and by establishing Chorology, which exerted considerable influence during the first half of the twentieth century. Chorology provided a bridge through which the regional tradition, consolidated by Paul Vidal de La Blache, came to treat transport as a fact of civilization integrated into economic life. Since its institutionalization, the discipline has been concerned with circulation. One example is Hettner's inaugural study, published in 1897 and devoted to Verkehrsgeographie, the specialized subfield of Geography concerned with the study of circulation and transport.

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Hettner's work provides an overview of transport research in Geography at the end of the nineteenth century, including studies of land routes, maritime transport, and postal and telegraph services. Hettner (1897, p. 704, our translation) stated: "The time when Transport Geography", or the Geography of Circulation, "was almost exclusively a descriptive discipline and a scourge of amateurism is over. A period of serious research has begun". From that point onward, the expansionist character of the German nation-state encouraged the development of systematic knowledge about its territory, both internally and for the organization of its colonies – at a time when colonialism was rapidly expanding. Among other contributions, H. O. Rosenhainer's doctoral dissertation, entitled Verkehrsgeographie Der Deutschen Schutzgebiete in Afrika, was defended at the University of Jena in 1904.

Among the foundational classics of our discipline, we can also identify the contributions of the French school. Vidal de La Blache is particularly noteworthy, as the third part of his work Principes de Géographie Humaine is devoted to circulation. This strongly historical current was characterized by an interest in genres de vie (ways of life) and studies concerned with the longue durée. For Vidal, circulation, roads, and routes were features of modern civilization, products of a process of continuous accumulation, although his approach adopted less comprehensive analytical frameworks in addressing the relationship with the "external" world (Vidal de La Blache, 1954). One concern regarding circulation was socio-economic transformation resulting from faster flows across the French pays (historical and geographical regions). The late nineteenth century witnessed the rapid expansion of railways, followed soon afterward by the diffusion of motorized transport through cars and trucks. These developments brought broader horizons and extended the reach of relational life.

Several studies have addressed the differences between the German and French traditions and the "pendulum" between studies of circulation and studies of transport (Giménez i Capdevila, 1986; Silveira, 2011b; Silva Junior, 2009). Today, these differences are understood more in lexical and translational terms, particularly regarding Verkehrsgeographie. In their origins, German studies favored a comprehensive perspective, whereas French studies tended to emphasize local and regional scales and changes occurring in places, although exceptions existed. In addition to the physiocratic current and its emphasis on the role of nature in shaping society, the notion of "circulation" drew on advances in other sciences, particularly Biology, giving rise to analogies involving the human body and the natural world.

The French school contributed to the systematization of studies on circulation and transport. Jean Brunhes and his colleague Camille Vallaux, for example, introduced theoretical innovations: circulation featured as an essential topic of geographical knowledge both in Brunhes's treatise on "Human Geography" and in Vallaux's work on the state, power, and the seas (Vallaux, 1914; Brunhes; Vallaux, 1921; Brunhes, 1962). This interest persisted in the works of Max Sorre (1948), with his focus on the conquest of space; Henri Cavaillès (1940); Robert Capot-Rey (1946); Jean Gottman (1952); René Clozier (1963); Max Derruau (1973); and Maurice Wolkowitsch (1973). The latter authored a classic dissertation on the relationship between region and railway (Wolkowitsch, 1958) and subsequently moved toward "applied Geography".

In Brazil, numerous works draw on these early contributions, since the origins of the country's "scientific Geography" were linked to French scholarship, which helps explain its extensive influence on studies of this subject (Mamigonian, 2025). One example is the pioneering work of Moacir Malheiros Fernandes Silva and his book Geografia dos transportes no Brasil (Silva, 1949), which offers an analysis rich in traditional empiricism. The author also published works such as Kilometro zero, A Geografia no Plano Rodoviário Nacional, and Geografia das estradas de ferro brasileiras. Moacir Silva's contributions were complemented by works such as those of Mário Travassos (1942), including Introdução à Geografia das Comunicações brasileiras. Travassos was a military officer who contributed to geopolitical studies.

Examples of broader studies are also plentiful. In his doctoral dissertation Le Brésil Méridional, Delgado de Carvalho examined navigation, ports, and Brazil's railway network. In his Ensaios de Geografia Humana, Josué de Castro addressed circulation and communication networks. In História Econômica do Brasil and Formação do Brasil contemporâneo, Caio Prado Júnior discussed circulation and routes. Milton Santos examined the transport network in Bahia's cocoa-growing region, while the work derived from his dissertation, O centro da cidade do Salvador, addressed transport in the center of that city, including streetcars and the transition to motorized transport. Geographer Odilon Nogueira de Matos examined railways in São Paulo and their relationship with the coffee economy. Pierre

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Deffontaines addressed circulation in the works “Como se constitui no Brasil a rede das cidades” and “A evolução dos transportes no Brasil para aviação”. In his classic Pioneiros e fazendeiros de São Paulo, Pierre Monbeig examined circulation and transport in the context of the expansion of coffee production in the states of São Paulo and Paraná.

Through the work of dozens of geographers, the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística – IBGE) produced studies on transport. One example is the publication of regional monograph series, with one volume devoted to each region. The Geografia do Brasil collections, published throughout the twentieth century, contained valuable analyses, including studies of the South region by Teixeira (1968) and Strauch (1977). Each of these works was organized thematically, covering climate, relief, population, urbanization, industry, and, of course, transport. The subject also featured in synthetic works, such as Ney Rodrigues Inocêncio’s Paisagens do Brasil, published in 1968, and Panorama regional do Brasil, published in 1969.

