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AUTHOR'S NOTE

This article stems from a doctoral thesis dealing with the "Spatio-temporal analysis of a scientific movement" and which used French-speaking European "theoretical and quantitative geography" as a case study (Cuyala, 2014). To carry on this work, three disciplines were mustered (sociology, history and geography).

Introduction

1 Theoretical and quantitative geography was born and developed in French-speaking Europe in the 1970's (Pumain, Robic, 2002; Orain, 2009; Cuyala, 2014). This manifested with the creation of a series of **recurrent collective events** (Cauvin, 2007), contributing to developing a "core of knowledge" **that challenged** disciplinary orthodoxy, a necessary condition for the birth of a scientific movement according to sociologists Frickel and Gross (2005):

1. Training locations on quantitative methods (ie: Aix-en-Provence (1971-...), Besançon (1972-2015);
2. Study groups (ie: the Dupont group in Avignon (1971-...) and specialized laboratories (from the 1980's and onward);
3. Forums (ie: the European Colloquium on Theoretical and Quantitative Geography, 18 sessions from 1978 (Strasburg) to 2013 (Dourdan)).

2 But what happens prior to this series of recurrent collective events which necessitates the gathering of a certain number of scientists and of people for them to become permanent?

3 The main hypothesis is that some French-speaking European scientific stakeholders crossed the Atlantic sea or translated Anglo-American books and therefore contributed to spreading innovations once they went back to their country (France, Belgium, Switzerland or Luxemburg).

4 This article pursues two goals:

- From a thematic point of view: to understand the process leading to the birth of French-speaking European theoretical and quantitative geography by studying its origins,
- From a methodological point of view: to use cartographical representations of the locations and of the movements of stakeholders that are based on oral testimonies in order to analyze the role of the origins of a scientific movement in its inception.

5 In order to identify these different categories of geographers and their location over time, we based our work on several theories, we carried out interviews with the participants of the movement we managed to contact, and we were consequently able to come up with different stages in the origins of the movement in question.

An interdisciplinary theoretical approach

6 The models of reference used to construct the history of a particular field of study developed within a discipline are rare. If we wish to produce an objective social history of this scientific operation instead of a strictly internal history which would take the form of a narrative on the evolution of theories and concepts, we must employ theories and categories established in *Sociology of science* (Martin, 2005). Yet, the concepts of reference and the models of analysis in this growing field are far from being stable. To complete this work, two theoretical elements are used.

A sociological theory…

7 *Firstly,* the general conceptual framework we used as a basis for our work is a sociological theory developed by S. Frickel and N. Gross (2005) which is applied in the study of "scientific or intellectual movements" (SIMs). We decided to adopt SIMs as a starting point for this work because of their following characteristics: 1. A SIM is **programmatic**, its program consisting in producing and diffusing a knowledge core, 2. The program of the SIM differs from current normative practices in the field of study, 3. The SIM constitutes itself through **collective action**, 4. The SIM is in this sense **political**, 5. The SIM is a **temporary phenomenon** (birth, development, end).

…Completed with a geographical approach to science

8 S. Frickel and N. Gross's approach (2005) is mainly sociological. Our aim is to complete their theory which summarizes various sociological studies, by adopting an approach of spatial analysis and more precisely to study the spatial diffusion.

9 Quite recently, particularly in the 1990s, a spatial approach started to be applied to the history of science. Science historians were interested in not only the history of the development of knowledge and the process of the social organization of disciplines over time, but also increasingly in the study of the spatiality of knowledge. This can be illustrated with the publication at the end of the 1980s of a collective work entitled *Elements of history of science*, edited by Michel Serres (2003 [1989]), which features "a page which is programmatic in all respects, [in which Michel Serres] turns space into an analysis scheme and cartography into a writing model for the history of science. [...] The aim was to show the centers, junctions, interactions and breaking points of this space-time continuum of science" (Besse, 2010, p. 2015). This resembles very much a spatial analysis approach that a geographer would present. Jean-Marc Besse underlines one of M. Serres's objectives, that of "breaking away from the linearity of the historical narrative".

10 In the 1990s and especially in the 2000s, a period which saw the spatial turn of social sciences, Anglo-American historians of geography explored this approach in the continuity of the social aspect of science studies. The British geographers David Livingstone and Charles Withers are the two iconic authors of this approach[1] (Livingstone, 1995, 2003; Livingstone, Withers, 2011; Withers, 2002, 2007). Rather than offering the spatial analysis of a scientific movement, this approach gives suggestions for the "implementation of a project on the historical geography of science, that is to say the project of comparing scientific knowledge with the spaces and places where the latter is produced and used", as was pointed out by J.-M. Besse (*Ibid.*) who provides in this article and in an earlier analysis of the geography of the Renaissance (Besse, 2004) a precise analysis of the geographical input of these essays. Textbooks are henceforth published, such as the one edited by John A. Agnew and D.N. Livingstone entitled *Geographical Knowledge* (2011), and attest the development of a "geography of geography".

11 Moreover, numerous general works have been published on the subject of the "spatial history of knowledge". In France, Christian Jacob coordinated a significant series on the history of knowledge dedicated to *Places of knowledge*, the first volume addressing the theme Space and community (2007) explained by the author with notions once again analogous to geographers' areas of expertise:

Create, relocate, circulate, explore, converge, deploy a network, go from the center to the periphery, act from the center towards the periphery, all these actions seem to constitute a spatial history of knowledge. (Jacob, 2007, p. 25)

12 Although it is principally specialists outside the geography discipline who developed this type of research, geographers also started to promote it.

13 In a first article entitled "Space in the history of science", which uses 16th century geographical knowledge as a case study, as well as his more recent article dedicated to "spatial approaches in the history of science and art" referred to earlier, J.-M. Besse (2004 and 2010) offers an overview and research perspectives in geography of science. Two elements caught our attention and will be used in our analysis of the French-speaking European theoretical and quantitative geography: 1) the models of spatial analysis to be implemented and 2) the mapping of results. Besse demonstrates the utility of using the models of spatial analysis that were adopted in the history of science and art, such as the hierarchical diffusion model, even if he believes they can be problematic because they often only consider a hegemonic center and not the countless movements between places of production (Besse, 2010b, p. 8). Moreover, J.-M. Besse insists on the utility of using cartographic representation in the spatial analysis of sciences:

Thanks to [cartographic representation], it is possible to produce an image of the spatial distribution of scientific activities and consequently [...] to better comprehend these activities. The use of cartography in the history [...] of science, far from being palliative or decorative, allows us to, it seems, "reveal", in the photographic sense of the term, a constitutive and determining dimension of these activities, that is to say their location, dispersal and spatial organization, their territorial cohesion, movements and scale of development. (Besse, 2010, p. 218)

14 These elements (models of spatial analysis and cartography) echo the publication in which J.-M. Besse wished to publish his article: *l'Espace géographique.* This journal is considered by many as one of the mediums for publishing "modernist" geography since the 1970s, especially French-speaking authors of theoretical and quantitative geography[2]. It also contains many debates and deals with many issues and therefore presents programmatic articles such as this one. It is in this publication that J.-M. Besse challenges geographers to invest in a promising field, that of "the consideration of space as a tool for understanding" the science of culture:

We observe in various fields of the science of culture a growing movement and interest in taking into consideration space as a tool for comprehension and interpretation. The question would be to see if geographers are ready to participate in these new historiographical orientations and to elaborate pertinent conceptual and methodological tools and how they would do so. Or must a geography without geographers develop in these fields? (Besse, 2010, p. 211)

15 In fact, the experiment of a geography of science had already been conducted and amongst the first drafts appeared the study of the expansion of "new geography" in the English-speaking world, overseen by Peter Haggett (1990), who suggested a sketch of its spatial diffusion; we will deal with this later on. In France, besides numerous other research applied to geography, the geography of science has led to a program of research documented in a special report entitled "Science, space and maps" (Eckert, Baron (dir.), 2013) in the journal *Mappemonde*.

