

## **Part II    Mapping Cities: Lyon and Barcelona as case studies**

## Lyons, the spatial analysis of a city in the 17<sup>th</sup> and 18<sup>th</sup> centuries. Locating and crossing data in a GIS built from written sources.

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**Abstract** The Lyons historical GIS was developed from the end of the 1990s. Its aim was to reach a new understanding of the transformation of urban and social spaces by spatializing data at the buildings' scale. We thought that by such a jump in precision of a factor 100, from a subdivision by 36 quarters to one by 3,500 buildings in the modern period, the mapping would lead to new perspectives and results in urban history. This involved working through two centuries of numerous and heavy archival records, taxes registers, censuses, building permits, property changes..., each record comprising generally between 3,500 and 8,000 entries, in order to create critically researched data bases followed by vector GIS layers. This required developing a method to reveal the implicit spatiality of these written sources, and to establish a mapping topography, allowed by a careful and geometrically checked reconstruction of the city's plot pattern together with its variation before 1800, with the help of numerous archival maps. It was also necessary to take into account the space transformation, studied at the actual scale of individual investments, owing to the building permits checked with the still extant constructions, and the administrative record. The changing built-up and social spaces are a constant preoccupation in our work. In short, understanding this process of change is absolutely necessary to analyze a situation at a given date, and its significance at different time scales in itself. This paper describes the way we achieved the intended goal, working together as a geographer who was also an historian, and an historian who became geographer. It develops some results and draws the research lines on which the work is in progress, or still to be done. One very interesting as-

pect of the method is that, once the historical address system has been established, in attributing successive owners to the same building, many sources become ‘spatializable’, including non-serial ones, and so deliver new historical insights.

## Introduction

The Lyons historical GIS was conceived in the late 1990s in order to use some still unexploited archival sources, notably the building permits given by the city administration, the Consulat, from 1600 to 1763 (Gauthiez and Zeller 2006; Gauthiez and Zeller 2009). This source constitutes a continuous series of about 8,000 acts, including about 2,535 complete reconstructions or new constructions and 840 raisings of either one or two floors. The rest are façade modifications, placing or removing of windows and doors, and water mains authorizations, together with urban signs<sup>1</sup>. This project had a primary goal: to map the evolution of the city at the scale of its elementary elements, in other words the ‘quanta’ of modifications, i.e. each new building, new story added, façade modification, and to see what this mapping could add to the understanding of the transforming city space. This transformation is not continuous, but is due to the multiplication of these tiny changes, in some cases according to relatively large schemes and planned developments whereas the identification of these schemes is another matter for investigation.

Another goal, only possible if the preliminaries for the first one were fulfilled, was to construct a cartography of the city on the base of each building or plot.

This project was extremely challenging as no vector plan of the pre-1800 period existed, and as the building permits were given only according to a proprietor, and indicated only a street location, without a proper address system, which was not developed until 1790 at Lyons. So it was necessary to reconstruct a precise topography of the city, and to try to build an address system from written records, based on the successive proprietors.

The project has by now been largely implemented, as about 2,280 (90% of 2,535) of the new constructions and 680 (80% of 840) of the raisings have been accurately mapped. But, to reach the initial goal, it was necessary to develop a completely new method, or, to say the least, to explain it, as some hand-working erudite scholars had already followed on along that path (Boudon and al. 1977, Claval and Claval 1986). Working in such a way, new, often unexpected fields were opened, which we are still trying to investigate thoroughly.

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<sup>1</sup> Lyons Municipal Archive (hence LMA), DD series registers.

## Building the GIS

### *Topographical basis*

To build the topographical basis, the following method has been developed (Schattī and Viaccoz de Noyers 2005; Gauthiez 2008; Gregory 2003; Gregory 2007):

First step: drawing a vector plan of the city based on the first cadastral plan of 1830-31, correcting its geometry in order to make the same objects correspond exactly with their present locations (georeferencing and rubber-sheathing are clearly not the right method). Three main layers were drawn: plots, buildings, other topographical features such as the bridges, river banks, stairs, etc.

Second step: based on this plan, and using more than 300 partial 18<sup>th</sup> century maps of the city<sup>2</sup>, such as seigneurie plans, a vector plan of Lyons c. 1745 was established on the same topographical basis, also in three layers<sup>3</sup>.