In the 1960s, Maria do Carmo Corrêa Galvão published “Características da Geografia dos Transportes no Brasil” (Galvão, 1966). The geographer, who contributed to agrarian studies and the development of postgraduate education in the discipline in Brazil, participated in the first Transport Commission of the International Geographical Union (IGU). The commission also included R. Caralp (France), E. Ullman (United States), I. Nikolsky (USSR), and G. Jacob (East Germany). It first met at the twenty-first International Geographical Congress, organized by the IGU in New Delhi, India, in 1968 (Giménez i Capdevila, 1986).

The regional tradition, with its strong historical emphasis and reliance on empirical research, remains important today, and the notion that it has been entirely superseded is mistaken. Nevertheless, this current was most influential until the late 1950s. This does not mean that it disappeared, but rather that it lost its central position. Research produced after the Second World War focused on quantification and the development of models, diagrams, and related approaches. The older foundations established by the German school and Vidal de La Blache’s “possibilism” were relegated to a lower scientific status or even dismissed as lacking scientific validity with the emergence of theoretical and quantitative Geography.

THE EMERGENCE OF QUANTITATIVE STUDIES AND THE NEW GEOGRAPHY

Considering technological progress, the rationality demanded by postwar reconstruction, and the advent of computers, the social sciences were also affected by these transformations. Philosophical conceptions and methodologies that challenged classical studies were introduced into Geography and other disciplines, portraying such studies as incompatible with scientific knowledge because they were supposedly laden with subjectivity and perspectives that disregarded advances in the industrial world (Andrade, 2008).

One major event of this period was the intense debate in American Geography between Richard Hartshorne (Wisconsin) and Fred Schaefer (Iowa). This debate represented a clash between two conceptions of the discipline. On one side stood Hartshorne, whose books The Nature of Geography (1939) and Perspective on the Nature of Geography (1959) championed the classical regional tradition: descriptive, grounded in fieldwork, focused on exceptionalism, and based on regional monographs. On the other side stood Schaefer and his posthumously published work “Exceptionalism in Geography” (1953), which criticized Geography as a discipline concerned with singularities. The debate led to a conception of science oriented toward the search for and establishment of general spatial laws. Among its consequences was the rise of logical neopositivism, influenced by Anglo-Saxon science and the Vienna Circle. Its formal methods also influenced intellectuals in socialist countries, given their relevance to the pragmatic requirements of economic development. Accordingly, as in other fields, Geography was expected to pursue coherence, rigor, and objectivity through the universalization of procedures and the unification of method according to logical, formalist, and supposedly apolitical principles.

The main movement within theoretical and quantitative Geography emerged from the Anglo-Saxon scientific world. Examples include David Harvey in England, with his 1969 book

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Explanation in Geography, as well as Peter Haggett, Michael Chisholm, and Richard Chorley. In the United States, key figures included Fred Schaefer, followed by Edward Ullman, William Bunge – with his 1962 work Theoretical Geography – and Brian Berry, alongside the Chicago and Washington schools. The movement also had repercussions in Sweden, through Torsten Hägerstrand, and in Poland, through Zbyszko Chojnicki, Marek Potrykowski, and Zbigniew Taylor. It also influenced the Soviet Union, owing to the pragmatism demanded by revolutionary society, without eliminating the relationship with Marxism-Leninism, which itself helped drive the development of geographical science (Saushkin, 1973).

Several of these scholars studied the subject under consideration here. The close relationship between territorial planning and economic flows encouraged the adoption of this "renewal" in studies of circulation and transport. R. Chorley and P. Haggett published influential quantitative works addressing physical and natural phenomena, spatial analysis, and networks. Edward James Taaffe, in turn, contributed to works such as Geography of Transportation (1973), while Michael Eliot Hurst authored the well-known Transportation Geography: Comments and Readings (1974).

According to Ullman (1980), Geography should be the science of spatial interaction, with particular emphasis on the study of transport. It is worth recalling that transport geography had already been valued by classical scholars such as J. Brunhes and J. H. Paterson, who regarded the "Geography of Circulation" or "Transport Geography" as a branch of "Human Geography" and a central specialization within "Economic Geography". In the works of Pierre George, including his treatises on Urban Geography and Economic Geography, and in Erich Otremba's work on the Geography of Communications and Services, transport appeared as one of several topics within Economic Geography. Beyond his association with the models and diagrams of neopositivism, Ullman also participated in heated debates about reintegrating Geography into government and planning. He also discussed the preservation of the discipline at Harvard, an effort that ultimately failed, before he subsequently taught in Washington (Harris, 1979; Glick, 1985; Sugiura, 1999).

Aware of the limitations associated with purely mathematical models, he defended the historical character of spatial interactions, addressing, for example, the difficulties involved in simply transferring spatial elements from one region to another.

In Brazil, quantification emerged through several interconnected processes, including the authoritarian and pragmatic regime of the Military Dictatorship; the role assigned to IBGE and its function as an informational "backbone" for urban and regional planning; and the influence of the Anglo-Saxon school on the training of technical and scientific personnel and on geographical literature more broadly (Campos, 2013). In transport studies, classical monographs remained influential until the late 1970s, while subsequent decades witnessed greater adoption of models and statistical syntheses, as illustrated in part by Ribeiro and Almeida (1995).

