Medical diagnosis and corporate use of Brazilian territory: an analysis of the spatial productive circuit of diagnostic reagents[1]

Diagnóstico médico e uso corporativo do território brasileiro: uma análise do circuito espacial produtivo dos reagentes para diagnóstico

Ricardo Mendes Antas Jr.
Universidade de São Paulo. Faculdade de Filosofia, Letras e Ciências Humanas. Departamento de Geografia. São Paulo, SP, Brasil.
E-mail: ricardomendes@usp.br

Rafael da Silva Almeida
Universidade de São Paulo. Faculdade de Filosofia, Letras e Ciências Humanas. Departamento de Geografia. São Paulo, SP, Brasil.
E-mail: rafael.silva.almeida@terra.com.br

Abstract

The formation of what Milton Santos called the technical-scientific and informational milieu is marked by the profound interaction between science and technique, both under shelter of the market. In this milieu, we see new technical objects arising, whose content is given by science. When dealing specifically with medicine, this trait is still more remarkable, which is evident, for instance, when we analyze technical diagnosis systems in the current period, for they come to configure specialized economic segments with high added value production. In this article, we discuss how a significant set of companies focused on diagnosis concurs to a new type of urbanization in Brazilian territory, considering the Health Economy and the health-industry complex. Marked by the corporate use of territory, this urbanization is shaped by the establishment of spatial productive circuits and their respective circles of space cooperation, and one of its main characteristics has been the concentration and centralization of capital.

Keywords: Spatial Productive Circuit; Circles of Space Cooperation; Corporate Use of Territory; Human Geography; Geographic Space.

Correspondence
Departamento de Geografia
Avenida Prof. Lineu Prestes, 338, Cidade Universitária.
São Paulo, SP, Brazil. Caixa Postal:72042. CEP 05508-080.

1 This article was the result of research supported by the Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP, process 2010/18.750-8.

DOI 10.1590/S0104-12902015000200022

Resumo

A formação daquilo que o geógrafo Milton Santos denominou meio técnico-científico-informacional é marcada pela profunda interação entre ciência e técnica, ambas sob a égide do mercado. Nesse meio, vemos surgirem novos objetos técnicos, cujo conteúdo é dado pela ciência. Quando tratamos especificamente da medicina, essa característica é ainda mais marcante, o que fica manifesto, por exemplo, quando analisamos os atuais sistemas técnicos de diagnóstico, que acabam configurando segmentos econômicos especializados com produção de alto valor agregado. Neste artigo, buscou-se tratar da economia da saúde e do complexo industrial que a envolve discutindo como um conjunto significativo de empresas voltadas ao diagnóstico concorre para um novo tipo de urbanização no território brasileiro. Marcada pelo uso corporativo do território, essa urbanização se conforma pelo estabelecimento de circuitos espaciais produtivos, dos quais focaremos aqui os da saúde e seus respectivos círculos de cooperação no espaço. Veremos, então, que entre suas principais características estão a concentração e a centralização do capital.

Palavras-chave: Circuito Espacial Produtivo; Círculos de Cooperação no Espaço; Uso Corporativo do Território; Geografia Humana; Espaço Geográfico.

Introduction

One of the most characteristic aspects of medicine nowadays is the exceptional specialized technological inventions and innovations combatting a variety of diseases and the way they have been rapidly, if not immediately, incorporated into medical practice. In this process the relationship between the actual productive structure and the health care system is clear, the latter frequently based on *curative medicine*, which has dictated the parameters for defining *illness* and *cure* and, therefore, for treating diseases. Thus, this medicine, largely constituted of surgical interventions and making diagnoses about bodies, participates in structuring industrial complexes aimed at researching and producing medical supplies as well as a wide range of health care in Brazilian territories (Almeida; Antas Jr., 2011; Antas Jr., 2014).

Such industrial complexes, specializing in providing a wide range of products, were first formed in the United States and in Europe – particularly in France, the UK and Germany – and are characterized as productive regional circuits, driven by the chemical and electronics industries (Perroux, 1975). With the establishment of what Santos (2008) called the *technical-scientific-and informational milieu*, the material base of the globalization process, and shaping the *technical-scientific-informational period* (Santos, 2008), we see such complexes, dedicated to encouraging medicine with a strongly technological component, going from regional dynamics to a global integration. This cooperation extends between industry and other productive forms, including different countries in one single technological system and is what we have called here *spatial productive circuits*, as proposed by Santos (1986, 1988).

Health oriented industrial complexes have existed in Brazil since the 1980s (Cordeiro, 1980), but it is from the 2000s onwards that we can point out their integration with those of other countries, forming productive spatial circuits in health. The year 2008 was a milestone in this process, being when the Brazilian State created the Executive Group of Industrial Health Complexes - *Grupo Executivo do Complexo Industrial da Saúde* (GECIS), inaugurating a series of incentives to strengthen the health oriented productive base, such as credit lines with

the National Bank for Economic and Social Development - *Banco Nacional de Desenvolvimento Econômico e Social* (BNDES), integrating the Ministries of Health, of Development, Industry and Foreign Trade and of Science Technology and Innovation, as well as creating laws to specifically encourage activities in the sector.

It is worth noting, therefore, the central role played by the Secretariat of Science, Technology and Strategic Supplies - *Secretaria de Ciência, Tecnologia e Insumos Estratégicos* (SCTIE) in implementing lines of investment for innovation, encouraging business in the sector to be created or to expand. Also noteworthy are the actions of the Department of Science and Technology - *Departamento de Ciência e Tecnologia* (DECIT) in developing health technologies, establishing cooperative links between the different productive agents.

The role of this Secretariat, then, was to direct a "national system of health innovations", the importance of which has already been indicated in Gadelha, Quental and Fialho (2003), consolidating a health oriented industrial complex in Brazil. It coordinated the innovation processes, integrating agents from industrial production, from high complexity services and from scientific production. Homma et al. (2011) highlight this strategic role when dealing with vaccines and immune-biological products, and this can be extended to producing diagnostic reagents (Gadelha; Quental; Fialho, 2003). Another example of the coordinating role played by the SCTIE is in the creation of the National Agenda of Health Research Priorities - *Agenda Nacional de Prioridades de Pesquisa em Saúde* (ANPPS), guiding the research topics and lines necessary for the different stages of which the industrial health complex is constituted.

The set of actions encouraging all types of production, as cited above, are denominated *circles of space cooperation* by Santos (1986), a concept that is inseparable from that of the *spatial productive circuits.* It was in fact through the expansion and institutionalization of circles of space cooperation (which may come from the State, but also from the market and/or organized society) that the *regional circuits* became *spatial circuits* in the different sectors of the capitalist economy.

It is important to note, however, that the network of health care services and the industrial complex have only expanded and concentrated themselves in the most dynamic parts of Brazil, mainly in the São Paulo metropolitan area, the command center of "socio-spatial formation" (Santos, 1977; Santos; Silveira, 2010). The spatial concentration of health care services and of the industrial complex, as well as the centralization of capital currently established by some companies in the sector, is configuring a new urbanization process, marked by *corporate use of territory*, in which "each company uses the territory according to their own ends, and exclusively according to these ends" (Santos, 2009b, p. 85), seeking specific points or areas with a dense technical base to encourage the production, circulation and consumption of their products.