16 The report, "aims, at this stage, at convincing us on the advantage of a spatialized analysis of science and on the possibilities and the utility of cartographic representation" (Baron, Eckert, 2013), the authors also judging that:

> The location, the spatial organization of networks and the weight of local cohesion considered as worldwide opportunities merit to be taken into consideration, to be measured and, more than ever, to be analyzed. (Baron, Eckert, 2010).

17 One of the four articles of this special report (Maisonobe, 2013) particularly caught our attention as is it similar to our program of analysis of a scientific movement and to our research process. In this article, Marion Maisonobe, a doctoral student in geography, presents an analysis of the "diffusion and [of the] spatial organization of a research question on molecular biology". She therefore deals with the diffusion of a "research question", and not that of a "movement", but mobilizes nevertheless a certain number of people, of scientists who can join in a research community (in her case, it was about issues dealing with the "reparation" and the "transcription" of DNA). Another important difference is that she studied this diffusion on a worldwide scale whereas we made the hypothesis that the scientific movement under study significantly falls under the French-speaking European context, as we suppose that it goes beyond national borders to exist within a language community. The timescale of Diana Crane's research project, which she calls "problem area" (1969), resembles that of a scientific movement that lasts "at least one decade", even if the latter is more likely to have a longer longevity. The main difference is that a scientific movement can have a comprehensive social structure that lasts on the long term, contrary to a "research issue" that can nevertheless evolve and transform itself.

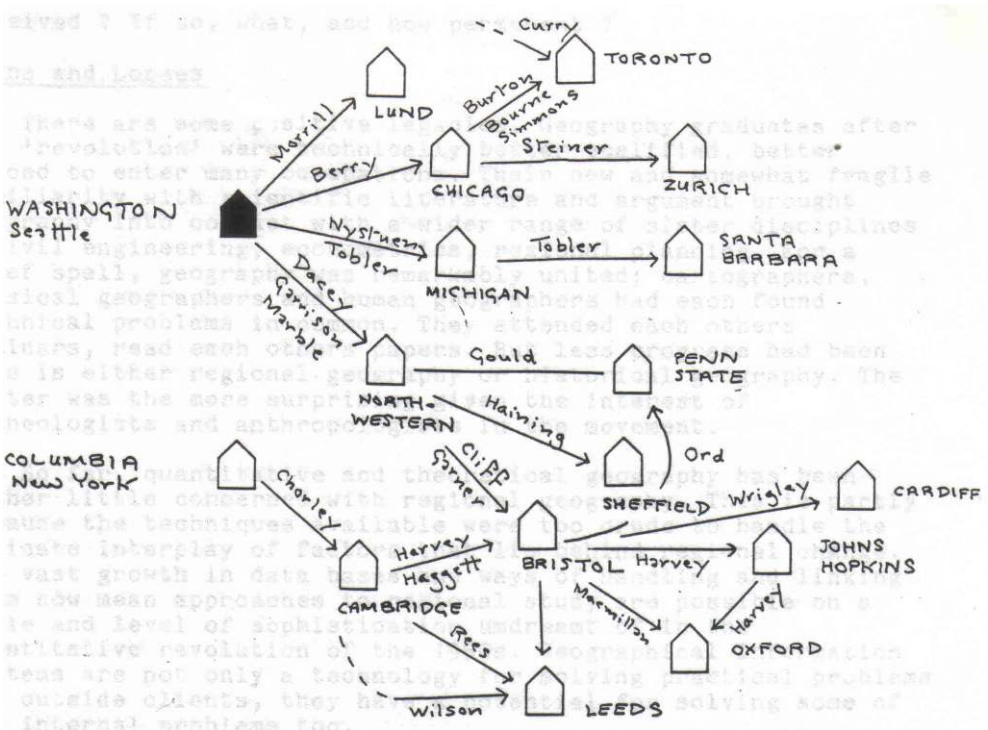
18 In the end, all these different programmatic positions (Besse, 2004, 2010; Baron, Eckert, 2013) and geographers' recent and significant investments (Matthiessen, Winkel, Schwarz, 2002; Baron, 2005; Ponds, Van Oort, Frenken, 2007; Berroir and al., 2009; Matthiessen, Winkel, Schwarz, 2010, Clerc, 2013; Cuyala, 2013, 2014; Eckert, Baron, Jégou, 2013; Levy, Sibertin-Blanc, Jégou, 2013; Maisonobe, 2013; Robic, 2013) show how beneficial it is for a scientific and even more a geographer to:

> consider space as a determining dimension in the making of scientific knowledge and especially as a key to comprehend the mechanisms of this process" [...] To take more interest in the material and symbolic spatialities that are implemented in the production, diffusion and adoption of scientific ideas, more generally to take into account scientific activities from a social, logical and methodological point of view. (Besse, 2004, p. 405-406)

19 A whole research field exists in this domain and consequently confirms our wish to analyze the temporal *and spatial* diffusion of a scientific movement.

20 Although the authors we have quoted so far did not specifically study the spatiality of a *scientific movement*, other geographers did by referring to models of spatial analysis. This is the case of Peter Haggett (1990) who, in *The Geographer's Art*, illustrated the spatial expansion of the North-American theoretical and quantitative geography, that took birth in the United-States, then spread to Canada and Europe (Great Britain and even Switzerland) (fig 1). He interpreted this expansion as a phenomenon of spatial diffusion based on its stakeholders' successive job transfers.

Figure 1 – The quantitative revolution as a diffusion process



Explanatory text accompanying the title: "A highly simplified and incomplete picture of some of the moves of geographers from two leading United States graduate schools in the 1950s and 1960s, and their impacts on the United Kingdom. Some of the second- and third-order moves occurred after 1970. For simplicity only one centre in human geography (Washington) and one in physical geography (Columbia) have been retained".

Source: P. Haggett, "Revolutions and quantitative geography: some personal reflections on the bicentennial", Paper to the Sixth European Colloquium on Theoretical and Quantitative Geography, Chantilly, France, September 6 1989.