### *Address system*

The sources allowed for only one possible comprehensive address system, i.e. the mapping of the successive proprietors of the buildings, as this record is the only more or less complete one that can be found in the archives. We were lucky as housing in Lyons was already largely pluri-familial in the 16<sup>th</sup> century, and not mono-familial as was generally the case in northern Europe, so we had to deal with a relatively small number of buildings, about 3,500<sup>4</sup>. Two complementary methods have been used to achieve success with the mapping process:

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<sup>2</sup> For example LMA 2 S 26, *Atlas de la rente noble de l'archevêché*; Archives Départementales du Rhône (hence ADR) 10 G 2338, St-Jean chapter; ADR 15 G 188, St-Nizier chapter.

<sup>3</sup> This plan was first drawn by hand in the early 1990s (Gauthiez B (1993) *Lyons, formation et évolution d'un espace urbain, 1.- cartographie du site et Moyen-Âge*. Ecole Nationale Supérieure d'Architecture de Lyon, Vaulx-en-Velin). It was vectorized and its geometry corrected in the mid 2000s.

<sup>4</sup> This peculiar aspect of the building pattern in Lyons has to be explained. It developed in a first phase in the early 16<sup>th</sup> century, and became dominant from the 1640s. It implies that average financing units emerged from a capitalistic development, and a dwelling pattern adapted to the low wages of the silk industry, on which the city's wealth was based, in fact the wealth was confined to only a small part of the population, notably the *marchands-fabricants*. In contrast, the average early 17<sup>th</sup> century building looks like raised houses, which they often were. In the course of time, the proportion of low incomes passed 80% and the wealth became concentrated (Garden 1970), as a consequence, whilst the average building grew in size, the average number of new construc-

- From the 1830-31 cadastre, and using the numeration system (even and odd numbers) established c. 1810, it was possible to map the proprietors in 1814-15, known from this year's census<sup>5</sup>. The first complete census was in 1808, but the numeration system was different at that time (this system was in use from 1790 to c. 1810). As the owners are very often the same in 1808 as in 1814, it was possible to map 1808 by keeping the names where they were documented at both dates, and by filling the gaps from the 1808 census, whose houses are numbered in numerical order (1, 2, 3... 148, for example) for each quarter<sup>6</sup>.
- The second phase involved the use of the listing order of the older tax documents to reconstruct the space order of the proprietries in the actual built up streets. It has been possible to prove that this registering order had been quite stable through the 18<sup>th</sup> century, even from the mid 17<sup>th</sup>, with only limited variations of the tax agent's route (Gauthiez and Zeller 2010). When compared to the 1808 census made according to numerated buildings, and as some 30% of the proprietors are the same, the route and proprietors in 1789 given in the 20<sup>th</sup> (*Vingtième*) tax list can be reconstituted with a fair degree of certainty<sup>7</sup>. The 20<sup>th</sup> tax list in 1766 can be mapped rather easily thanks to a very high proportion of common proprietors compared to 1789, and so on. Unfortunately, the series of remaining sources (the identified ones, as some unexplored archives may reveal new ones) make it impossible to go earlier through time when using this tax record, but other sources can be very useful for earlier dates. The lantern tax list of 1698 has been mapped by using the *Règlement Général d'Alignement* of 1680<sup>8</sup>, a text giving street by street the line of the façades to be respected if a building were to be reconstructed, and which mentioned nearly all the angle houses proprietors, i.e. about 800<sup>9</sup>. From this source and the unfortu-

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tions decreased accordingly. The concentration of real estate and economic wealth was extreme in 1789. For Paris, see Cabestan 1997.

As a consequence of the growing size of the new buildings, their increased number of floors up to seven, and of the grouping of 2-3 previous plots to build them, the built-up area at Lyons expanded by about 30% between 1600 and 1789, although the population had more than tripled, from c. 40,000 to c. 150,000 inhabitants.

<sup>5</sup> LMA 921 WP 023-025.

<sup>6</sup> LMA 921 WP 005-010. The numeration system established in 1790 is an evolution of the previous one, determining a lesser number of quarters and attributing the number to a given building, rather than to the order place of a proprietor.