Studies of road passenger transport illustrate the transition in the epistemological background of the discipline. As a basis for classifying urban networks and their areas of influence – giving rise to traditional studies of the urban network – researchers examined intermunicipal transport systems in different Brazilian states. Theoretical frameworks such as W. Christaller's central place theory, P. Haggett's locational analysis, and graph theory provided the conceptual foundations. Although these studies lacked a comprehensive approach to geographical space, the number of studies devoted to transport increased, some of them constituting broad empirical investigations. Contributions from Great Britain and Sweden also informed this research, including F. Green's work on England, S. Godlund's studies of Sweden – associated with the "Lund School", which also included T. Hägerstrand – and I. Carruthers's research on Wales. These contributions classified cities and analyzed their relationships with their hinterlands through the provision of bus services.

A pioneering study was published by Langenbuch (1970) and subsequently influenced other studies. The author focused on the urban network of São Paulo state and the problem of intermunicipal road passenger transport, aiming to classify the network of cities based on regional bus flows. Throughout the 1970s, Brazilian journals published several related studies. Gehlen (1971) examined the Metropolitan Region of Porto Alegre (Rio Grande do Sul); Neves (1971), Teixeira (1972), and Rua (1973) analyzed, respectively, the urban networks of Rio Grande do Sul, Rio de Janeiro, and Espírito Santo. Corrêa and Teixeira (1975) synthesized existing research to highlight the relevance of this mode

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of transport to discussions of central places. Mello e Silva (1982) examined the state of Bahia and proposed an isochrone-based classification of road accessibility. Pompilio (1987) and Machado (1997) studied, respectively, the state of Santa Catarina and the city of Juiz de Fora, in Minas Gerais.

In France, geographical studies of transport underwent a process of reinterpretation oriented toward practical application, particularly through aménagement du territoire (territorial planning) (Andrade, 2008). One example is Initiation à la Géographie Appliquée, by Bernard et al. (1978). Maurice Wolkowitsch's Géographie des transports (1973) is another example, followed by the similarly titled works of Jean Ritter (1976) and, more recently, Émile Mérenne (2013). Pierre Merlin (1991; 1992) also contributed through Géographie, économie et planification des transports and Les transports urbains. This "applied Geography" differs from purely mathematical models, reflecting a more moderate approach to quantification that also emerged in other countries.

For example, Pons and Bey (1991) published Geografía de redes y sistemas de transportes, a book that surveys the field throughout the twentieth century and focuses on spatial models of demand and density, as well as methods for representing origin–destination pairs within urban space. Similarly, German scholarship includes Nuhn and Hesse's (2006) Verkehrsgeographie, which provides an overview organized around individual transport modes. Its content addresses spatial structures, functional interdependencies, and the impacts generated by the movement of people, goods, and information. As an inheritance of the New Geography, the work also discusses theoretical models of networks and regional development.

To overcome language barriers, we also consider Russian-language scholarship. In Evolutionary Morphology of Transport Networks, Tarkhov (2005) brings together regional studies, spatial modeling, and a critical perspective. The work examines accelerated urbanization and demand for public transport, using Moscow as a case study. Tarkhov and Semina (2009) argued that the act of transporting, when examined in Geography, should not be treated as a mere variable. In contrast to purely technical, economistic, or quantitative conceptions, transport infrastructure and systems constitute an active spatial element that interacts dialectically with spatial organization. Semina, Folomeikina, and Krylov's (2023) work revisits the trajectory of studies on this subject in Russian geographical science. They also mention the establishment, in 1954, after the Second World War, of the Institute of Complex Transport Problems (ICTP), affiliated with the planning committee and the USSR Academy of Sciences. The institute helped advance geographical research alongside the development of Economic and Social Geography (Saushkin, 1973).

In their study, Jin et al. (2016) examine the development of geographical research on transport in China. As in Western scholarships, research initially consisted of empirical studies focused on local areas, before progressing toward modeling and quantification, approaches that remain prevalent. The dominant theoretical current continues to be technical and scientific pragmatism oriented towards planning and spatial models. More explicit analyses grounded in historical materialism or the critique of Political Economy remain largely absent. Thus, Chinese "Transport Geography" can be understood as having consolidated itself as a scientific field primarily supporting economic development in a relatively narrow sense. Its contributions focus on developing indicators of connectivity and accessibility and understanding economic belts (traffic economic belts), thereby providing a basis for decision-making in infrastructure projects.

According to Giménez i Capdevila (1986), a common thread of concern runs through French scholarship, from Vidal de La Blache and Brunhes to Clozier, Capot-Rey, and the other authors mentioned above. Although French geographical research has focused more on the morphology of transport systems than on structural and historical dimensions, it has been less affected by the neopositivist influences of the United States and Great Britain, a pattern that may be explained by the strength of its own "national school" (Mamigonian, 2025). Nevertheless, more critical approaches have developed in the Anglo-Saxon, German, French, Canadian, and Brazilian traditions. Quantitative Geography and hybrid approaches, however, continue to inform studies to varying degrees.