21 The graph starts off with academic centers that diffused *New geography*, which were essentially the University of Washington in Seattle and the University of Columbia in New York and then spreads to Northwestern University (Evanston, Illinois), the University of Chicago and the University of Michigan (Ann Arbor); *"new geographers"* are therefore mainly concentrated in the Middle West. Many of the quoted geographers, such as Haggett and Chorley, or even Harvey and Berry, actually studied in Europe and some of them went back, which led to the creation of the two big centers of *new geography* in Cambridge and in Bristol (this geography of the movement was questioned by T. Barnes (2008a, 2008b) and Johnston XX (2008), as they believed it to be extremely simplistic). Many English-speaking geographers who participated in the theoretical and quantitative movement had begun their careers in Europe and took their part in the "brain drain" that saw young British students leave their country to go work in the United-States. Some of them, such as Peter Haggett, regularly flew back and forth between the two continents. Morrill did not participate in the diffusion of the movement by going to Lund; he did so because Torsten Hägerstrand, who led the department of geography at the time, was known in the United States for his work on migrations and on the spatial diffusion of innovation.

22 Other geographers showed the utility of studying the diffusion of theoretical and quantitative geography in relation to centers of innovation. After having made a

preliminary description of certain aspects of the diffusion of innovation in British theoretical and quantitative geography, J.W.R. Whitehand (1970, 1971) studied this diffusion with the diffusion centers of Cambridge and Bristol Universities as a starting point; he demonstrated that since 1966, these two centers boasted the most authors who contributed to scientific articles using quantitative methods. On this basis, he studied the phenomenon by examining the diffusion of issues relating to theoretical and quantitative geography in British university geography exams. By using the key article by Torsten Hägerstrand (1953) on the spatial diffusion of innovations, he made the hypothesis that this diffusion was done by word of mouth between friends or colleagues, by contamination or by ripple effect from one department of geography to another. He tested his hypothesis by evaluating the physical distance between the two universities which instigated the movement and those that adopted theoretical and quantitative geography and found that proximity between the places that adopt theoretical and quantitative geography plays a role. M. Maisonobe also revealed that "spatial diffusion is mainly the consequence of a ripple effect within the countries that were the most productive during the first stage" of diffusion (Maisonobe, 2013, p. 8).

23 This early research drew its inspiration from the notion of spatial diffusion theorized by the Swedish geographer T. Hägerstrand (1916-2004) (he is a major figure in this field of research and one of the pioneers of *New Geography*). It is this model we wish to use for our spatial analysis of the making of a scientific movement. This article therefore attempts to complete the sociological understanding of the study of the making of a scientific movement with the help of a spatial analysis approach that uses diffusion models. Our work derives its originality from this combination that consists in instilling a geographical dimension to the sociological model of a scientific movement. We particularly seek to determine the distribution, concentration and spatial diffusion of this scientific movement. More generally, these investigations fall under the category of science studies (Berthelot, Martin, Collinet, 2005) and especially the implementation of a geography of science (Withers, 2002; Livingstone, 1995; Withers, 2009; Besse, 2010; Livingstone, Withers, 2011; Eckert, Baron, 2013).

A geographical analysis of the origins of a scientific movement based on its stakeholders' testimonies

A rich stock of memories

24 We founded our analysis on a rich stock of memories. We questioned the memories of the stakeholders of this period to study the making of this scientific movement and consequently to constitute a symbolic capital on the role of certain modernists of the 1960s. The analysis we offer in this article is mainly based on a corpus of 58 semi-structured interviews of stakeholders and of conveyors of the theoretical and quantitative movement and on these witnesses' statements about the 1960s and early 70s. The early period of this movement has been little studied in literature, yet data is essential to comprehend it. However, 50 years later, a substantial symbolic capital of the role of some of the modernists was assembled through the recollections of some of these stakeholders of scientific modernization. The stakeholders' interviews constitute retrospective viewpoints that contribute to constructing a precise account of French-speaking European geography in the 1960s and early 1970s. We have tried to depict the

history of the movement as it was told to us by its stakeholders, by paying attention to the places and the spaces they found themselves in. We did not objectify our findings but rather analyzed them as elements of the collective memory of the interviewed stakeholders. We must therefore note that these distinct experiences are contained in an individual and collective memory that has become very codified after 40 years of feedbacks either between the interviewed stakeholders, through the stories as told in workbooks, or through a certain number of self-narratives that were written, read and commented numerous times. We cross-checked the interviews between themselves but also with other sources and archives.

25 Because a scientific movement has vague and dynamic limits, it is difficult to determine precisely who the stakeholders concerned by the field of study are. Nevertheless, the analysis of the different sources presented above (*the Directory of French geographers*, *Intergeo Bulletin*, *Espace géographique*, or even the lists of statements made during European Colloquiums on theoretical and quantitative geography) allowed us to estimate the number of stakeholders very implicated in the movement between 1960 and 2013 to around 250. Our sample represents a coverage rate of over 20%. To increase the representativeness of the sample, we separated it into categories according to certain criteria that ensure that a variety of backgrounds of the stakeholders of the French-speaking European theoretical and quantitative geography is represented.[3] This diversity of respondents gave us a relatively thorough overview of the accounts and perceptions within the scope of the stakeholders in question and consequently allowed us to cover as many aspects of the movement as possible. It represented a great wealth of experiences and accounts which fueled our comprehension of the history of European theoretical and quantitative geography. The material collected during the interviews is especially interesting as the protagonists of the movement feel they possess knowledge that needs to be shared and that can bring legitimacy to the history forged with their help.[4]

26 The seven criteria chosen to produce the sample are:

27 1. The participants' country of origin. Our study area being French-speaking Europe, we found it crucial that the following be represented:

- countries (Belgium, France, Luxemburg and Switzerland),
- historical centers found in literature,
- places that experienced the diffusion of theoretical and quantitative geography following the appointment of young quantitative specialists, for instance.

28 We consequently traveled from Rennes to Nice, from Louvain-la-Neuve to Lausanne, from Besançon to Rouen, or even from Paris to Aix-en-Provence, via Strasbourg. Most of the time we met several persons in each city.

1. Stakeholders of different generations: from the pioneers to the youngest. It is nevertheless much more difficult to meet with doctoral students than with retired geographers. The reasons they give are often linked to their careers since young geographers do not yet have a permanent appointment and can be apprehensive of the interpretation made of their statements and remarks.
2. The position of stakeholders within the movement: central, peripheral, capable of evolving from a secondary to a prominent position as the movement develops. This dimension is linked to their role within the sub-networks of the stakeholders of the movement: a more or less key role as leader, as a conveyor or as a guide. This depends on their degree of participation to theoretical and quantitative scientific events, on the number of publications produced or even on the number of doctoral students mentored. For example, we

interrogated pioneers of the movement who are mainly authors of historiographical narratives or of textbooks that allude to the history of theoretical and quantitative geography.