<sup>7</sup> The 20<sup>th</sup> tax is annual and based on 1/20<sup>th</sup> of the rent value of a property, generally a single building, but sometimes a group, or a part of a single building. As the annual rent value is about 1/20<sup>th</sup> of the real estate value of the building, the 20<sup>th</sup> tax amount equals more or less 1/400<sup>th</sup> of the total value of the building (or group of them, or part of it).

<sup>8</sup> LMA DD 56.

<sup>9</sup> The *Consulat* decided in 1698 to establish a public street lighting system, which was financed by a tax based on the building's value, LMA FF 0754-0755. The 1680 *Règlement Général d'alignement* is a by-law adopted in December 1680, to determine for all streets and squares the

nately partial list established in 1677 for a city loan, it is possible to redraw the sequences of the route of the tax agent<sup>10</sup>.

These reconstructed proprietors' locations, fairly reliable for 1814, 1808, 1789<sup>11</sup>, 1766<sup>12</sup>, 1698<sup>13</sup> and 1677 (when the data is available)<sup>14</sup>, can be extended, but only partially, in conjunction with other partial sources, for example 1744, 1723, 1636. The system can be in fact strengthened by the location of the building permits. Once a permit can be located according to the name of the proprietor involved, its neighbors, generally mentioned in the deed according to North, South, East and West, can be also easily located, and so give some new proprietors' names. This is of great importance as more than 50 percent of the rebuildings and façade modifications were carried out by a series of neighbors.

These locations can be matched to the still extant 17<sup>th</sup> and 18<sup>th</sup> century buildings, one third of the constructions erected, and documented in another vector layer in the GIS<sup>15</sup>. The iconography, despite being rather thin, can also be of some help<sup>16</sup>.

Each source forms a particular layer which can be matched with the other ones to cross data. The description and approximate dating of the buildings using art history methods, including the survey of urban signs and of the proprietor's initials which are often placed over the main door, constitutes another very useful layer.

Years of mapping and crossing the available information from many sources have led to a rather secure system of location of the proprietors, and thus of a secure location of the building permits. The certainty is more or less total for the central streets, which are more documented, and where many buildings are still extant. The locations in the areas that have disappeared and along the longer streets (Grande Côte, Pierre-Scize street running more than one kilometer) where the sequences of proprietors may shift, retain generally some uncertainty, for example a location can be displaced to the neighboring plot according to new information. It seems that the city was administered quite conscientiously, as the build-

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façade lines each new building had to respect. Its goal was to regularize the street width in a context of rapidly growing traffic, and to organize the embellishment of the city.

<sup>10</sup> The *Consulat* went bankrupt in 1677. Among various measures, it was decided to impose a loan on all the rich people in the city. An inquiry followed in every quarter, but half of the results are unfortunately lacking, LMA CC 4187. The mapping of the wealth in the city, despite being partial, is quite interesting.

<sup>11</sup> LMA 3 C 52.

<sup>12</sup> LMA 2 II 160.

<sup>13</sup> LMA FF 0754-0755.

<sup>14</sup> LMA CC 4187.

<sup>15</sup> Many still extant buildings also bear the initials of the owner's name, placed in wrought iron over the main door. Some rare dates are still in existence. This was made by undertaking a field survey.

<sup>16</sup> But it tends to nearly always represent the same places. And the iconography is somewhat rare at Lyons.

ing permits were, with only a few exceptions, systematically followed on by the actual transformation or construction of a building, and those who tried to escape the authorization, or simply ignored its necessity, were fined. Some had even to demolish what had been erected without authorization, or to rebuild according to a different façade line, which was indeed quite expensive. Few areas are a little less informed, mainly the St-Jean Cathedral area, where the jurisdiction of the chapter made the canons master of the building permits, and for which the record is not complete, and the area of the fortifications where the military administration had the jurisdiction, whose record seems to be lost.

From this rather burdensome work, which was only made possible by searching through many important archival sources with each one set up in a database and then a vector layer associated to a database<sup>17</sup>, a new world of urban history comes alight.

Here are some examples of the new horizons now opened.