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THE CRITICAL TRANSITION IN GEOGRAPHICAL SCIENCE AND THE INCOMPLETE INCORPORATION OF STUDIES ON CIRCULATION AND TRANSPORT

The 1970s saw the incorporation of more critical theories into Geography in different national contexts. One example was the proposal for an "Active Geography" associated with P. George, B. Kayser, R. Guglielmo, and Y. Lacoste. The Anglo-Saxon world also witnessed the emergence of "Radical Geography". In Brazil, the critical renewal of the discipline reached a high point with Milton Santos and his formulation of the category-concept of socio-spatial formation. In the capitalist periphery, the critique of traditional methods developed with varying degrees of intensity. In Brazil, Marxist categories and concepts were incorporated through the outstanding intellectual contributions of scholars such as Manuel Correia de Andrade, Armen Mamigonian, and Ruy Moreira.

Santos (1977; 2012; 2014) and Santos and Silveira (2001) emphasized the need to approach geographical space through the dynamic process of history – that is, through formation, rather than by focusing on forms as static elements. These forms encompass both fixed elements and flows. In analyzing circulation and transport, rather than concentrating solely on the equipment employed, the observable characteristics of the resulting flows, and their quantitative synthesis, we must investigate historical imperatives and the transformative role of interactions between different spatial forms and their functions in societal development. Public transport, for example, can become either a barrier that prevents progress or a driving force for social advancement and interaction among the working class, including access to opportunities that enable social mobility. It can also contribute to regional integration by facilitating access to public goods and services for local populations, particularly in relation to work, education, leisure, and healthcare. However, it is through examining the relationship with structure – that is, with a social formation – that we can apprehend and deepen our analysis of this subject and understand its significance as a variable.

A qualification is necessary regarding the transition from quantitative approaches to critical studies of circulation and transport. This transition was not complete; in practice, it involved the abandonment of thematic studies on circulation and transport. With reference to Brazil, we identify three possible explanations. The first may be associated with the abandonment of the classical, comprehensive thematic propositions and methodological traditions of geographical science during its renewal and the emergence of the New Geography (Santos, 2008). The second concerns the almost complete rejection of the theoretical and quantitative approaches of the New Geography itself. To some extent, these approaches had helped keep transport within the geographical research agenda, despite their extensive reliance on statistical diagrams and models and their impoverished analysis of society (Lamego, 2010). Finally, the third explanation concerns the incorporation of methods and methodologies from other sciences into Geography, which has consequently reduced interest in theoretical analysis grounded in geographical space. This tendency has diminished the standing of these thematic studies within the discipline (Silveira, 2011b).

Despite the decline in studies of circulation and the pressing issues arising during this period of the globalization of capital, the field of the Geography of Circulation, Transport, and Logistics encompasses a broad range of issues that require further research. Silveira's (2011b) important contributions showed that one possible reason for the devaluation of this field lies in the excessive and uncritical adoption of analytical scales, methodologies, and theoretical conceptions imported from other sciences. This is particularly true of "more technical, uncritical fields oriented toward highly technicized forms of planning", which disregard "a geographical analysis of transport grounded in a critical and spatial conception and oriented toward regional and national economic development" (Silveira, 2011b, p. 37, our translation).

Regarding transport studies, Mamigonian (2017, p. 17, our translation) observed that "over recent decades, they have practically disappeared from Brazilian geographical research, despite continuing to interest economists and engineers. It is essential to revisit this geographical subject". Concerning the trajectory of this topic within the discipline, Ferreira (2006, p. 2, our translation) noted that the "question of transport, once one of the pillars of geographical science in previous decades, is now little explored", warning that it may have "become overly theoretical, entering the realm of metaphysics, while such

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subjects may be too grounded in reality for geographers' tastes".

The decline in geographical studies of circulation and transport between the 1980s and the 2000s did not result from a loss of relevance of the phenomenon itself, but rather from what we identify as a dual rejection. On the one hand, critical geographers rejected neopositivist formalism and its association with technocratic planning, particularly as observed in Brazil during the Military Dictatorship (1964–1985). On the other hand, interest in more empirical subjects declined in favor of greater attention to theoretical renewal, which achieved certain advances of political significance. In addition to this dual movement, transformations in the world economy and the discourse of globalization contributed to a diminished emphasis on economic planning, which was undermined in Brazil by the country's adoption of neoliberalism and implementation of the measures associated with the Washington Consensus.

The renewed scientific output observed from the 2010s onward did not represent a return to studies conducted under neopositivism. Rather, it involved a shift toward more sophisticated epistemological foundations, sometimes grounded in historical and dialectical materialism as both a worldview and a method. The operational dimensions of transport were redefined through the comprehensive categories of the circuit of capital, considering Political Economy, incorporating the category of social formation into the analysis of concrete reality. It is worth emphasizing that new studies were published amid a recovery in Brazilian economic growth, supported by public and private investment after 2003. During this period, transport infrastructure gained prominence, despite the uneven and inconsistent nature of investment (Silveira, 2022; Gomes; Cruz, 2026).

Returning to the critical transition, M. Santos's theoretical framework became central to the discipline's methodological foundations and its engagement with Marxism. It encompasses dialectical pairs such as fluidity and viscosity, fixed elements and flows, opaque and luminous spaces, verticalities and horizontalities, spatial circuits of production and circles of cooperation, upper and lower circuits of the urban economy, and regions of concentration and rarefaction, among others. These concepts elucidate circulation as an inherently geographical phenomenon: the role of infrastructure in the spatial organization of underdeveloped countries; the relationships among urban, road, railway, and other networks; the state and monopolies; geographical networks at different scales; fixed elements and flows; and the dialectics of norms within territory. As a synthesis, the technical-scientific-informational milieu characterizes the organization of world space as a tendency or possibility, whose flows are filtered through socio-spatial formations. Santos's works A natureza do espaço and O Brasil contain chapters devoted to the "Geography of Networks" and the "Geography of Movement". The latter includes thematic contributions on Brazil's territorial movement systems and its road engineering system (Contel, 2001; Xavier, 2001).