In the specific case of industries producing diagnostic reagents and of laboratories, consumers of these reagents, we can see the establishment of logics specific to the sector and, conforming with the current dynamic of the capitalist system, functionalized by planet-wide flows and eager for ever greater accumulation. Meeting these demands for production, spatial productive circuits and their respective circles of space cooperation are established, consolidating new health oriented productive dynamics essential to contemporary technical-scientific development.

The state and city of São Paulo has been the privileged locus of action for these businesses, we therefore focus the spatial dynamics configured by this new use of territory here, calling attention to the process of spatial concentration and centralization of capital engendered by certain companies in the spatial productive circuit for diagnostic reagents. We seek, then, to consider the network of tangible and intangible flows of the companies in this circuit, highlighting laboratorial analysis services in the health care sector.

Diagnosis in the technical-scientific-informational period

The triage of diagnosis has changed radically since August Von Wasserman invented blood testing in 1906. So-called modern medicine has in fact long

been making use of scientific-technical development and this becomes still more evident when talking of diagnosis based on laboratory tests. The preference for using technology in curative processes is due, among other factors, to modern society becoming increasingly convinced, at least since the early 20th century, by the scientific community, including grand public presentations on scientific discoveries (Latour, 2000), that knowledge developed in the laboratory is capable of curing all ills, so that such knowledge has been affirmed and legitimized by society as a collective (Stengers, 2006, p. 140). This process occurred in such a way that it those doctors who values modern means of diagnosis in the early 20th century achieved not only good fees and technical-scientific knowledge regarding the patient's state, but also a good reputation and professional respect among their peers (and patients) (Porter, 2004, p. 59-60). Thus, non-humans, as well as humans, came to be mobilized in order to confirm clinical diagnoses (Latour, 2000, p. 28-30).

The turn of the 20th century was an important milestone for the development of diagnostic imaging and diagnostic reagents.[2] There was a proliferation of countless technologies, ranging from simple blood testing, in the early days of that process, through to magnetic resonance imaging a few decades later. These technologies not only enabled diagnostic triage to be improved, but also conferred significant legitimacy on the doctors' clinical diagnoses. According to Lilia Blima Schraiber, the diffusion of services and greater use of medicine "would change the conception of medicine itself, redefining it based on specialties which, in turn, would reflect the structural tendency towards technical division of labor" (Schraiber, 2008, p. 66).

Technical-scientific developments and the formation of the diagnostic reagents industry began in earnest with the Second World War and reflected the first concerns about viral infections, motivated by incidents of hepatitis transmission through blood transfusions, although more exact studies on transfusion risks only appeared in the 1970s (Busch, 2006, p. 1624). And it was at the end of this decade, with the establishment of the technical-scientific and informational milieu, that technical affirmation became a central element of medical practice

> [The] technical-scientific and informational milieu is the geographical space from the current period, in which technical objects are elaborated based on scientific commandments and serve as an informational technique from which they obtain a high coefficient of intentionality and with which they serve the various modalities and stages of production (Santos, 2009c, p. 187).

In such medicine, anchored in technological innovation, elements belonging to modern science can be observed. According to Latour (2000), science as we know it today would be settled in the antagonistic divide between nature and society and, thus, the world could only be understood through objects (nature pole) or though subjects (society and culture pole). This separation into two ontological zones would be broken down by the increasing emergence of objects that are not entirely of the subject nor of the object domain. They would be hybrids, inseparable mixtures of nature and culture (Latour, 2000).

With the advent of *globalization*,[3] a process of multiplication of hybrids became evident in medicine, especially in clinical diagnosis, due to the ontological separation between subject and object. Le Breton (2011, p. 294) states that, in search of objectifying medical knowledge, Western medicine has, throughout history established "an absolute separation between the subject and the object of its knowledge, separating the sick person and their disease in order to establish the latter as knowledge".

Corporative medicine induces technological innovation, pursued by the productive sectors, operating as the basis in this separation between the sick individual and the disease, or between subject and object. If this mechanism is promising for medical companies, the same cannot be said for professionals, and much less so for public health, the crisis

2 The brazilian market refers to "reagents for in vitro diagnosis" or "diagnostic kit" but the National Agency for Sanitary Vigilance - *Agência Nacional de Vigilância Sanitária* (ANVISA) gives as correct the expression "products for in vitro diagnosis", which includes reagents and kits (Brazil, 2006). Here, we say only "diagnostic reagents."

of which has been going on for some time, as "the greater scientific knowledge and power, the greater the capacity to make diagnostic and treatment devices and the more difficult it is to find a good doctor, or even any doctor" (Jaspers, 1998, p. 42). Hand in hand with the greater development of diagnostic techniques came a simultaneous fall in the "prestige of medical professionals, and the growth of patient complaints about them" (Lopes, 2008, p. 110). Thus, "a devaluing of clinical exams was noticed. On the one hand, less was invested in acquiring the necessary skills, as it was thought that the machines could give the diagnosis" (Lopes, 2008, p. 110). The doctor, in turn, "was content to become a hyper-specialist interpreter of his diagnostic utensils, the doctor moved away from the patient, objectifying the disease more, disconnected himself from the singular adventure and the parameters of the patient" (Le Breton, 2011, p. 341).

This characteristic is now so marked that diagnostic reagents have come to be essential components in evaluating improvements in overall health and "contribute up to 94% of the information in meeting the objectives of clinical records, and more than 70% of medical decision making – from diagnosis to treatment – is based on the results of laboratory trials" (Paiva, 2009, p. 25). The importance of diagnostic reagents in the health care economy is evident in the figures presented by the main chemical and biotechnology industries responsible for producing the wide ranges of reagents currently available in the market; annually, they shift around US$ 28 billion, with an "estimated 5% annual overall growth, varying between 4% and 10% within the segment" (Paiva, 2009, p. 55).

Together with the rationale of modern medicine, these economic factors lead to technologies being increasingly incorporated into medical practice, substituting the "doctor's scientific eye" with "scientific knowledge", leading to greater dependence on instruments and intensifying the use of third party resources and new treatment instruments (Almeida, 2005, p. 552). This process can also be viewed as a change from "liberal medicine" to a "technological medicine" (Schraiber, 2008), characterized above all by the establishment of the "industrial health complex" (Gadelha, 2003).

This industrial complex is responsible for producing medical hospital supplies and significant investment has been made in mechanical diagnosis equipment and biotechnological diagnostic reagents. Industries specializing in this technology become spatial productive circuits through new forms of cooperation. It is, then, the circles of space cooperation which, be expanding the corporations at the same time as they reinforce extended intercompany alliances, that establish new territorial use – corporate use. The diagnostic reagent spatial productive circuit is in competition, along with the others, for this process.