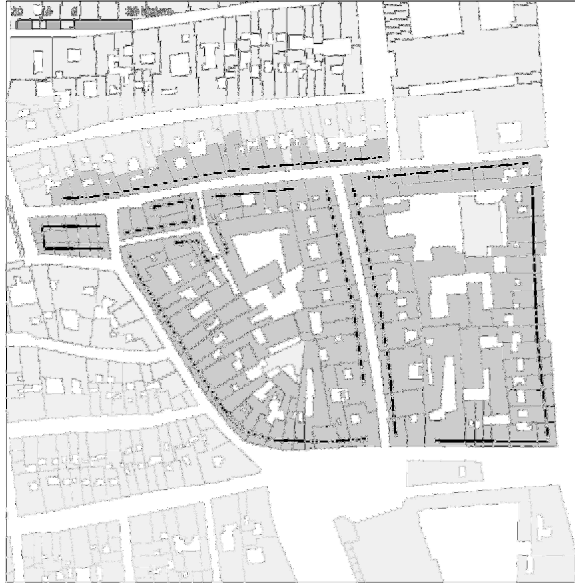
### *The routes of the administrative and tax agents*



**Fig. 1.** Route of the administrative agent, Lyons, *quartier* St-Pierre, 1677.

A case of a complicated route, explained by the passing from door to door between the two sides of a same street. (B. Gauthiez©2013)

<sup>17</sup> The obvious method would be to make a 'juncture' between a layer of polygons and a database, but, as the lines in the tax database do not systematically correspond to a single building, but sometimes also to a part of one or a group of them, each line has to be reexamined. For instance, the 1789 20<sup>th</sup> tax documents list 3,821 entries, but only 3,431 buildings existed in 1786 (Brac 1787).



**Fig. . 2:** Route of the administrative agent, Lyons, *quartier* Cordeliers, 1677.

An example of a rationalized route, examining the properties going around the same block, one at a time. (B. Gauthiez©2013)

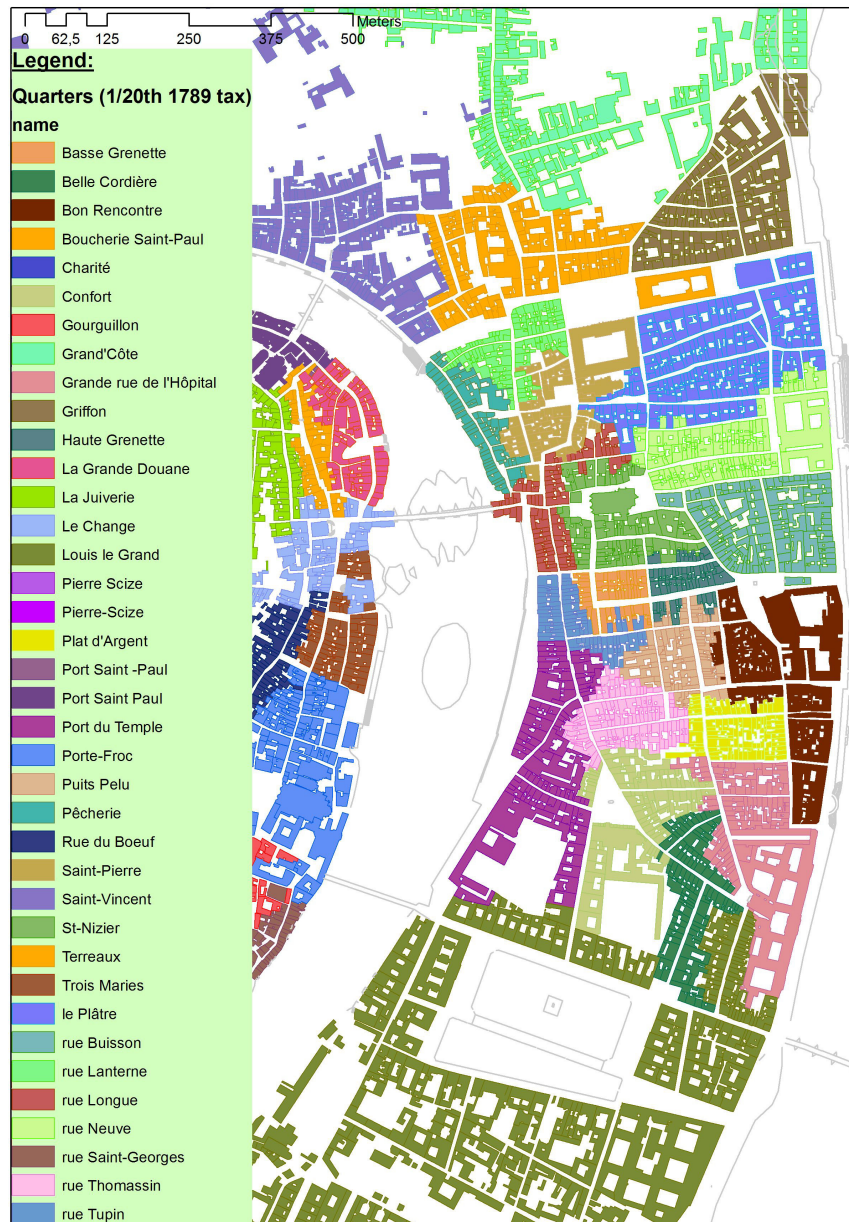
This reveals how space was surveyed when no plans were used, according various route determinations. The way each one of the 36 *quartiers* (or *pennons*) of the city was surveyed is very varied (Gauthiez and Zeller 2010)<sup>18</sup> (Fig. 1, Fig. 2). This implies that each quarter administration had to determine its own way to list the proprietors at some moment in time (probably in the early 16<sup>th</sup> century). The route followed by the tax agent was very stable and subject only to small modifications. This became also the base for the progressive introduction of a numbering system from 1723. But, if the route was exactly the same in 1766 and 1789, the number of a given building was shifting as it was first of all the number of a given property in a list.