3. What the witness specializes in. All specialties are represented as it was shown that this movement spans the spectrum of specialties of the discipline, which is what makes it so specific. Specialists in climate, rurality, urbanity, morphology, cartography or even risks were interviewed.
4. The witness's discipline: as geography has strong links and interactions with other academic fields, specialists other than geographers, such as mathematicians and computer engineers, participated in the development of the movement in different ways.
5. The status of the stakeholders of the movement, according to their professional situation and to their institutional affiliation, is a useful information to comprehend their potential role: researchers, university lecturers, research engineers for example, who belong to institutions such as a university, the CNRS or the French Institute of Research for Development (formely known as ORSTOM).
6. The position of the witness relative to the movement: to have a comprehensive view, we surveyed persons exterior to the theoretical and quantitative movement, but who still belong to the field of geography. These people are or were in contact with the movement in one way or another. It must be noted that the participants' various characteristics may have evolved during the study period. We did not only take their current status into consideration.

29 With the help of the different resources mobilized, these diverse criteria allowed us to identify up to 60 witnesses, which we classified by date of birth.

30 This article focuses more particularly on the period which preceded the scientific movement, its origins. The collected data is innovative for a number of reasons: the stakeholders are still alive, the interviews are not structured and therefore not directly comparable and some of them were done in several phases with subsequent requests for clarification.

Cartographic representation

31 The qualitative exploitation of the interviews allowed us to clarify the nature of the most active diffusion places of new geography and to offer a cartographic representation of the places and spaces where the seeds of the French-speaking European theoretical and quantitative movement burgeoned.

32 With this mapping, the aim of the analysis is to illustrate the spaces and the places where the scientific movement originated as well as the **movements** which helped shape these spaces and which led to **the diffusion of scientific innovation**.

33 The main methodological contribution of this work is to express in the form of schematic maps a phenomenon of diffusion (sources, movements, spaces) by using a corpus of interviews (an oral history).

34 After appreciating the stakeholders' statements, we produced graphics (fig. 2, 3, 4) that represent:

- The concerned stakeholders, whether they are geographers or not, according to their role as we identified them and according to their linguistic characteristics and country of origin,
- The places where the related experiences took place (countries, cities and universities),

- The migrations which allowed innovators to build a space of academic freedom at a local level, and the temporary travels they and younger geographers did that led to them adopting "New geography" (Gould, 1968).

35 What we are studying is an innovation entitled "New Geography" (Gould, 1968), also known as "quantitative geography", which originated from the United States in the 1950s-60s and gradually spread to Canada (first in the English-speaking part, then in the French-speaking part) and Great Britain in the early 1960s, before reaching French-speaking Europe. There are therefore two major territories at stake:

1. An "Anglo-American" community: at the origin of the innovation,
2. A "French-speaking European community": who adopts the innovation.

36 **Finally**, from a theoretical point of view, this article enriches the work of Frickel and Gross (2005) in regard to two main points. Firstly, we wish to highlight how important the origins of the movement is for its crystallization, in addition to the three periods that sociologists theoretically give to the chronology of a movement. Secondly, we seek to show the utility of incorporating the spatial logics of the development of a scientific movement in these sociologists' framework of analysis. We have implemented various processes to show that spatialization is one of the steps of the structuration process of a scientific movement.

Three stages in the origins of the scientific movement

37 Thanks to different testimonies, we were able to determine three stages in the origins of the French-speaking European theoretical and quantitative movement, whose spatiality we schematically represented. As we have already indicated previously, we used the same environment in the mapping analysis for each of these stages, composed of the **two key elements**:

1. The Anglo-American community, at **the origin of the innovation**, and
2. The French-speaking European community, who **adopts the innovation**.

38 There are three clusters within the Anglo-American community: the United-States, Canada and the British Isles, composed of the United-Kingdom and Ireland. We will especially focus on the following cities or universities: Sherbrooke, Montreal and Ottawa for Canada, Berkeley and Clarke University for the United States. Concerning the French-speaking European community, the white circle symbolizes France, whereas Belgium and Switzerland are represented by a black circle.

Disjointed places (1945-1960)

39 The witnesses gave us few elements on the places of scientific innovation in post-war French-speaking Europe, between 1945 and 1960 (figure 2).

40 There are some rare exceptions in climatology where some researchers explored and were curious about new methods, such as René Emsalem in Limoges (purple circle), while others were already **leaders in novelty**, such as Charles-Pierre Péguy in Rennes, who taught statistical climatology (purple circle with a black border).

41 Sylvie Rimbert was one of the few who had already been across the Atlantic. In 1951, she left Paris to study during two years at Clark University in Massachusetts. However, this

was not an innovating experience from a scientific point of view. She then went back to Paris, but did not stay as she was recruited by Jean Tricart and moved permanently to Strasbourg in 1955.

42 In the end, there was no large-scale movement of renewal of geography in the places mentioned (Rennes, Limoges, Toulouse or even Strasbourg) during this period; at most, there were individuals who were dissatisfied with the scientific heritage delivered to them or with scientific practices and who tried to innovate on their own.

Beginnings (1960-1968)

43 After examining the oral histories shared by the witnesses, we found a second stage to the origins of the movement, which we designate as "beginnings" and which spreads from 1960 to 1968 (figure 3).

44 This period saw the appearance of **dispersed** centers led by relatively **isolated** innovators (purple circle with a black border). The number of places where innovators can be found is multiplied by 4 in comparison to the previous stage: Rennes, Lille, Reims, Paris, Strasbourg, Besançon and Grenoble are centers of scientific innovation.

45 Although Roger Brunet was only an explorer and not a leader in modernity when he was still in Toulouse (purple circle), he became so when he arrived in Reims in 1966. This medium-sized university gave him a certain freedom of action and allowed him to introduce a theoretical and methodological renewal to geography purple circle with a black border). He launched a statistics course and taught this discipline to students.

46 A specific spatial organization of French-speaking European scientific modernization occurred from two perspectives:

- **Firstly**, certain links and predominant places for innovation appeared. Links, such as the one between Rennes, Grenoble and Nice, came into existence, due to the travels and relations of Ch.-P. Péguy, who regularly went to teach quantitative methods in Nice whilst being a researcher in Grenoble.
- **Secondly**, a specific geography of modernization materialized following the appointments of Roger Brunet in Reims and of Charles-Pierre Péguy in Grenoble, who were respectively formerly based in Toulouse and Rennes. Henceforth, all the innovators were established in the **eastern part of France**.

47 These innovators worked to **gather new resources and ideas** in these centers of innovation, by, for instance, **searching for bibliographic references** when travelling for professional reasons or by **systematically buying books and journals**. The library generated by Paul Claval in Besançon illustrates this the best.

48 During this period, movements towards the English-speaking world depended on proximity. Relationships with Great-Britain had been smooth and open for a long time, and some geographers such as Philippe Pinchemel maintained close scientific relations with his colleagues from across the Channel, discovering together, for example, the utility of hydro-morphometry.