Producing health care supplies in Brazil: from regional productive structures to spatial productive circuits

It is not an easy task to set the historical moment from which we can begin to speak of the industrial health complex in Brazil, as the structure of the different industrial sectors, in the territory, in the current complex did not appear at the same time or with the same technical and organizational capacity. The first which installed themselves here were, without a doubt, the pharmaceutical industries. Gabriel F. Santos (1996, p. 10) points out that the first to invest in the country was Bayer, in 1890, and, up to 1945, in addition to the many small and medium sized companies, 10 more large European and 6 American firms also installed themselves.

3 We use here the definition of globalization based on the mobilized theoretical framework, i.e., "as the supreme stage of internationalization, the amplification into a 'world system' everywhere and of all individuals, albeit to varying degrees [...] we can therefore admit that globalization is a paradigm for understanding the different aspects of contemprary reality" (Santos, 2008, p. 45). Thus, globalization correspond to what Santos calls the *technical-scientific and informational period* and its spatial correlate, the *technical-scientific and informational milieu*, generally demarcated from the 1970s onwards, with the advent of new information and communication technologies and the emergence of *ubiquity* as an exercise of power. For the author, the economic, political and cultural bodies are all inextricable constituents of this process.

Between 1945 and 1975, a lot of new laboratories also came and the 40 largest European and American companies installed in Brazil were multinationals also present in the majority of capitalist countries.

These figures reveal that the importance of the health care industrial apparatus in Brazil since the 1970s, as well as the passage of regional circuits to spatial circuits (Santos, 1988, p. 50) is related to the accelerated integration in the countries to the north that began to coalesce with some strategic areas in southern countries. In this passage, we can see the strengthening (and formation) of not for profit organizations directed at encouraging cooperation between companies connected with health care from the 1960s and 1970s onwards, as is the case of the Brazilian Association of Medical, Dental, Hospital and Laboratory Equipment - *Associação Brasileira da Indústria de Artigos e Equipamentos Médicos, Odontológicos, Hospitalares e de Laboratórios* (ABIMO), founded in 1962, and of the São Paulo State Union for Dental, Medical and Hospital Products and Equipment - *Sindicato da Indústria de Artigos e Equipamentos Odontológicos, Médicos e Hospitalares do Estado de São Paulo* (SINAEMO), in 1971, among other. The foundation of the São Paulo State Union for Pharmaceutical Products - Sindicato da Indústria de Produtos Farmacêuticos no Estado de São Paulo (SINDUSFARMA), in 1933, was prior to that of the Brazilian Pharmaceutical Association - Associação Brasileira do Comércio Farmacêutico (ABCFARMA), in 1959, corroborating the statement that pharmaceutical laboratories were the first and the strongest sector in the industrial health complex. It should be noted that, from the 1960s onwards, these institutions, linked to pharmaceutical laboratories and geared towards the market, began to be the protagonists in the cooperative ties between firms in the territory and the commercial and productive integration with foreign firms, especially American and European firms (Table 1).

Driven by the military industrial complex, the expansion of pharmaceutical laboratories all over the world was what lead Dupuy and Karsenty (1980), in *The pharmaceutical invasion*, and Ivan Illich (1984), in his celebrated *Medical nemesis*, to criticize the accelerated process of medicalizing society and transforming medical practices, growing increasingly close to the market, through the adoption of new and advanced technologies, not always concerned with revolutionary cures, but with economizing the time spent per patient in order to achieve more profitable productivity (Cordeiro, 1980, p. 71).

In Brazil, the research by Hésio Cordeiro on the main relationships between the pharmaceutical industry and the development of medical practice is one of the milestones in analyzing the social consequences of an industrial complex oriented towards producing medical supplies. Thus, although it is preferable to leave human resource training, the links between medical school and the pharmaceutical industry and the relationships with the medical equipment sector to one side" (Cordeiro, 1980, p. 113), the author does not neglect to point out the formation of a *medical-industrial complex*. This complex involves professional training, the industries and provision of medical services, especially the process of producing and consuming medication, medical and dental equipment companies formed since the 1950s and 1960s, as well as those of private medical care and if the bureaucratic and financial sectors. Finally, he points out that at that moment there was a fairly significant set of State companies, especially official laboratories (Santos, 1996), including the Instituto Biomanguinhos (Fiocruz) and the Instituto Butantan. However, most of them were privatized in the 1990s, with the neoliberal policies that particularly favored large transnational laboratories:

> the recent movement of the third technological revolution and of globalization, accompanied, at the level of power relations, by the clear hegemony of the capitalist system in the world and the wave of State reforms, which focused markedly on the health sector, this process became an overwhelming planet-wide movement (Gadelha, 2003, p. 522).

Thus, a set of technical and organizational innovations arrives in Brazil, as in other countries with health oriented industry, pressuring the agents there to reference the logic of obtaining competitiveness and economic efficiency, establishing a new stage in the productive sector, configured by the industrial health complex (Gadelha, 2003), from where, we understand, the productive spatial

Table 1 - The 20 largest American and European pharmaceutical laboratories in Brazil, according to the year founded, until 1975(*)

American firms		European firms	
01. Sidney Ross	1920	01. Bayer	1890
02. Johnson-Johnson	1936	02. Rhodia	1919
03. Abbott	1937	03. Decchar	1922
04. Merch-Sharp-Dohme	1941	04. Nerck	1923
05. Bristol Myers	1943	05. Androwaco	1928
06. Schering	1944	06. Roche	1931
07. Wyeth	1949**	07. Roussei	1936 **
08. Squibb	1953	08, Glaxo	1936
09. Upjohn	1954	09. Ciba	1937
10. Cyanamid (Lederle)	1955	10. Organon	1940
11. Parke-Davis	1955	11. Recordati	1947
12. Sintex	1957	12. Sandoz	1947
13. B. Nerrell	1958**	13. Hoechst	1949
14. Searle	1959	14. De Angeli	1950
15. Ayerst	1960	15. Carla Erba	1950
16. Need-Johnson	1961	16. B. Brown	1954
17. Eli Lilly	1962	17. Berlimed	1954
18. Pfizer	1965	18. Wellcome	1955
19. ICN	1971**	19. Boehringer	1956
20. Smith Eline & French	1973**	20. Byk	1969 *

Source: Associação Brasileira da Indústria Farmacêutica, ABIFARMA, Brazilian Pharmaceutical Industry Directory, Rio de Janeiro, 1975, from FINEP Research, apud "CPI da Indústria Farmacêutica", 1980.
* Date of purchase of local laboratory. Source: Adapted based on Santos (1996, pp. 10 and 11).

circuits have emerged, breaking with the merely regional dynamics that characterized them until that time. This complex, however, is constituted by companies specializing in different supplies for clinics and hospitals, the production of which, being fairly specific, requires applied knowledge, such as research, strictly speaking, requiring the support of public and private institutions in order to establish links with the productive agents.