The reconstruction of the agents' routes allowed for a precise mapping of the quarters as each property is part of a given one, and its evolution (Fig. 3). So it opens a new window on the administration's history. This allows for all the mapping subsequently evoked.

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<sup>18</sup> The number of pennons varied slightly through time, but the central ones remained constant. Their limits also varied slightly.



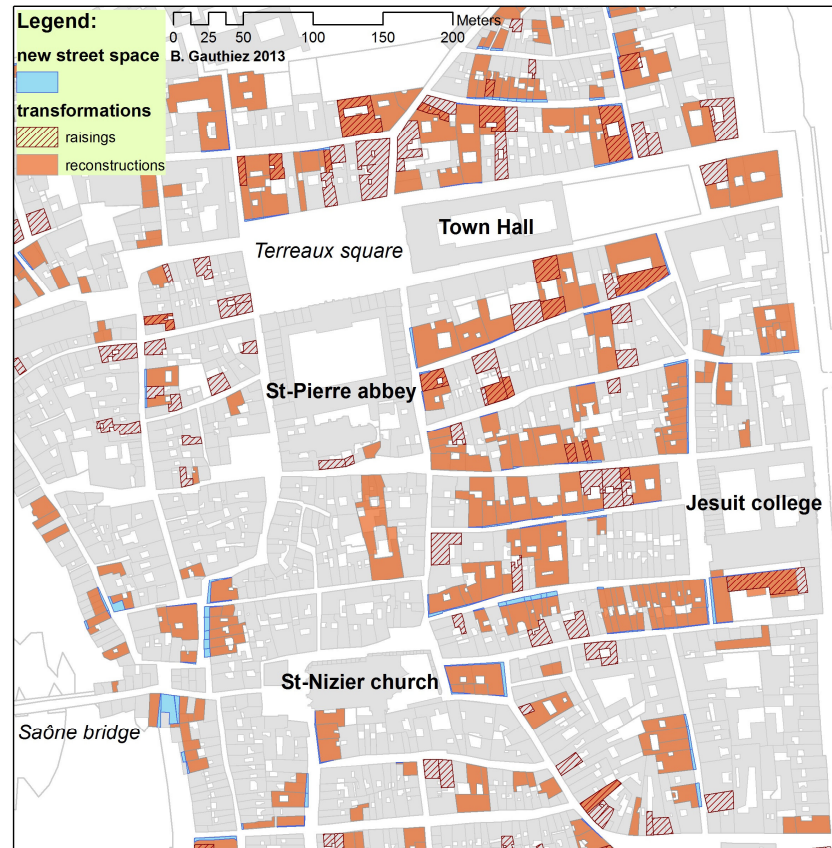


**Fig. 3.** The map of the Lyons central quarters in 1789, from the 20<sup>th</sup> tax. (B. Gauthiez©2013)

### *Mapping the building permits*

As these were made according to objects which were the results of retraceable social processes (Gauthiez 2004), this enables the reconstruction of the film of the urban fabric transformation and leads to questioning its logics: location, social milieus, and uses when crossed with economic data. The film of the building investment highlights the periods and places of higher and lower intensity. It also discloses some scale effects previously not referred to, especially the way the new buildings follow a 'chain' pattern, i.e. very often. When one was replaced, the neighboring houses were also rebuilt, or at least renewed in the subsequent years. This process was certainly encouraged by the Consulat administration, as many places affected by this process were streets to be widened and/or embellished. This process concerns probably more than 50% of the new constructions. Another effect of the rebuildings was made obvious by mapping the widening of the streets on account of the obligation to place the new façade backwards, in order to gain from one to more than 10 feet (0.3 to more than 3 m) of street width (Fig. 4). The Consulat street policy was constant and very efficient in that respect. The general street widening was in response to the increasing traffic of coaches and carriages, and was also intended to ease the traffic jams. This change took place in the early 17<sup>th</sup> century and became common from the 1660s. It probably signifies a great change in the way commercial goods were carried, using previously principally mules and horses then more and more carriages, including heavy ones. It is probably a major step towards the Industrial Revolution. Lyons developed very early as a great industrial city. This change had not previously been noticed.

This mapping is clearly very efficient for determining and interpreting the planning policy of the municipality (Gauthiez and Zeller 2013).



**Fig. 4.** Cartography of all the constructions and raisings in the centre of Lyons between 1698 and 1763 (match with figures 6 and 7). (B. Gauthiez©2013)

The map shows in blue a concentration of new constructions (the raisings are hatched) between St-Nizier church and the Hôtel de Ville, where the land value grew steadily during this period. This concentration contrasts with a sparser renewal elsewhere in the area. The red spaces indicate the street widening operated during the same period and the opening of the quay on the Saône bridge extremity in 1719.