49 Moreover, the **North-American** pole of attraction came to existence during this period. This **attraction became established and was consolidated at the end of the 1960s** by distinctly focusing on Canada and by rallying several geographers early on in their careers. These geographers went to different universities on missions that varied in duration. They sometimes went back and forth between Europe and Canada and made the

latter a springboard for brief stays in the United-States. In the mid-1960s, Jean-Bernard Racine, who was then based in Nice, left to teach in Sherbrooke, Quebec. In 1966, he was joined by a French professor, Henri Reymond. After a while, J.-B. Racine contacted American geographers like Brian Berry, who read and provided a critical review of his thesis, whose subject was very conventional for the time. Thanks to these American geographers he got in contact with, he discovered New geography.

50 All in all, this stage is characterized by three practices: 1. A first acquaintance with Anglo-American literature on New Geography by reading and searching for documents and translations (for example: Bunge, 1962; Burton, 1963), 2. Professional travels made essentially in neighboring English-speaking countries, apart from a few exceptions (such as Canada), 3. The appearance of a spatial organization of the French-speaking European community with links and predominent places.

Crystallization (1968-1972)

51 Finally, the period stretching from 1968 to 1972 was marked by the beginning of the crystallization of the movement (figure 4). As we will see, movements multiplied between the places of innovation and those of diffusion.

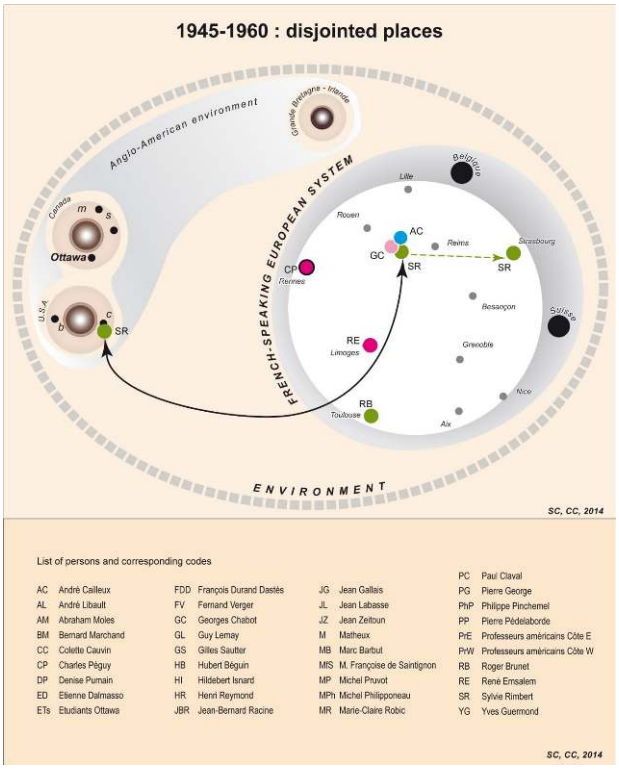
52 The places where New geography was adopted are not the nearest countries of potential diffusion: neither Great-Britain nor Sweden are the most determining centers, except perhaps for the first French-speaking innovators.

53 It is North-America that is the greatest source of innovation. Nevertheless, the United-States does not weight much, despite two key characteristics:

- the quantitative revolution was instigated there,
- the United-States was very influent due to the magnitude of their publishing production as well as to their number of innovating geographers.

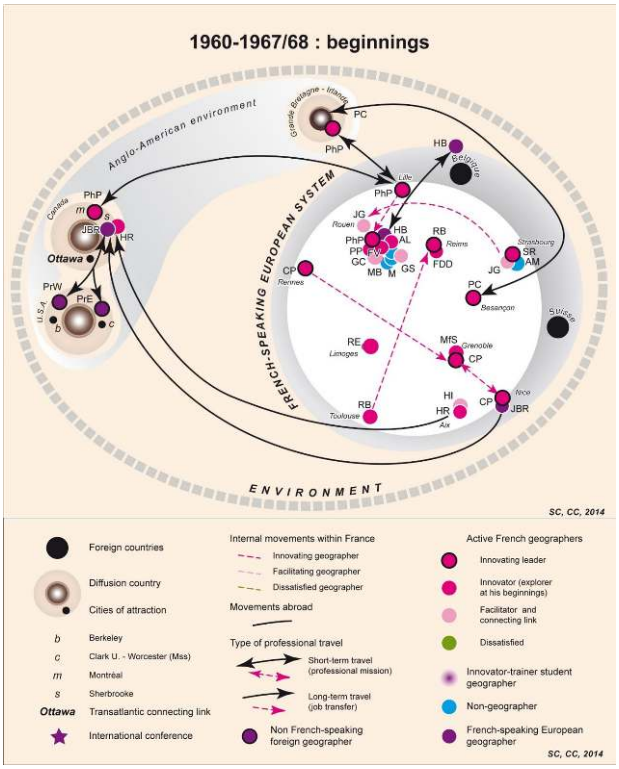
54 In North-America, it is the **appearance and the development of a Canadian center** that we observe, especially due to the existence of the department of geography at the bilingual University of Ottawa, at the interface between the French-speaking and the English-speaking worlds.

Figure 2 – 1945-1960: Disjointed places



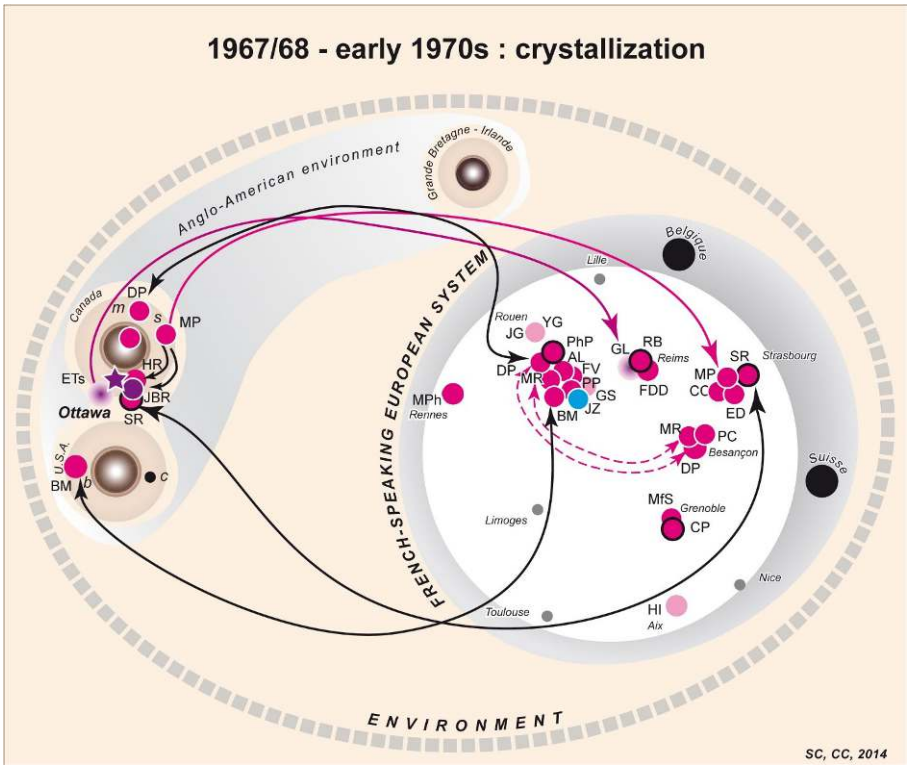
Sources: corpus of interviews with stakeholders of the theoretical and quantitative movement
Authors: Sylvain Cuyala, Colette Cauvin, 2014