A form of overcoming quantification through the philosophical principle of Aufhebung – overcoming through both negation and preservation – began with Corrêa (1997). Revisiting the concept of spatial interaction, proposed decades earlier by Ullman (1980), Corrêa pointed toward a critical understanding of the cycle of capital reproduction and its inherent territorial dimension. An advance in transport studies came from the articulation of spatial interactions with historical and dialectical materialism developed by Silveira and Cocco (2011) and Cocco (2017). Rather than abandoning the concept, these authors superseded its initial conception, which had been developed under neopositivism. Spatial interactions thus assumed a fundamental position in the relationship among the categories of structure, process, function, and form (Santos, 2013). They represent the contradictory encounter between different material formations and encompass the means of movement that constitute the production process and its spheres.

The critical transition did not occur with the same intensity or to the same extent across national geographical traditions. Nevertheless, critical advances in transport studies took place in different contexts, retaining some aspects of the Euclidean conception of geographical space while incorporating social themes and structural issues, including the state, norms, corporations, and public and private investment. Issues such as mobility and accessibility at urban and regional scales, particularly considering energy-related concerns and new technical paradigms, have become prominent in thematic research. Examples include the classic Ciudad y transporte, by Miralles-Guasch (2002), as well as Geografía de los Transportes, by Pons and Reynés (2004), and Transport Geographies, by Knowles, Shaw, and Docherty (2008). Urban mobility has assumed a central role, with studies examining

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transport as a service, the need to improve accessibility, and the expansion of more comprehensive transport options across a range of settings, from low-density regions to metropolitan areas.

The recent work by Libourel, Schorung, and Zembri (2022) presents a review of transport and Geography, covering a range of topics and constituting an important reference. The continuity of French research on the subject, decade after decade, is particularly noteworthy. The book presents several case studies, including transport dynamics in the United States, the Mediterranean logistics corridor, the ports of Shanghai and Rotterdam, and Latin American public transport, with Curitiba (Brazil) and Bogotá (Colombia) as case studies, among others. From an epistemological standpoint, the work addresses inequality and aligns more closely with French spatial analysis and institutional Political Economy, focusing on network analysis and the political regulation of flows.

Pons (2023) provides a synthesis of what she calls the "Geography of Transport and Mobilities" during the first decades of the twenty-first century. The author identifies an epistemological shift away from an emphasis on infrastructure toward cultural studies, including the relationship between mobility and the human body, as well as what she calls virtual mobility. Two points deserve particular attention. The first concerns the role of new technologies in circulation and the complex production chains associated with intermediation. The second, which accelerated the first, relates to the COVID-19 pandemic and the paradox of "hypermobility", which had to be sharply curtailed between 2020 and 2022.

Another example is the updated edition of The Geography of Transport Systems, by Rodrigue (2024). Canada has a research tradition, or "school", devoted to this subject, with varied contributions from geographers such as Jean-Paul Rodrigue, Claude Comtois, and Brian Slack. Like the French current, this work distances itself from Marxist critique. However, rather than focusing on territorial planning and state action, it emphasizes the optimization of economic flows, offering extensive analyses of containerization, ports, and international trade.

An important point is that, unlike the theoretical propositions of the early quantitative studies, the renewed and more critical approaches – which vary according to their methods – do not restrict transport systems and networks to the status of a mere variable or an instrument for understanding the spatial organization of the urban network. Rather than treating them as externalities in relation to geographical space, these approaches regard economic activity itself, together with its organizational and political structure, as an object of analysis. The act of transporting is understood as an action that produces and reproduces the historical determinations of territory. It must therefore be understood as something that goes beyond a simple, formalist, and neutral indicator of spatial interactions. Instead, it provides a foundation for socio-economic development and territorial integration; in other words, it synthesizes the conditions of the capitalist mode of production and its movement of reproduction. This approach also incorporates concerns with norms and the intangible dimensions of geographical forms, as conceived in relation to normative and institutional arrangements. It represents an advance over quantitative approaches because it seeks to elucidate the historical dynamics of the broader phenomenon of circulation.

Whereas studies conducted between the 1950s and the 1980s proposed using regular road passenger transport flows to analyze urban networks and their centralities, the situation today is different, particularly because of the broader diffusion of paved roads, access to credit and consumption, the expansion of private means of transport, and the relative loss of centrality of public transport in everyday travel. Nevertheless, the declining relevance of regular bus services does not mean that their role has become merely ancillary. Rather, their organization and provision have become incompatible with the needs of recent urban and regional contexts. This highlights the need to move beyond the more static and descriptive perspective inherited from positivism, which privileges forms at the expense of formation.

AN OVERVIEW OF RECENT STUDIES IN BRAZILIAN GEOGRAPHY

Over recent decades, the subject has featured in studies focused on infrastructure at the regional level, the urban scale and the urbanization process, analyses of urban networks and medium-sized and

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small cities, and, more recently, research on urban and regional mobility and accessibility, as well as e-commerce and on-demand transport platforms. In seeking to establish the state of the art, we selected primarily those studies that are theoretically, conceptually, and methodologically aligned with the intersection of Geography, History, and Political Economy, grounded in analyses whose objects fall within one or more dimensions of circulation, transport, or logistics.