A flexible logistic enabling the specialized transport of these different supplies is also necessary (Antas Jr., 2011, p. 2). Thus, as this industrial complex is founded on new scientific-technical paradigms and has a strong territorial and informational dynamic, it was only able to be consolidated in the late 1970s. But it was with globalization and conformation of the technical-scientific and informational milieu (Santos, 2008) that a deepening internationalized division of labor was in fact observed. This consolidation of the industrial health complex in the territory "obeys the laws of combined international division of labor and the internal division of labor. This is how to establish a territorial division of labor that is both international and internal to each country" (Santos, 2009b, p. 44).

The place plays a fundamental role in this territorial division of labor, as is installs itself upon old divisions, in a process in which the "historical conditions facilitate the mechanism of capital expansion through the use of forms" (Santos, 2003, p. 188). Places, then, are a condition of, and condition production, and we can further add that such complexes oriented towards "curative medicine" are inductors that urbanize and transform the cities that host them. In this process, the networks become increasingly relevant, as despite being in a particular territory, they connect different economic health agents, often dispersed across various far flung points of the territory, and they also connect the different stages of the productive process. Thus, the health care companies are true "multi-location organizations", with a variety of functionally different, spatially separate units, operating in an integrated manner (Pred, 1979, p. 12). Points of the

territory of high technological and informational density then come to support the networks that transport the utilitarian rules and norms for the companies, irrespective of the places in which they are established, manifesting the networks' capacity to work simultaneously in space and time, instruments of the hegemonic practice in the period.

The spatial productive circuit and the circles of space cooperation of diagnostic reagents

In order to grasp this new articulation between the various agents in the territory, and account for the entire geographic space, Santos (1986) and Santos and Silveira (2010) proposed the concepts of *spatial productive circuits* and *circles of space cooperation*, which can be used to study the companies in the industrial health complex as they reveal the dynamics and links with the economy, politics, the law and culture, are not limited to the relationships between the companies involved in this capitalist cooperation, the privileged focus of analyses based on the concept of the production chain (Castillo; Frederico, 2010), as such complexes are normally analyzed. The idea of the spatial productive circuit:

> Emphasizes the circulation (*circuit*), in the chain of the various stages of production; the condition of space (*spatial*) as an active variable in social reproduction; and the focus centered on the branch, i.e. on the dominant productive activity (*productive*) (Castillo; Frederico, 2010, p. 463, italics as original).

Circles of space cooperation are understood as intangible stages of the production process in which a relationship is established between place and agents, connecting the various, spatially separate, stages of production (Santos, 1988; Silveira, 2010). The flows from the set of companies linked to producing diagnostic reagents go beyond the borders of the region and we therefore treat them as spatial circuits, as they demonstrate a "global circularity" (Moraes, 1989) in which different companies, dispersed among various national locations all over the world exercise significant influence on their shape, which we shall now analyze.

In Figure 1, the circularity of these spatial productive circuits for diagnostic reagents can be seen through the data on importations and exportations, showing that trade is not limited to a merely socio-spatial formation but is consolidated by global links selling intermediate (unfinished) products. Another datum to consider when analyzing these maps is the strength of trade between Brazilian territory and the two largest health industry complexes (in the USA and Germany), as well as the inequality between export and import volumes between Brazil and these countries. In 2011, we imported U$ 155 million from the USA and U$ 107 million from Germany, and exported U$ 615 thousand and U$ 14 thousand, respectively:

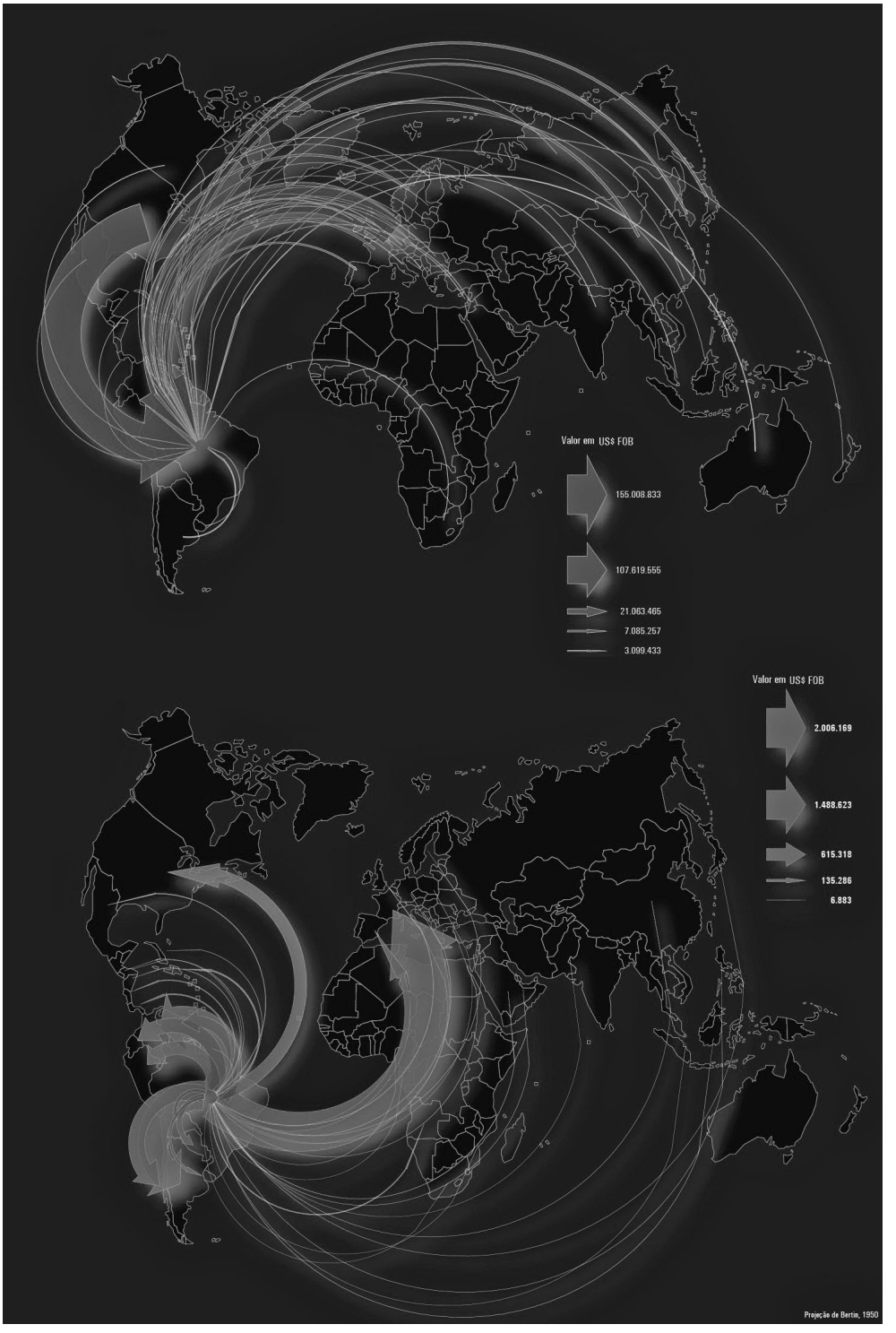
> it is an extremely unequal trade and a territorial division between complexes that are more than just consumers. This pattern of trade is also clear in other spatial circuits of Brazil (Antas Jr., 2014, p. 7).