Figure 3 – 1960-1967/68: Beginnings



Sources: corpus of interviews with stakeholders of the theoretical and quantitative movement
Authors: Sylvain Cuyala, Colette Cauvin, 2014

Figure 4 – 1967/68 – early 1970s: Crystallization



Sources: corpus of interviews with stakeholders of the theoretical and quantitative movement
Authors: Sylvain Cuyala, Colette Cauvin, 2014

55 Ottawa emerged as a main center for teaching and diffusing the theoretical and quantitative movement in French-speaking Europe (symbolized by a purple star). A team gathered and developed theoretical and quantitative geography in Ottawa thanks to Hugues Morrisette, the director of the department of geography. This team was composed of Jean-Bernard Racine, who had recently arrived from Sherbrooke, then Henri Reymond who joined him in 1970, and local students. It is in Ottawa that Jean-Bernard Racine continued his exploration of American New Geography and notably of theoretical and quantitative geography, as he went to meet **on several occasions** the main stakeholders of this new geography to then develop it in Ottawa.

56 Why did the department of geography in Ottawa, located very close to French-speaking Quebec and from English-speaking United-States, play this essential role in the adoption of theoretical and quantitative geography by French-speaking Europeans?

57 First of all, the French and the Quebecers have a long history of relations, Raoul Blanchard and Pierre Deffontaines having led the creation of Quebecois geography; there have also been numerous cultural exchanges between the two territories in the 1960s.

58 Yet, during these same decades, Quebec was a complex interface in regard to the field of new geography. Although Quebecers are established near the United-States and near the most active centers of the quantitative revolution, such as the University of Chicago or Northwestern University, they perceived a strong language barrier and rejected the linguistic imperialism of English. In comparison to English-speaking Canadians, they vacillated between their demand for recognition, or even independence, and their desire for modernity. **In the end**, the diffusion of the quantitative revolution in Canada was

done by the means of language and concerned English-speaking Canadians first. It was only after 1969 that the first courses in quantitative geography were taught in Montreal and Laval.

59 As early as the beginning of the 1960s, the United-States and Canada thus had **close** cross-border scientific relations. This can explain why it was Ian Burton, a Canadian geographer from the University of Toronto, who completed the renowned manifesto entitled "Quantitative revolution and theoretical geography" in 1963.

60 **Neighboring and mainly English-speaking**, Canada could rapidly receive the wave of innovation. As a member of the Commonwealth, the country could also continue inheriting English influences (although probably to a lesser extent then French influences in Quebec), especially as it was often geographers of British origin who cultivated American quantifiers These researchers were part of the massive brain drain to the United-States as early as the 1950s, before moving around during their university careers.

61 One of the negative critics of J.-B. Racine's thesis project in 1965, Brian Berry, was a neighboring university professor as he taught at the University of Chicago at the time, not far from Quebec. He had started his career in the *space cadets* of the University of Washington in Seattle, before settling for good in Harvard in 1973.

62 From an academic point of view, the only place where a certain fusion seemingly happened is the bilingual University of Ottawa where some geographers trained in Quebec, such as Hughes Morrissette, director of the department of geography at the time, tried to integrate both trends and where French-speaking and English-speaking students interacted.

63 It was thus in the **bilingual** university of the capital of Canada that the active and intense adoption of the movement was made possible for many French geographers, as it was **an interface on several levels, a buffer zone between the Canadian communities, a link between the United-States and Canada**: **neighbor to the United-States and to the main center of quantifiers in the Middle West** on one hand, and to Quebec which welcomed many French researchers on the other. **In the French-speaking European community**, modernizers continued to diffuse the new Anglo-American New Geography. We can mention two examples:

64 Firstly, Philippe Pinchemel, based in Paris, initiated the French translation of two main books on spatial analysis by Peter Haggett and Brian Berry.

65 Secondly, Paul Claval opened his library in Besançon to young geographers eager for disciplinary renewal. For instance, on the recommendations of Philippe Pinchemel, Maire-Claire Robic and Denise Pumain went back and forth between Paris and Besançon in the early 1970s to acquaint with Anglo-American geography.

66 During this last stage in the origins of the movement, movements and exchanges became more systematic between French-speaking Europe and North-America. Bernard Marchand, for example, left to Berkeley for a year and discovered quantitative methods there. When he came back, he taught the first course in quantitative geography in Paris, as requested by Philippe Pinchemel. Nevertheless, it was still with Quebec that exchanges flourished the most, as was the case with Sylvie Rimbert who taught several times in Ottawa.

67 During this period, novelty spawned from young Canadian geographers from Quebec mostly, who **left for good to go to France** to develop academic quantitative methods and

to assist modernizers. This was the case for Guy Lemay, a student from Ottawa who went to Reims to work with Roger Brunet.

68 Finally, during this period, **embryonic groups** of French or French-speaking European geographers emerged and tried to introduce "new geography" in research and teaching. This was the case in Paris with a group constituted around Philippe Pinchemel, in Strasbourg with Sylvie Rimbert, in Besançon with Jean-Claude Wieber, in Grenoble with Charles-Pierre Péguy and in Reims with Roger Brunet.

69 Three significant elements structure this last phase: 1. the appearance and the development of a Canadian center: Ottawa as a key university for the training and the diffusion of the movement in French-speaking Europe, 2. Movements and exchanges henceforth made with both close and distant Anglo-Saxon countries, 3. Embryonic groups of French or French-speaking European geographers who try to introduce "new geography" in research and teaching.

70 Finally, with this cartographic construction elaborated from a corpus of interviews, we were able to detect the stakeholders, the places, the movements and the articulations:

- stakeholders eager to **renew geography** and to take initiatives.
- in **sporadic places of innovation** in terms of theory and mostly methodology: Philippe Pinchemel in Paris, Roger Brunet in Reims, Sylvie Rimbert in Strasbourg, Paul Claval in Besançon and Charles-Pierre Péguy in Grenoble.
- modernizers' **assimilation** of new tendencies in international geography, particularly through **contacts** with individuals or groups located outside the study area, especially in Canada, which is a privileged **interface** between American *new geography* and French geographers and for which **Ottawa** is an ideal **connecting link**.

Conclusion

71 This contribution aimed at participating in the construction of a geographical history of science. We demonstrated the utility of incorporating the following elements within the study of science and especially within the study of a scientific operation:

1. The **spatial logics of development**,
2. The **testimonies of stakeholders (oral history)** on their location and movements.

72 When considering the theoretical and quantitative movement which is our case study, our analysis shows that witnesses experienced and engaged in the emergence of a theoretical and quantitative "movement" that was organized and internalized by French-speaking European geographers in different ways, but that on the whole, whether they were innovators or eager for progress, they saw a gradual change of course in geography. More generally, the 1960s marked the beginning of a very changing context in French-speaking European geography with the emergence of centers of innovation in terms of theory and especially of methodology.