### *Location of the weaving looms in 1744 and 1833*

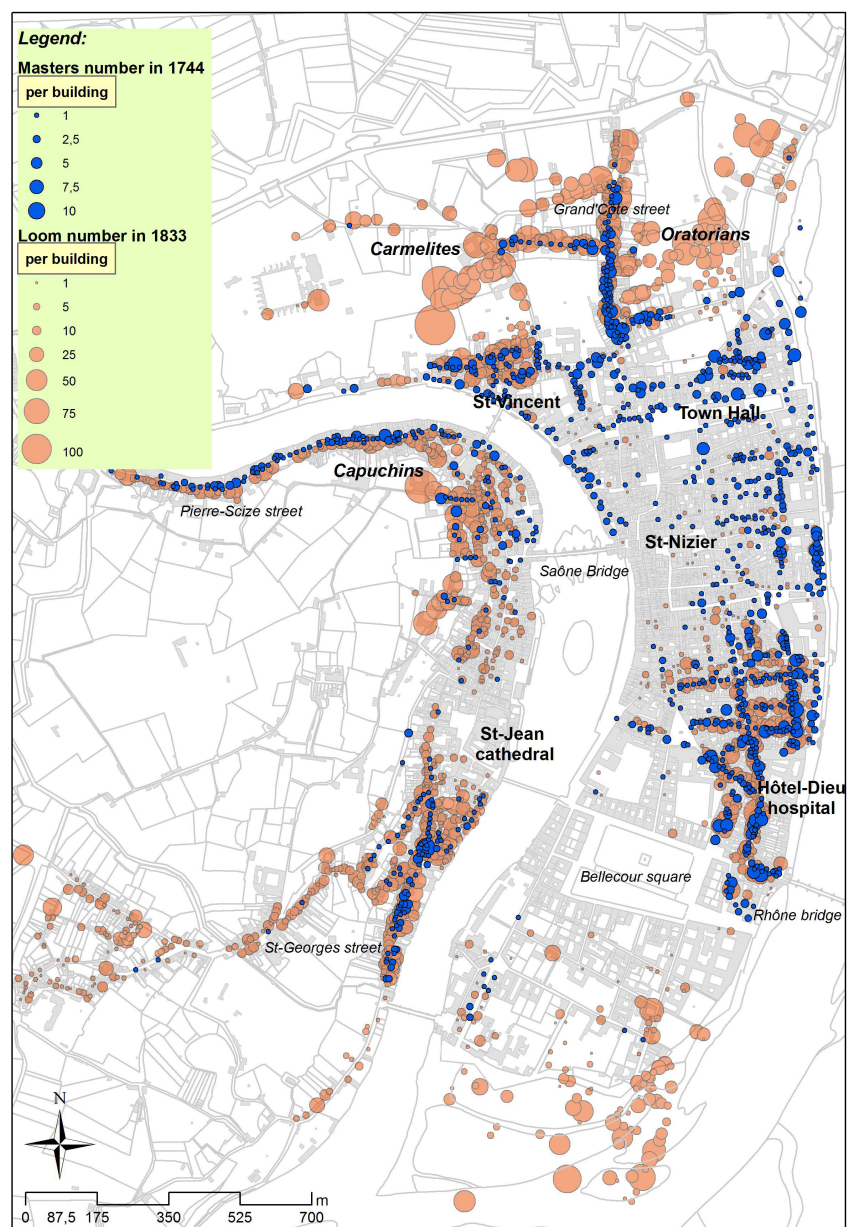
From the 17<sup>th</sup> century Lyons, a great industrial city whose economy was based on the silk industry, experienced several social upheavals, the most important one in the modern period being the 1744 revolt (Zeller 1990). This revolt led to several decisions of a mainly political nature. The police quarters' division was reorgan-

ized in 1746<sup>19</sup>, the Consulat was also reorganized, and a register of the masters and workers of the silk industry (the '*Grande fabrique*') was established in 1745<sup>20</sup>. Its main scope was to gain a better control of this shifting rowdy population, a goal probably only partly achieved, as no police system ensued. We mapped the location of the silk masters in order to have a better understanding of the geography of the silk industry in the city (Fig. 5). The image is striking on two different levels: the masters (and the workers, one worker being generally employed by a master) were generally located in the outskirts of the city, but still present not far from the center (in blue). In the center and the aristocratic areas such as Place Bellecour, neither workers nor loom were present. They were concentrated in the poorest sectors of the city. The 1677 data gives a clue on the progressive displacement of the silk industry from the center, which the map of the weaving looms in 1833 later confirms. This is a *longue durée* trend lasting roughly two centuries, and only clearly apparent on account of mapping. Another unexpected scale is the frequent grouping of the silk masters in particular buildings. This implies that a specialization took