Notwithstanding the concentration of trade between the two aforementioned complexes – an unsurprising characteristic of the inequality between economic agents marking the current stage of the capitalist system–, it is essential that we also take into consideration the large number of countries that trade with the Brazilian industrial health complex, corroborating the existence of a planet-wide spatial productive circuit of diagnostic reagents.

The oligopolistic structure controlling the worldwide diagnostic reagent sector is also relevant, with the three largest companies standing out (Table 2) whose reagent production consists of productive specializations from the large transnational pharmaceutical laboratories. A characteristic of the health spatial productive circuits that stands out is the capacity of different companies to participate in different yet related technical-scientific specializations, a fact that written observation of production chains often fails to take into account, taking an overall look at the company and its production volumes, without taking into account the ramifications such cooperation establishes in the technical-scientific and informational milieu and in its organizational dynamics.

Such specializations in more than one productive

Figure 1 - Import and export of diagnostic reagents in 2011



Source: Sistema de Análise das Informações de Comércio Exterior. ALICE-Web [http://aliceweb.desenvolvimento.gov.br/].
Data organized by: Rafael da Silva Almeida.
Maps produced by: Eduardo Dutenkefler, Nov. 2012. Map created using Cartes & Donnés © Articque.

sector can largely be accredited to the connections between agents, previously separate or in competition with each other, through the circles of space cooperation extending a territorial division of labor on a planetary scale and ensuring supply to vast regions. Once again, such cooperation circles can be seen as intangible essentials in the spatial division of production (Moraes, 1989, p. 11) which link companies, public authorities and not for profit organizations through a plural relationship, establishing partnerships between companies, universities and other research institutions (Antas Jr., 2014, p. 11).

When the scale of analysis moves to concentrate on the region and places in which production plants are effectively installed, we see how the companies and the specialties needed to manufacture the wide range of products of which this sector is made up multiply, revealing both the diversity of cooperation to be established, as this is a branch with a significant set of companies oriented towards specific products to be used by others, before reaching the end user.

Table 3 shows the largest, most important companies in the in vitro diagnosis systems market, as the Administrative Council for Economic Defense - Conselho Administrativo de Defesa Econômica (CADE) denominates them, that is, the hegemonic firms in the spatial circuit (especially Siemens and Roche) who have relationships with the other, more specialized firms, and with suppliers of goods to be used in production, as shown in Table 4. It is important to highlight that a mere 7% of all the diagnostic reagents sold in Brazil are made there (Table 3), and that the reagent market is mainly controlled by companies that import and sell them (Table 4). It is also noteworthy that it is not possible to use

Table 2 - The 5 largest companies in the IVD (in vitro diagnosis) market, worldwide

Company (country of origin)	IVD Sales (US$ millions)	Company total sales (US$ millions)	Company IVD market share (%)
Roche Diagnostics (Swiss-US)	$ 6,300	$ 27,000	23%
Bayer Diagnostics (Germany)	$ 2,500	$ 32,000	8%
Beckman Coulter (US)	$ 6,300	$ 27,000	79%
BioMerieux (France)	$ 1,200	$ 1,200	100%
Diagnostic Products Corp. (US)	$ 399	$ 399	100%

Source: Medical Product Outsourcing, (Jun. 2006). From Saiote (2007).

Table 3 - Structure of the in vitro diagnosis system market in Brazil – 2008

Company	Estimated market share (%)
Siemens	20-30
Abbott	0-10
Roche	10-20
Biomerieux	0-10
Diasorin	0-10
Horiba	0-10
Johnson & Johnson	0-10
Labtest (nacional)	0-10
Others	20-30
Total	100

Source: Brasil, 2010

Table 4 - Structure of the Brazilian market for distributing diagnostic reagents – 2011

Company	Market share (%)
Applied Biosystems	22.1
Invitrogen	14.6
General Eletric Health Care	16
Sigma	14
Prodimol (nacional)	6
Bioeasy (nacional)	3.1
Others	24.2
Total	100

Source: (Brasil, 2011a).

Table 5 - Structure of the in vitro diagnosis system market in Brazil 2008 and 2009

Infectious Immunology segment (Brazil – 2008)	
Company	**Market share (%)**
Abbott (sem o negócio Murex)	30-40
Abbott (Murex)	10-20
Diasorin	10-20
Biomerieux	0-10
Siemens	0-10
REM	0-10
Roche	0-10
Alka	0-10
Johnson & Johnson	0-10
Others	10-20
Total	100

Immunochemical segment (Brazil – 2009)	
Company	**Market share (%)**
Prodimol	0.41
Bioeasy	2.06
Medlab	0.05
Abbott	23.18
Siemens	22.72
Roche	15.87
Others	35.69
Total	**100**

Clinical chemistry segment (Brazil – 2009)	
Company	**Market share (%)**
Prodimol	1.29
Bioeasy	2.27
Medlab	0.13
Roche	23.39
Siemens	17.79
Labinbraz	13.8
Others	41.3
Total	100

Hemostasis segment (Brazil – 2009)	
Company	**Market share (%)**
Prodimol	0.06
Bioeasy	0.1
Medlab	21
Siemens	34.7
Horiba	19.3
Werfen	8.4
Others	16.7
Total	**100**

Molecular biology segment (Brazil – 2009)	
Company	**Market share (%)**
Applied Biosytems	31
Invitrogen	21
General Eletric Health Care	18
Qiagen	10
Prodimol	8,8
Bioeasy	4,8
Others	6,4
Total	100

Source: (Brasil. 2010. 2011a. 2011b).

diagnostic reagents at prices which are competitive on the international market, as in order to import them, special licenses are needed, which are only granted to importers and not to the end user, in this case laboratories, hospitals, outpatient clinics etc. Direct importation only takes place in special cases defined by the importers and are generally cases involving large foundations or private clients with a high volume of consumption.

Just as we can see the strong hold highly specialized logistics companies have on the distribution of production, implementing electronic circulation and stock control systems (Table 4), forming a sector with companies that are at times in competition and at others working together, we can also see how these sectors multiply in producing reagents based on molecular biology, immunochemistry, clinical chemistry, hemostasis, hematology, microbiological testing, genetic and molecular tests and renting medical equipment. Table 5 shows the productive segments associated with different products with the market breakdown, that is, by company for each sector, in which it is noteworthy how many companies – usually transnationals – appear repeatedly, changing their position somewhat, but figuring among the main producers and suppliers in the market. These data were organized by the CADE for the purpose of analyzing the concentration process for Prodimol, the company which acquired Bioeasy and Medlab:

In this market, segmented by different companies, the action of the State can also be seen, forming a strong circle of space cooperation in encouraging innovation, increasing the participation of private companies. One example of this was the creation of a new reagent kit, establishing various links between a company and other agents of the spatial productive circuit. In 2010 Lifemed, a Brazilian company operating in the market of producing health care equipment and supplies for over 30 years, began to develop a new diagnostic device able to detect up to 20 different diseases (HIV, rubella, syphilis, toxoplasmosis and hepatitis A, B and C, among others.).