Despite the decline in studies of circulation and transport observed during the 1990s, Brazilian Geography has seen important contributions in recent years. The macroeconomic context and the transformations occurring in Brazil since 2003, together with the resumption of public and private investment, may have helped stimulate this research. In the absence of the earlier regional studies, IBGE published Ligações rodoviárias e hidroviárias (IBGE, 2016). Much of this research has been conducted by research groups, laboratories, and academic programs at the Federal Universities of Santa Catarina, Amazonas, Uberlândia, Goiás, Rio de Janeiro, and Latin American Integration; at the University of São Paulo and the University of Campinas; and at the State Universities of Goiás and Mato Grosso do Sul. Other established centers include São Paulo State University in Rio Claro and the Federal University of Bahia. At these latter two institutions, professors Enéas Rente Ferreira, Juergen Langenbuch, and Sylvio Bandeira de Mello e Silva contributed to the production of geographical studies on the subject. Undergraduate curricula tend to incorporate circulation and transport into Economic Geography, sometimes alongside Geography of Trade and Services and, occasionally, Transportation Geography. At the postgraduate level, course titles vary considerably, including specialized subjects devoted to territory, circulation, infrastructure, and economic development.

Contributions take a variety of forms, including doctoral theses, master's dissertations, monographs, edited volumes, and journal articles. Without examining each work in depth, we can identify several reference publications on circulation, transport, and logistics in Geography. A substantial gap separates Moacir Silva's pioneering work (1949) from more recent publications focused on national, regional, or local studies of transport, mobility, flows, fixed elements, and related topics. At the academic level – that is, excluding the broader studies published by IBGE – gaps in the literature have been gradually filled during the first decades of the twenty-first century.

Silveira et al. (2009), for example, addressed national and regional issues concerning Brazilian territory in connection with studies of circulation. Silveira's important subsequent work (2011a) examined theories and analytical approaches to circulation and established dialogue with foreign scholars and researchers from other disciplines. Druciaki, Ferreira, and Oliveira (2011) examined transport at regional and urban scales. The edited volumes by Silveira (2014; 2016) and Silveira and Felipe Junior (2019) presented case studies of São Paulo and Santa Catarina states, as well as analyses at the national scale. Arroyo and Cruz's book (2015) explored the subject across different analytical frameworks and scales, emphasizing the contradictory dynamics of circulation in the age of globalization. The volume edited by Sposito (2015) presented studies of São Paulo state addressing spatial interactions, road concessions, air transport, and productive restructuring and its repercussions for transport. The recent collection edited by Silva, Zioni, and Ulian (2022), in turn, brings together analyses of inequalities in mobility and accessibility at the urban and regional scales.

Considering these works according to their thematic focus, we can begin with rail freight and passenger transport. Several broad studies examine the sector's evolution in Brazil and its crisis over recent decades, as well as its relationship with road-based transport, railway concessions, the state's role in planning, and the transport equipment industry (Silveira, 2003). Railway concessions and their recent developments have also been examined in studies that include comparisons with other national contexts (Fici, 2017; Julio, 2018). Commodity transport is another research concern, given the central role of freight railways, despite the limited diversity of productive sectors served (Pereira; Santos Neto; Ferreira, 2026). Surface and underground rail passenger transport has also been examined through urban and regional analyses, particularly in the context of São Paulo state (Luz, 2010; Guimarães, 2025).

Road passenger transport at regional and interregional scales has been examined from the perspective of territorial integration (Lemos, 2021; Oliveira Neto, 2024; Santos, 2024). Other studies focus on urban networks, levels of urban centrality, and intermunicipal passenger transport (Ferreira, 2006; Souza Filho, 2006; Nishimori, 2011; Batista, 2021). Chartered transport at regional and metropolitan scales is also addressed in recent research (Giberti, 2012). Other contributions examine the urban, regional, and metropolitan dynamics of public bus passenger transport and its contradictions

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(Ulian, 2008; Druciaki, 2014; Cocco, 2017; Siqueira, 2018; Pereira, 2018; Dias, 2019; Santos, 2022). The role of the state, institutional action, and regulatory issues also feature in studies at the intersection of objects and actions, or territory and norms (Almeida, 2006; Silva, 2017; Dias, 2019). Within road transport, freight transport has been examined in studies focusing on the importance of road-based transport for the integration of the national market. This process, initiated in the 1930s and accelerated after the 1950s, helped forge national integration while also generating weaknesses that remain to be overcome (Huertas, 2018; Silva Junior, 2004).

Studies of air transport have examined the organization of passenger flights, the expansion of airport terminals, and the structure of the capital groups that control the sector (Pereira, 2014; Teixeira, 2018; Rodrigues, 2024). The role of regional air transport in national integration has also been addressed, with the sector characterized as falling short of existing needs (Santos Junior, 2024). Research has examined airport concessions and recent developments such as "aeroshoppings", as well as their relationship with policies in other national contexts. Another area of research concerns air freight, which is strategically important for a country of continental dimensions such as Brazil (Quintilhano, 2019).