place in some buildings, all the more apparent when one crosses the map with the building authorizations. Some buildings were obviously financed and erected to house silk weaving looms and their workers. As no typological adaptation of the buildings appears, this is also only visible thanks to mapping. The way some private investors and the Hôtel-Dieu hospital built houses for silk weaving has still to be investigated. The general view in Lyons's history is that each silk master was working independently, possessing their own weaving looms and operating in their apartments. It is obvious now that the regrouping of the masters was organized and that some buildings were functioning more or less like manufactures, even if their occupants were not wage-earners, and even if they were said free artisans.

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<sup>19</sup> LMA EE 11, LMA 3 S 693.

<sup>20</sup> LMA HH 578.



**Fig. 5.** Cartography of the silk masters in 1745 and of the silk weaving looms in 1833, by building, at Lyons. (B. Gauthiez©2013)

This was all the more obvious in 1833, the first year of a census registering the loom number by building<sup>21</sup>. The information was needed, as in 1745, for another revolt had occurred in 1831, one of the two famous ‘*Canuts*’ revolts (*canut* = a silk worker, in fact also to the many various jobs related to this industry. The second *canuts* revolt took place in 1834). The city center was then also held for some time by the *canuts*. So, in two similar circumstances, the administration reacted, at 90 years’ distance, in a same way, notably by establishing a census, precious for us as it provides previously unknown information.