A partnership between Lifemed and the Fundação Oswaldo Cruz (Fiocruz) undertook the development of this new device and its reagent disk, the latter being responsible for "researching and developing new diagnostic applications and devices and Lifemed was to research and produce all of the equipment needed for the platform to be used" (Valverde, 2010). According to the data organized by Silveira (2012), with the improvement of this research, other research bodies began to take part in the process of technological innovation, including the following institutes and universities: Instituto Carlos Chagas (ICC), Universidade Federal do Paraná (UFPR), Universidade Nacional de Ciência e Tecnologia do Paraná (UNCTPR), Instituto Nacional de Ciência e Tecnologia (INCT), the Financiadora de Estudos e Projetos (FINEP) agency and the Instituto de Biologia Molecular do Paraná (IBMP). We can see, then, how the creation of this new reagent disk drove significant cooperation between different agents (above all public ones), dispersed throughout Brazil, in order to research and develop this new device for the health care economy. Lifemed was also supplied with significant investment from BNDES which, from 2006 onwards, set up a link and invested around R$ 36 million in establishing a new plant in Pelotas (RS). There are currently three production units in Rio Grande do Sul and a commercial matrix in São Paulo[4].

Finally, we reach another point in the process which connects the whole productive circuit. In order for each patient's demand originating in medical prescription to be met – an essential element in the entire productive logic structured into diverse interlinked markets -, we have the distribution of products for retail sale, a sector in which, in the case of Brazil, two central firms form an oligopoly that distributes most of the reagents produced by the spatial productive circuit.

Therefore, in laboratorial diagnostic services, the following companies stand out: Diagnósticos da América (DASA), the largest such company in Latin America (and the fourth largest in the world), it operates in the sector with 25 different brands and, in 2012, a gross turnover of R$ 2.5 billion; and

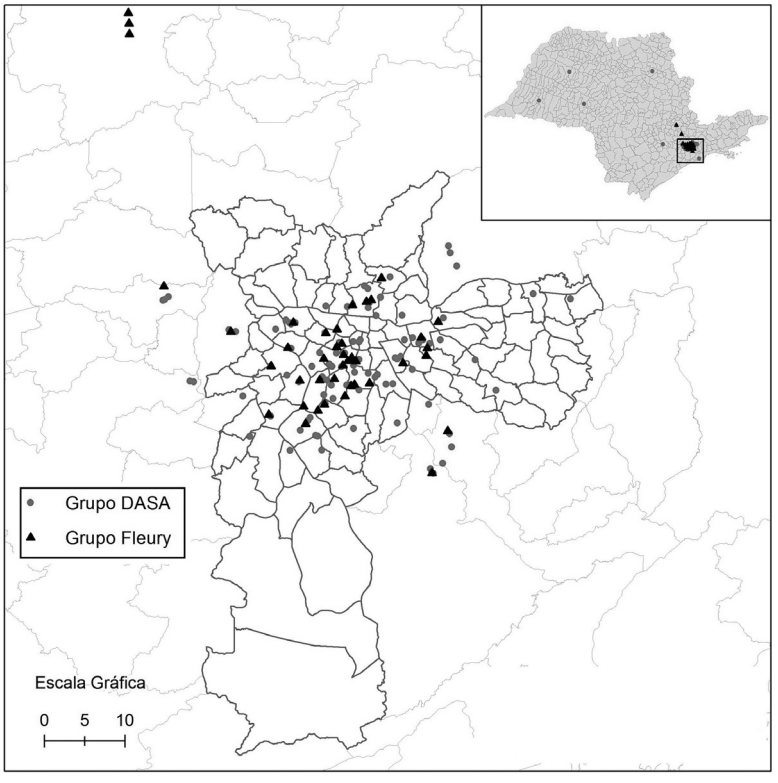
4 Dados disponíveis no sítio eletrônico da empresa, www.lifemed.com.br, acesso em 20 de maio de 2013.

its main competitor, Fleury, also owning several different brands and in the process of growing rapidly through mergers, with a turnover of R$ 485 billion in 2012. These are shining examples of this market in the spatial circuit of diagnostic reagents as, operating in outpatient, hospital and public support segments, they often have a direct relationship with patients, in addition to their sophisticated logistics.

As can be seen in Figure 2, in the central areas of the capital of São Paulo state, the main market for these companies, there is a high concentration of laboratories linked to these groups. it can also be seen that, where such concentrations exist, we have the presence of other health fixtures, the Hospital das Clínicas complex belonging to the USP, the Faculty of Medicine (FMUSP), Faculty of Public Health (FSP-USP), the Escola Paulista de Medicina (UNIFESP), the Instituto do Coração (INCOR-HCFMUSP), Instituto do Câncer, Instituto Adolfo Lutz, and the Instituto de Infectologia Emilio Ribas, to mention but a few, indicating the probable relationships between these institutions and DASA and Fleury.

Thus, corporate urbanism is imposing itself as health spatial productive circuits – as well as spatial productive circuits in general – install themselves in the territory, reorganizing the urban space according to the companies' logic of private ownership. In the capital of São Paulo state, we can see the confirmation of what Milton Santos (1990) calls a "corporate and fragmented metropolis", in which health care services such as diagnosis come to be controlled by large oligopolistic companies that even determine which products are to be used by patients/clients and, above all by public and private hospitals, also conditioning a series of public health dynamics. This spatial concentration "enables mechanisms of

Figure 2 - Distribution of DASA and Fleury laboratories in the state of São Paulo in 2012



DASA Group Fleury Group Scale
Source: IBGE, DASA e Fleury. Geographic projection: lat/long WSG84. Map organized by: Iara Viviani e Souza.
Data organized by: Rafael da Silva Almeida.

controlling and administering capital to be clarified" (Lencione, 2008, p. 8), mechanisms that often bring with them "the destruction of one capital and a sharp increase in the valuation of another" (Smith, 1988, p. 179), culminating in reducing the number of companies controlling the sector.

Another item to take into account is the centralization of capital engendered by the diverse agents in the complex: "it is part of the rationale of capitalist accumulation to concentrate together a large population, income, high tech industry and qualified labor" (Lencione, 2008, p. 8) in certain points of the territory. This is what can be seen in the city of São Paulo, in the economic dynamic of large laboratories leading to the so-called "corporate and fragmented metropolis" logic (Santos, 1990).

The role of DASA in the centralization process has been of great relevance in the sector: over the last few years, it has acquired 22 laboratories and it has also incorporated a large diagnostic company (MDI Diagnósticos) from the health insurance provider, Amil. Fleury has also centralized capitals. Incorporating more than 25 diagnostic laboratories in the last decade. Together, these two laboratories dominate more than 20% of the diagnosis sector in Brazil in terms of distribution and sales. Together with spatial selectivities, centralization and concentration produce a real segmentation of tasks in the territories (Santos, 2009a), in which certain points come stand out as "specialized" in certain services and activities and/or concentrating certain infrastructure of interest to capital expansion. The concentration of activities in these points and the way in which the firms come to use public health infrastructure - as mentioned above, forming the Health Quad - *Quadrilátero da Saúde*, and the Paulista Arch[5] - Arco da Paulista, and encourage the construction of others are one face of so-called corporate urbanism, that is to say, large companies privately using existing plots of public investment in order to promote health care services and specialist knowledge and technology, as has been happening since the early 20th century.