73 However, neither an official collective action in French-speaking Europe nor a program with a core of knowledge that would challenge the French school of classic geography appeared at the time, which are two essential conditions for the existence of a scientific movement (Frickel, Gross, 2005). It is only in the early 1970s that the establishment of a series of collective events led to the emergence of the theoretical and quantitative movement in French-speaking Europe (Cuyala, 2015). It is likely that these various events, which came to be organized regularly over time, were elements that sparked off the

emergence and the development of a movement within a disciplinary field run by the representatives of classical geography.

BIBLIOGRAPHY

Agnew, John A., Livingstone, David N. (dir.) (2011). *The Sage Handbook of Geographical Knowledge*. Londres, Sage Publications.

Barnes, Trevor J. (2008a). "Geography's underworld: The military-industrial complex, mathematical modeling and the quantitative revolution". Geoforum, n. 39, pp. 3-16.

Barnes, Trevor J. (2008b). "Stuck in a mess (agaon): A response to Johnston, Fairbrother, Hayes, Hoare and Jones". Geoforum, n. 39, pp. 1807-1810.

Baron, Myriam (2005). "Les migrations étudiantes dans le système universitaire français au début des années 90". Revue d'Economie Régionale et Urbaine, n. 2, pp. 281-300.

Baudelle, Guy, Ozouf-Marignier, Marie-Vic, Robic, Marie-Claire (dir.) (2001). Géographes en pratiques (1870-1945). Le terrain, le livre, la Cité. Rennes, Presses Universitaires de Rennes.

Bédarida, François (2001). « Le temps présent et l'historiographie contemporaine ». Vingtième Siècle, Revue d'histoire, vol. 69, pp. 153-160.

Berroir, Sandrine, Cattan, Nadine, Saint-Julien, Thérèse (2009). « Les masters en réseau : vers de nouvelles territorialités de l'enseignement supérieur en France ». l'Espace géographique, vol. 38, n. 1, pp. 43-58.

Berthelot, Jean-Michel, Martin, Olivier, Collinet, Cécile (2005). *Savoirs et savants. Les études de la science en France*. Paris, Presses Universitaires de France, coll. Science, histoire et société, 282 p.

Besse, Jean-Marc (2004). « Le lieu en histoire des sciences. Hypothèses pour une approche spatiale du savoir géographique au XVIe siècle ». MEFRIM, vol. 116, pp. 401-422.

Besse, Jean-Marc (2010). « Approches spatiales dans l'histoire des sciences et des arts ». L'Espace géographique, vol. 39, pp. 211-224.

Bourdieu, Pierre (dir.) (1992). La misère du monde. Paris, Seuil.

Bunge, William (1966 [1962]). *Theoretical geography*. Lund, Royal University of Lund.

Burton, Ian (1963). « The Quantitative Revolution and Theoretical Geography ». The Canadian Geographer, vol. 7, pp. 151-162.Chamboredon, Hélène, Pavis, Fabienne, Surdez, Muriel, Willemez, Laurent (1994). « S'imposer aux imposants. À propos de quelques obstacles rencontrés par des sociologues débutants dans la pratique et l'usage de l'entretien ». Genèses, vol. 16, pp. 114–132.

Cauvin, Colette (2007). « Géographie et mathématique statistique, une rencontre d'un nouveau genre ». *La Revue pour l'histoire du CNRS*, n° 18, pp. 15-23.

Clerc, Pascal (2013). *Les espaces du géographique. Acteurs locaux et savoirs coloniaux à Lyon de 1850 à l'entre-deux guerres*. Habilitation à diriger la recherche, Université de Lyon 2.

Cuyala, Sylvain (2015). « L'affirmation de la géographie quantitative française au cœur d'un moment d'ébullition disciplinaire (1972-1984) ». Bulletin de l'Association des Géographes français (BAGF).

Cuyala, Sylvain, Commenges, Hadrien (2014). « Le mouvement de la « géographie théorique et quantitative » en France : quel modèle de diffusion ? ». L'Espace géographique, n. 4, pp. 289-307.

Cuyala, Sylvain (2014). « Analyse spatio-temporelle d'un mouvement scientifique. L'exemple de la géographie théorique et quantitative européenne francophone ». Thèse de doctorat de géographie, Université Paris 1, UMR Géographie-Cités.

Cuyala, Sylvain (2013). « La diffusion de la géographie théorique et quantitative européenne francophone d'après les réseaux de communication aux colloques européens (1978 – 2011) ». Cybergeo, European Journal of Geography.

Descamps, Florence, Weber, Florence, Müller, Bertrand (2006). « Archives orales et entretiens ethnographiques ». Genèses, vol. 62, pp. 93–109.

Descamps, Florence (2005 [2001]). L'historien, l'archiviste et le magnétophone : de la constitution de la source orale à son exploitation. Paris, Ministère de l'économie des finances et de l'industrie, Comité pour l'histoire économique et financière, Ministère de l'économie, des finances et de l'industrie.

Eckert, Denis, Baron, Myriam (2013). « Construire une géographie de la science ». *M@ppemonde*, n. 110.

Eckert, Denis, Baron, Myriam, Jégou, Laurent (2013). « Les villes et la science : apports de la spatialisation des données bibliométriques mondiales ». M@ppemonde, n. 110.

Frickel, Scott, Gross, Neil (2005). "A General Theory of Scientific/Intellectual Movements". American Sociological Review, vol. 70, n. 2, pp. 204-232.

Gould, Peter (1968). "The new geography: where the action is". Harper's Magazine.

Hägerstrand, Torsten (1953). *Innovationsförloppet ur korologisk synpunkt*. Lund, C. Bloms boktryckeri [traduction par Haag, Greta (1967). *Innovation Diffusion as a Spatial Process*. Chicago, Chicago University Press].

Haggett, Peter (1990). *The Geographer's Art*. Oxford, Blackwell.

Jacob, Christian (dir.) (2007). *Lieux de savoir. 1. Espaces et communautés*. Paris, Albin Michel.

Johnston, Ron J., Fairbrother, Malcolm, Hayes, David, Hoare, Tony, Jones, Kelvyn (2008). « The Cold War and geography's quantitative revolution ; Some messy reflections on Barnes' geographical underworld ». Geoforum, n. 39, pp. 1802-1806.

Levy, Rachel, Sibertin-Blanc, Mariette, Jégou, Laurent (2013). « La production scientifique universitaire dans les villes françaises petites et moyennes (1980-2009) ». M@ppemonde, n. 110.

Livingstone, David N. (1995). « The spaces of knowledge: contributions toward a historical geography of science ». Environment and planning. Society and space, pp. 13-42.

Livingstone, David N. (2003). *Putting Science in Its Place: Geographies of Scientific Knowledge*. Chicago, University of Chicago Press.

Livingstone, David N., Withers, Charles W.J. (dir.) (2011). *Geographies of Nineteenth-Century Science*, Chicago, University of Chicago Press.