Studies of waterway transport, particularly passenger and freight flows in riverine settings (Nogueira, 1994; Santos, 2012), are concentrated mainly in the Amazon region because of its territorial configuration. Waterway transport that combines passengers and freight is fundamental in states such as Amazonas, Pará, and Amapá, where journeys over long distances can last more than a day. At this "last mile" of transport, in localities far from major centers, locally adapted strategies associated with the lower circuit of the economy become necessary. We should also highlight studies of coastal shipping and maritime transport more generally, particularly in relation to international trade (Neu, 2009; Felipe Junior, 2012; Fonseca, 2012; Monié, 2015; 2019; Mamigonian, 2017; Machado, 2020; Pereira, 2020; Felipe Junior; Silveira, 2022). Brazil's size and its Atlantic coastline have inspired studies of the formation and development of port complexes, as well as the country's "amphibious" character and the wealth associated with inland navigation. These studies emphasize the sector's macroeconomic importance and the implications of institutional innovations for port modernization and increased installed capacity in the context of globalization, a process that has accelerated since the 1990s.

Among integrative studies linking different transport modes, scales, and activities associated with circulation, transport, and logistics, recent research can be divided into three groups. The first includes contributions adopting the perspective of spatial circuits of production, corporate circulation, and mobility (Silva Junior, 2009; Castillo; Frederico, 2010; Castillo, 2017), as well as an analysis of the concept of a circulation corridor (Bartholomeu, 2021). The second group focuses on circulation and logistics nodes and the operations of specialized agents. It encompasses the Brazilian Post and Telegraph Company (Empresa Brasileira de Correios e Telégrafos – ECT) and its strategic role (Venceslau, 2021); the expansion of logistics service providers (Trevisan, 2007, 2012; Cruz, 2021); the topology of multimodal platforms (Braga, 2013); and storage systems and agricultural frontiers (Frederico, 2008). The third group comprises studies of the modernization of technical networks in regional and national contexts. These include research on the dynamics of mineral extraction flows and international trade (Lamoso, 2001; Pereira, 2015; Castro, 2021); the guidelines of the National Logistics and Transport Plan (Plano Nacional de Logística e Transportes) (Arantes, 2012); the regulatory impact of road concessions (Oliveira, 2016); South American integration policies (Souza, 2019); and the development of technical networks at the state level (Castilho, 2014; Osorio, 2019). Other studies examine commodity circulation and international trade (Arroyo, 2018), as well as national-scale analyses of the structural corridors underpinning Brazil's territorial integration (Oliveira Neto, 2020; 2025).

Several frequently used concepts and theoretical frameworks deserve attention. These include the concept of the geographical network, based primarily on contributions by M. Santos, R. L. Corrêa, and L. C. Dias. Territory has also been examined through the critical renewal of Geography and the contributions of C. Raffestin, R. Haesbaert, and M. Santos, including the notion of the "return of territory". Other theoretical foundations have also been incorporated, such as D. Harvey and N. Smith on uneven development; M. Castells on networks; J. Schumpeter on innovation; N. Rosenberg on technological progress; J. M. Keynes on the state's role in investment; and M. Porter on competitiveness, among others.

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Also in 2026, it is worth noting that the volume edited by Silveira (2011a), entitled Circulação, transportes e logística: diferentes perspectivas, marks fifteen years since its publication. This major undertaking sought to revive and expand contributions to the field, introduce new theoretical perspectives, and bring together, in a single volume and for the first time in Brazil, contributions from scholars in other disciplines. The book organized its contributions into three thematic strands. The first examined theoretical and conceptual developments, from classical authors to contemporary perspectives. The second analyzed Brazilian reality through the impact of globalization and modernization on road, railway, air, and maritime infrastructure at national, regional, and local scales. Finally, the book deepened the debate from a regional perspective, examining public policies, development corridors, concessions, and the specific characteristics of mobility and transport modes – including river, rail, and air transport – in regions such as the Amazon, the Center-West, and São Paulo state. Similar efforts have been undertaken in other national contexts, and the author continued this line of work in subsequent years, including studies of São Paulo and Santa Catarina.

Given the abundance of studies and thematic and empirical approaches produced in Brazil, several research priorities have become increasingly urgent in the current conjuncture. The main thematic areas can be summarized as follows:

1) Agribusiness, export corridors, and the need for modal diversity across different regions and urban contexts. Brazil lacks investment in road transport infrastructure, including the duplication of major highways, while also requiring diversification of its transport networks, particularly through the construction and expansion of a railway network that remains severely limited. This is evident in the country's South region, where concessions granted in the 1990s did not lead to improvements or an expansion in the share of the urban network served by railways. In fact, dozens of sections and branch lines were eliminated over subsequent decades. In the Center-West and North regions, meanwhile, the capacity to facilitate flows remains limited, even where commercial relations driven by external demand for agricultural commodities require greater fluidity. Investment in major infrastructure entails the creation of new fixed capital, with powerful multiplier effects both upstream and downstream of transport activity itself.

2) Public transport, collective means of consumption, and their relationship with national economic development and potential reindustrialization. In connection with the preceding point, expanding public transport networks requires in-depth analyses, whether through case studies or comprehensive approaches, of road transport, railway operations, regional aviation, and the consolidation of waterborne transport, including lake, maritime, and inland waterway transport. This is a sector in crisis, lacking investment in social infrastructure of the kind classified as public utility services by Rangel (2012), Bielschowsky (2013), and Brandão (2017), among others. Brazil has a complex industrial base and expanding productive capacity while incorporating new technological paradigms represents a fundamental challenge for economic sovereignty and for meeting the social needs of Brazilian cities. Medium- and high-capacity regional trains, metros, electric buses, express corridors, navigation terminals, regional domestic flights, and similar systems constitute relevant research topics that should be linked to concrete demands.