The extent and coverage of the cooperation involving the spatial productive circuit for diagnostic reagents can, then, be seen - with relationships between agents ranging from actions on a worldwide scale, through industrial health complexes of a regional structure and down to the local dimension, in the daily life of individuals, implicated in the dominant concept of curative medicine, strongly anchored in technological innovation -, and thus capable of inducing profound changes in the spatial dynamics of the societies involved.

Final considerations

Throughout the 20th century and up until today, the exercise of Western medicine reveals knowledge strongly tied to corporate interests, concentrating on one single idea about what "disease" is and how to combat it - the essence of so-called "curative medicine", to the detriment of "preventative medicine" - , we can see the historical technological development responding to the demands of such a concept. Controlled by hegemonic companies, the highly specialized technical-scientific structures today tend towards strong cooperation that extends worldwide and from which the health spatial productive circuits emerge, of which we have only examined that of diagnostic reagents. Moreover, the way in which the companies in the complex are distributed in the territories clearly demonstrates the process of intense spatial concentration of these companies and laboratories.

In the early 20th century, Camille Vallaux (1914, p. 164) had already warned that "when certain paths are controlled, it is impossible not to have influence on those countries that they connect. Thus, politics and economy are enmeshed in the gears of circula-

5 The Quadrilátero da Saúde is the area covered by the Hospital das Clínicas complex, the Instituto de Infectologia Emílio Ribas, the Instituto do Coração (INCOR), Instituto do Câncer do Estado de São Paulo (ICESP), the Faculty of Medicine (USP), Faculty of Public Health (USP), the Instituto Médico Legal and the Secretaria de Saúde, as well as public and private institutions existing in adjacent neighborhoods. The so-called Arco da Paulista is the name the SEADE report on *Ciências da vida humana na cidade de São Paulo*, from 2010, gave to the health care cluster running from the Quad to the region where the Hospital São Paulo and the Escola Paulista de Medicina (UNIFESP) can be found, as well as related institutions producing applied knowledge, teaching and even industrial production and services. This report indicates four clusters in the city, the most important of which is the Arco da Paulista (Seade, 2010).

tion". It is possible to draw an important connection between circulation and political and economic issues of Brazilian socio-spatial formation, as the companies in the complex make great use of the networks that shape and dominate the territory.

In order to mitigate the harmful consequences of such use of territory, we must consider it as a whole, not just as a support network transporting the vectors of modernization unrelated to the wants of the places. The creation of large engineering systems, such as required for the diagnostic reagent circuit, must take into account the various possible uses that can be made of public health in the territory in which they operate. A regulatory public policy favoring the planning of national legislation - that health is everyone's right and the duty of the state - requires current logic, which concentrates services and highly skilled professionals from the territory in just a few central points, to be reversed.

References

ALMEIDA, E. P. O uso do território brasileiro e a segmentação dos serviços de saúde. In: ENCONTRO DE GEÓGRAFOS DA AMÉRICA LATINA, 10., 2005, São Paulo. *Anais...* São Paulo: AGB-SP: USP, 2005. p. 552-565.

ALMEIDA, E. P.; ANTAS JR., R. M. Os serviços de saúde no estado de São Paulo: seletividades geográficas e fragmentação territorial. In: MOTA, A.; MARINHO, M. G. (Org.). *Práticas médicas e de saúde nos municípios paulistas*: a história e suas interfaces. São Paulo: CDG, 2011. p. 281-295.

ANTAS JR, R. M. Notas sobre o uso do conceito de circuitos espaciais produtivos para estabelecer o nexo entre a reestruturação urbana e as refuncionalizações do espaço: um estudo sobre os fixos de saúde no estado de São Paulo. In: ENCONTRO NACIONAL DA ASSOCIAÇÃO NACIONAL DE PÓS-GRADUAÇÃO E PESQUISA EM PLANEJAMENTO URBANO E REGIONAL, 14., 2011, Rio de Janeiro. *Anais...* Rio de Janeiro: ANPUR, 2011. p. 1-15.

ANTAS JR., R. M. O complexo industrial da saúde no Brasil: uma abordagem a partir dos conceitos de circuito espacial produtivo e círculos de cooperação no espaço. *GEOgraphia,* Rio de Janeiro, v. 16, n. 32, p. 38-67, 2014.

BRASIL. Agência Nacional de Vigilância Sanitária. Diretoria Colegiada. Resolução nº 206, de 17 de novembro de 2006. Estabelece Regulamento Técnico de Produtos para Diagnóstico de uso *in vitro* e seu Registro, Cadastramento, e suas alterações, revalidações e cancelamento. *Diário Oficial da União*, Brasília, DF, 17 nov. 2006. Seção 1, p. 36-38.

BRASIL. Ministério da Fazenda. Conselho Administrativo de Defesa Econômica. Ato de concentração nº 08012.002963, de 18 de agosto de 2010. Referente a operação de aquisição, pela DiaSorin S.P.A, de ativos da Abbott Laboratories. *Diário Oficial da União*, Brasília, DF, 18 ago. 2010. Seção 1, p. 25-26.

BRASIL. Ministério da Fazenda. Conselho Administrativo de Defesa Econômica. Ato de concentração n.º 08012.000056, de 25 de março de 2011. Referente a operação de aquisição, pela Prodimol Biotecnologia S.A., da totalidade das quotas de capital social da Medlab Ltda. *Diário Oficial da União*, Brasília, DF, 25 mar. 2011a. Seção 1, p. 45-46.

BRASIL. Ministério da Fazenda. Conselho Administrativo de Defesa Econômica. Ato de concentração n.º 08012.000055, de 18 de maio de 2011. Referente a operação de aquisição, pela Prodimol Biotecnologia S.A., da totalidade das quotas de capital social da Bioeasy Diagnóstica Ltda. *Diário Oficial da União*, Brasília, DF, 18 maio 2011b. Seção 1, p. 56-57.

BUSCH, M. Transfusion-transmitted viral infections: building bridges to transfusion medicine to reduce risks and understand epidemiology and pathogenesis. *Transfusion*, Arlington, v. 46, n. 9, p. 1624-1640, 2006.

CASTILLO, R.; FREDERICO, S. Espaço geográfico, produção e movimento: uma reflexão sobre o conceito de circuito espacial produtivo. *Sociedade e Natureza*, Uberlândia, v. 2, n. 3, p. 461-473, 2010.

CORDEIRO, H. *A indústria da saúde no Brasil.* Rio de Janeiro: Graal, 1980.

DUPUY, J. P.; KARSENTY, S. *A invasão farmacêutica.* Rio de Janeiro: Graal, 1980.