Maisonobe, Marion (2013). « Diffusion et structuration spatial d'une question de recherche en biologie moléculaire ». M@ppemonde, n. 110.

Martin, Olivier (2005 [2000]). *Sociologie des sciences*. Paris, Armand Colin, coll. 128.

Matthiessen, Christian Wichmann, Winkel Schwarz, Annette, Find, Soren (2002). "The Top-Level Global Research System, 1997-99: Centres, Networks and Nodality. An analysis Based on Bibliometrics Indicators". *Urban Studies*, vol. 39, n°5-6, pp. 903-927.

Matthiessen, Christian Wichmann, Winkel Schwarz, Annette, Find, Soren (2010). "World Cities of Scientific Knowledge: Systems, Networks and Potential Dynamics. An Analysis Based on Bibliometric Indicators". *Urban Studies*, vol. 39, n°5-6, pp. 903-927.

Orain, Olivier (2009). *De plain-pied dans le monde. Ecriture et réalisme dans la géographie française au XXe siècle*. Paris, L'Harmattan, coll. Histoire des sciences humaines, 427 p.

Ponds, Roderik, Van Oort, Frank, Frenken, Koen (2007). "The geographical and institutional proximity of research collaboration". *Regional Science*, Vol. 86, pp. 423-443.

Pumain, Denise, Robic, Marie-Claire (2002). « Le rôle des mathématiques dans une « révolution » théorique et quantitative : la géographie française depuis les années 1970 ». *Revue d'histoire des sciences humaines*, 6, pp. 123-144.

Reis Junior, Dante F. (2012). "Desacato aos papas: uma historiografia da geografia teorética francesa (parte um)". Geografia, Vol. 37, n. 3, pp. 343-365.

Reis Junior, Dante F. (2013). "Desacato aos papas: uma historiografia da geografia teorética francesa (parte dois)". Geografia, Vol. 38, n. 1, pp. 5-36.

Robic, Marie-Claire (2013). « Connaître son Monde ». Terra Brasilis (Nova Série) [Online], 2.

Serres, Michel (dir.) (2003 [1989]). *Éléments d'histoire des sciences*. Paris, Bordas.

Whitehand, Jeremy W.R. (1970). "Innovation Diffusion in an Academic Discipline: The Case of the 'New' Geography". AREA, Vol. 2, n. 3, pp. 19-30.

Whitehand, Jeremy W.R. (1971). "In-Words Outwards: The Diffusion of the 'New' Geography, 1968-70". AREA, vol. 3, n. 3, pp. 158-163.

Withers, Charles W.J. (2002). "The geography of scientific knowledge". Dans Rupke, Nicolaas (dir.). *Göttingen and the development of the natural sciences*. Göttingen, Wallstein Verlag, pp. 9-18.

Withers, Charles W.J. (2007). *Placing the Enlightenment: Thinking Geographically about the Age of Reason*. Chicago, Londres, University of Chicago Press.

Withers, Charles W.J. (2009). "Place and the "spatial turn" in geography and history". *Journal of the History of Ideas*. vol. 70, n. 4, pp. 637-658.

NOTES

1. During this period, other authors, mainly Anglo-Americans, also took interest in this issue, as noted by J.-M. Besse (2010): Sophir, Shapin, 1991; Shapin, 1995; Livinstone, 1995; Smith, Agar (dir.), 1998; Galison, Thompson (dir.), 1999; Gregory, 2000; Withers, 2002; Dierig, 2003; Naylor, 2005; Raj, 2007; Powell, 2007.

2. He had already published a programmatic article in 2004 entitled "Place in the history of science. Hypotheses for a spatial approach to XVIth century geographical knowledge", (MEFRIM, volume 116, p. 401-422), in a medium with a restricted readership amongst geographers, especially French geographers.

3. However, it is with deep regret that some of them have passed away: Hubert Beguin (Louvain-la-Neuve), Jean-Claude Wieber and Jean-Philippe Massonie (Besançon), René Grosso (Avignon), Jean-Luc Bonnefoy (Aix-en-Provence) or Michel Vigouroux (Montpellier), amongst others.
4. One of the witnesses we met declared: "I don't understand that some people write about our common history without coming to meet us!" (Roger Brunet, interview, 5/04/2012).

ABSTRACTS

This article presents a mapping of the making of a scientific movement built upon the records of its stakeholders, by using an interdisciplinary approach that mobilizes the general theory of a scientific or intellectual movement (Frickel, Gross, 2005), the history of the present moment (Bédarida, 2001) and a spatial analysis approach. This work belongs to the discipline of "geography of science". We were able to identify the stakeholders, the places, the movements and the connections that led to the birth of a scientific movement. We suggest splitting the origins of French-speaking European theoretical and quantitative geography into three periods: disjointed places (1945-1960), beginnings (1960-1968) and crystallization (1968-1972).

Mobilizando uma abordagem interdisciplinar que conjuga a teoria geral de um movimento científico ou intelectual (Frickel, Gross, 2005), a história do tempo presente (Bédarida, 2001) e uma aproximação da análise espacial, este artigo propõem uma apresentação cartográfica da pré-história de um movimento científico, construída a partir da memória dos atores deste movimento. Este trabalho se inscreve, assim, em uma "geografia da ciência" que permite detectar os atores, os lugares, a circulação e as interfaces que conduzem ao nascimento de um movimento científico. Ele propõem, ademais, uma periodização das origens da geografia teorética e quantitativa europeia e francófona em três momentos: lugares desconexos (1945-1960), premissas (1960-1968) e cristalização (1968-1972).

Siguiendo una aproximación interdisciplinar que tiene en cuenta la teoría general de un movimiento científico o intelectual (Frickel, Gross, 2005), la historia del momento presente (Bédarida, 2001) y el enfoque del análisis espacial, este artículo propone un cartografiado de la prehistoria de un movimiento científico construido a través de la memoria de los actores de ese movimiento. Enmarcado en la disciplina de la "geografía de la ciencia", este trabajo permite identificar los actores, los lugares, las circulaciones y las conexiones que lideraron el nacimiento de un movimiento científico y propone la escisión de los orígenes de la geografía teórica y cuantitativa europea francófona en tres períodos: algunos lugares desconectados (1945-1960), surgimiento (1960-1968) y cristalización (1968-1972).

Dans une démarche interdisciplinaire mobilisant la théorie générale d'un mouvement scientifique ou intellectuel (Frickel, Gross, 2005), l'histoire du temps présent (Bédarida, 2001) et une approche d'analyse spatiale, cet article propose une cartographie de la préhistoire d'un mouvement scientifique construite à partir de la mémoire des acteurs de ce mouvement. Ce travail inscrit en géographie de la science permet de détecter des acteurs, des lieux, des circulations et des interfaces menant à la naissance d'un mouvement scientifique et propose de scinder les origines de la géographie théorique et quantitative européenne francophone en trois moments : quelques lieux disjoints (1945-1960), prémices (1960-1968) et cristallisations (1968-1972).

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