3) Digital platforms providing on-demand transport services for passengers and freight, using collective or individual means of transport. A recent contribution to this debate is the volume edited by Tozi (2023), which examines the impact of technology corporations entering peripheral countries and competing with existing public services. This development intensifies existing contradictions. In urban settings where transport services are often inadequate, a wide range of issues merits analysis: the expansion of platforms; the emergence of local and regional equivalents; and the ways in which the state has sought to regulate their operations, among others. The subject encompasses on-demand urban transport, freight delivery, and the recruitment of road transport drivers, among other activities. The arrival of foreign corporations, such as the German company FlixBus, has led to the transfer of business strategies across national borders and pressure to deregulate normative arrangements, as observed in bus passenger transport (Oliveira Neto; Santos, 2021; Lemos, 2025).

4) E-commerce, mass consumption, and the implications for logistics services, alongside the urgent need for territorial planning that critically examines public and private investment and infrastructure concessions. E-commerce has grown substantially in recent years, changing consumption patterns and the ways in which society accesses durable and nondurable goods. Despite its apparent

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intangibility, synchronized geographical networks are activated with every click and purchase, reinforcing hierarchical relationships within the urban network. This is particularly evident in the unequal provision of infrastructure across the country, including duplicated highways, logistics storage facilities, and airport cargo terminals (Huertas, 2018; Quintilhano, 2019; Cruz, 2021).

These last two thematic areas also prompt us to consider recent methodological procedures. Fieldwork is fundamental and constitutes the starting point for preparing any study, since familiarity with the reality under investigation is necessary for empirical engagement and for avoiding reflections detached from the territory. Fieldwork can be complemented by interviews and data, including dialogues with the social actors who contribute to production. Moreover, the ease with which large datasets can now be handled – a defining feature of our time and of the big data paradigm – provides new sources for analysis. In thematic studies, reports can be supplemented with databases updated more frequently than was possible ten or fifteen years ago. Open data represents a fertile field for Brazilian research, alongside institutional innovations that have made data provision an obligation of the state.

CONCLUSION

There is a broad horizon of possible studies and research within the field that may be called the Geography of Circulation, Transport, and Logistics. This encompasses circulation in the Marxist sense; transport as the act or process of moving, considering both mobile and immobile objects; and logistics in relation to storage, the supply of goods and inputs, and the competitive strategies of production chains, among other aspects. These dimensions have a clear spatial character because, despite the existence of a "digital world", it can only be realized through the tangible operation of an intricate network of complex, synchronously interconnected systems. This becomes even more evident when we consider the circuit of capital and the attempt to bring its turnover time close to zero, making enhanced fluidity a central driving force.

Despite advances and setbacks, qualitative leaps, and theoretical challenges, geographical studies of this subject have developed along a rich trajectory. Depending on the national context and scale under consideration, researchers have produced broader studies focused on specific transport modes, including rail freight and passenger transport, regular bus services, commercial air passenger transport, port facilities and their interactions with hinterlands and international trade, and urban public transport, among others.

In Brazil, a variety of studies were produced, particularly between the 1960s and the 1980s, followed by a decline during the 1990s and 2000s and a revival, especially in the 2010s. During this first quarter of the twenty-first century, new debates have become necessary in these thematic fields considering the challenges posed by urbanization and prevailing macroeconomic conditions. Critical approaches to this research can, for example, foster debate on the resumption of a national development project oriented toward industrialization. They can also contribute to public debate aimed at mitigating deficiencies in mass transport systems in metropolitan areas and regional capitals. Furthermore, they can help alleviate the spatial injustices characterizing peripheral and segregated areas or improve the integration of places located in agricultural production zones.

In pursuit of our objective, we examined how this subject was approached as one of the topics within the "General Geography" of the classical authors and as an element addressed in regional monographs. Drawing on rich empirical evidence, the authors and works regarded as "foundational" established approaches that informed subsequent research and remain present today, including attention to circulation networks, their relationship with the regional scale, and the technical dimension.

We can argue that the "quantitative revolution" brought about an involutionary form of overcoming the classical tradition, involving the abandonment of part of the descriptive empirical investigation of the geographical environment. Nevertheless, attention to transport networks and the adoption of new methodological procedures contributed to a quantitative expansion of research, including graphical modeling of public transport, freight movements, input-output studies, and isochrone analyses.

The transition toward a more critical geographical science, grounded primarily in Marxism, renewed interest in structures as expressed through social formation, in time as an important factor in

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both persistence and transformation, and in form-function relationships as expressions of contradictions that either constrain or facilitate territorial integration. The incorporation of the critique of Political Economy, which made it possible to understand the circuit of capital, also enriched these studies, including the research conducted in Brazil examined here.

To conclude, geographical science must be oriented toward national development while recognizing the contradictions inherent in Brazilian capitalism and acknowledging the need to increase the stock of socially relevant social fixed capital throughout the national territory. The relationship between industry and transport systems is a central point of convergence in this field – or, more precisely, in any analysis concerned with resuming the country's economic growth. It is therefore necessary to examine the challenges and possibilities of circulation, transport, and logistics through theoretical and practical approaches informed by historical and dialectical materialism, thereby making the Brazilian socio-spatial formation and its regional particularities intelligible.

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DATA AVAILABILITY

Not applicable.

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Lemos, J.H.Z. - The author contributed to the elaboration, realization and manipulation of the data and writing

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The authors declare that there is no conflict of interest.

Research Data Availability

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Use of AI

No Artificial Intelligence tools were used.

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