GADELHA, C. A. G. O complexo industrial da saúde e a necessidade de um enfoque dinâmico na economia da saúde. *Ciência & saúde coletiva*, Rio de Janeiro, v. 8, n. 2, p. 521-535, 2003. Disponível em: <http://dx.doi.org/10.1590/S1413-81232003000200015>. Acesso em: 10 dez. 2012.

GADELHA, C. A. G.; QUENTAL, C.; FIALHO, B. C. Saúde e inovação: uma abordagem sistêmica das indústrias da saúde. *Cadernos de Saúde Pública*, Rio de Janeiro, v. 19, n. 1, p. 47-59, fev. 2003. Disponível em: <http://dx.doi.org/10.1590/S0102-311X2003000100006>. Acesso em: 8 jul. 2014.

HOMMA, A. et al. Atualização em vacinas, imunizações e inovação tecnológica. *Ciência & Saúde Coletiva*, Rio de Janeiro, v. 16, n. 2, p. 445-458, 2011. Disponível em: <http://dx.doi.org/10.1590/S1413-81232011000200008>. Acesso em: 8 jul. 2014.

ILLICH, I. *Némesis médica*: la expropiación de la salud. Ciudad de México: Joaquín Mortiz, 1984.

JASPERS, K. *O médico na era da técnica.* Lisboa: Edições 70, 1998.

LATOUR, B. *Jamais fomos modernos:* ensaio de antropologia simétrica. Rio de Janeiro: Editora 34, 2000.

Le BRETON, D. *Antropologia do corpo e modernidade.* Petrópolis: Vozes, 2011.

LENCIONE, S. Concentração e centralização das atividades urbanas: uma perspectiva multiescalar: reflexões a partir do caso de São Paulo. *Revista de Geografia Norte Grande*, Santiago, n. 39, p. 7-20, maio 2008.

LOPES, J. A. O médico e a tecnologia: reflexões com enfoque na cardiologia. *Revista Médica de Minas Gerais*, Belo Horizonte, v. 18, n. 2, p. 108-115, 2008. Disponível em: <http://rmmg.medicina.ufmg.br/index.php/rmmg/article/viewFile/9/8>. Acesso em: 18 dez. 2012.

MORAES, A. C. R. Los circuitos espaciales de la producción y los círculos de cooperación en el espacio. In: YANES, L. A.; LIBERALI, A. M. (Org.). *Aportes para el estudio del espacio socio-economico.* Buenos Aires: Editorial El Coloquio, 1989. v. 1. p. 151-177.

PAIVA, L. B. *Análise estratégica da indústria brasileira de reagentes para diagnóstico e das potencialidades de atuação do Instituto de Tecnologia em Imunobiológicos frente aos desafios da saúde no Brasil.* 2009. Dissertação (Mestrado em Tecnologia de Imunobiológicos) - Instituto de Tecnologia em Imunobiológicos, Fundação Oswaldo Cruz, Rio de Janeiro, 2009.

PERROUX, F. O conceito de polo produtivo. In: FAISSOL, S. *Urbanização e regionalização*. Rio de Janeiro: IBGE, 1975. p. 98-100.

PRED, A. *Sistemas de cidades em economias adiantadas*: crescimento passado, processos presentes e opções de desenvolvimento futuro. Rio de Janeiro: Zahar, 1979.

PORTER, R. *Das tripas coração*: uma breve história da medicina. Rio de Janeiro: Record, 2004.

SAIOTE, A. R. G. *Centro de Medicina Molecular*: diagnóstico in vitro. 2007. Dissertação (Mestrado em Engenharia Biomédica) - Departamento de Física Faculdade de Ciências e Tecnologia, Universidade de Coimbra, Coimbra, 2007.

SANTOS, G. F. *Política de assistência farmacêutica e o setor produtivo estatal farmacêutico*: o caso da Fundação para o Remédio Popular de São Paulo – FURP. 1996. Tese (Doutorado em Economia) - Instituto de Economia, Universidade Estadual de Campinas, 1996.

SANTOS, M. Sociedade e espaço*:* a formação social como teoria e como método. *Boletim Paulista de Geografia*, São Paulo, n. 54, p. 81-99, jun. 1977.

SANTOS, M. Circuitos espaciais da produção: um comentário. In: SANTOS, M.; SOUZA, M. A. (Org.). *A construção do espaço.* São Paulo: Nobel, 1986. p. 121-134.

SANTOS, M. *Metamorfoses do espaço habitado.* São Paulo: Hucitec, 1988.

SANTOS, M. *Metrópole corporativa fragmentada*: o caso de São Paulo. São Paulo: Nobel, 1990.

SANTOS, M. *Economia espacial*: criticas e alternativas. São Paulo: EDUSP, 2003.

SANTOS, M. *Técnica, espaço, tempo*: globalização e meio técnico-cientifico-informacional. São Paulo: EDUSP, 2008.

SANTOS, M. *A urbanização brasileira*. São Paulo: EDUSP, 2009a.

SANTOS, M. *Por uma economia política da cidade*. São Paulo: EDUSP, 2009b.

SANTOS, M. *A natureza do espaço*: técnica e tempo, razão e emoção. São Paulo: EDUSP, 2009c.

SANTOS, M.; SILVEIRA, M. L. *O Brasil:* território e sociedade no início do século XXI. Rio de Janeiro: Record, 2010.

SCHRAIBER, L. B. *O médico e suas interações*: a crise dos vínculos de confiança. São Paulo: Hucitec, 2008.

SEADE - SISTEMA ESTADUAL DE ANÁLISE DE DADOS. *Ciências da vida humana na cidade de São Paulo*. São Paulo, 2010.

SILVEIRA, E. Diagnóstico fácil. *Pesquisa Fapesp*, São Paulo, n. 192, p. 62-65, fev. 2012.

SILVEIRA, M. L. Região e globalização: pensando um esquema de análise. *Redes*, Santa Cruz do Sul, v. 15, n. 1, p. 74-88, 2010.

SMITH, N. *Desenvolvimento desigual*: natureza, capital e a produção de espaço. Rio de Janeiro: Bertrand Brasil, 1988.

STENGERS, I. Para além da grande separação, tornarmo-nos civilizados? In: SANTOS, B. S. (Org.). *Conhecimento prudente para uma vida decente:* um discurso sobre as ciências revisado. São Paulo: Cortez, 2006. p. 131-149.

VALVERDE, R. Seminário anuncia duas parcerias inovadoras em produtos para diagnóstico. *Agência Fiocruz de Notícias*, Rio de Janeiro, 29 nov. 2010. Disponível em: <http://www.agencia.fiocruz.br/semin%C3%A1rio-anuncia-duas-parcerias-inovadoras-em-produtos-para-diagn%C3%B3stico>. Acesso em: 7 jul. 2014.

VALLAUX, C. *El suelo y el Estado*. Madri: Daniel Jorro, 1914.

Authors' contribution

Antas Jr. was responsible for the theoretical elaboration, structuring and writing of the article. Almeida was responsible for organizing the data, mapping and obtaining historical information.

Received: 18/11/2013
Resubmitted: 24/06/2014
Approved: 11/07/2014