Between 1745 and 1833, and overall after 1810, the silk industry had spread considerably, following directions already perceptible in 1745: with old linear suburbs to the west, at St-Georges and to the north, and around the Hôtel-Dieu hospital. It had also acquired new areas around the city, to the north, in new developments in religious tenements suppressed during the Revolution such as the Oratorians and the Carmelites where the main concentration of looms was situated in 1833. The same process was also operating at the Capuchins, to the west. On this side of the city, many buildings previously occupied by rich people, merchants and bankers, were now occupied by poor people weaving silk. The balance between the two sides of the Saône river changed, with the west side pauperizing and the east side gentrifying. The tendency to produce adapted buildings to place weaving looms is still clearer in 1833, as some new developments are fully dedicated to the silk industry. For example in Blanc Street, established through the Carmelites convent’s close, all the new buildings, erected from 1827, were occupied by silk weavers. In one of them 139 looms were counted, just a little less than in the nearby “*immeuble aux 400 fenêtres*” (“400 windows building”), with 158 looms. At the Capuchins, the old convent was sheltering some 119 of them. The expression *caserne ouvrière* (workers’ barracks) was sometimes used to describe these concentrations making the buildings appear like manufactures or mills. As the grouping of the silk workers was organized and through the rents quite profitable to investors (with some money coming from silk trade), the official discourse referring to the silk workers as free artisans, and the folklore built up accordingly and still today embellishing their very hard life, seem rather cynical. In 1834, a new revolt exploded, with a more political tone; the city was again occupied and managed by the workers, about 1000 workers and soldiers had died when order was reestablished by the government.

The industrial development, putting aside some central pauperizing, was mainly an outer fringe phenomenon, but some rich areas also developed at the periphery with the St-Clair quarter at the north-east, and around the old Ainay abbey and Bellecour royal square to the south.

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<sup>21</sup> LMA 921 WP 151-158.

## **An example of complex data processing: the land value in 1698, 1766 and 1840**

Establishing the land values is extremely rich in information about the link between social and built up space, mainly in relation with the age of the building and its location pattern, which may reflect economic and/or social polarities.

Its mapping represents therefore a significant breakthrough for our knowledge of the city's history. To achieve such a scope, the method has followed this path:

*First:*

Establish the reality of the built up area at the particular periods of time which correspond to the available serial sources. This has been described in the previous part of this paper.

*Second:*

Calculate the value of the buildings from the sources. This is rather easy, as, the sources being mainly taxes, their amounts are derived from the rent value of the buildings. This means actually calculating the annual income perceived by the owner from the tenants and establishing the tax as a proportion of this income. As the annual income is generally considered as about  $1/20^{\text{th}}$  of the building's value, the amount of the  $1/20^{\text{th}}$  1766 tax, for example, equals  $1/400^{\text{th}}$  of this value. In 1698, the lantern tax amount is  $1/1000^{\text{th}}$  of the building's value, and, in 1840, the municipal census gives the rents of all the dwellings and activities included, which, when totaled, is about  $1/20^{\text{th}}$  of the total value. In this way, it is possible to establish the values of each property, according to consistent valuation in the rent market, in 1698, 1766 and 1840, fortunately at some fairly equal intervals (68 and 74 years). Our investigations in the archival records have given, at the moment, no other source providing this value for the period, except for the years 1789 and 1790.

*Third:*

Calculate the total floor area of the buildings. This is a task involving more incertitude and difficulty. The area of the buildings is ascertainable for the 1830 cadastre maps and earlier documents when available and re-drawn as has been previously described. This area has to be checked according to the reality of existence of the building at the tax's date, which we know from the reconstructions carried out at a later date and for still extant buildings. We know all the buildings extant in 1840, described in the census and very close to the 1830-31 cadastre<sup>22</sup>, but, when we go backwards in time, the number of buildings for which we lack sufficiently precise information increases accordingly. The land value has been calculated as a floor value, i.e. a value per  $\text{m}^2$ , because the height of the building may vary from three to seven stories (or 2 to 6 floors, excluding the ground floor). We have excluded the cellar story(ies). The land value calculated in that way is significant as a comparison value (which does not actually exclude the significance

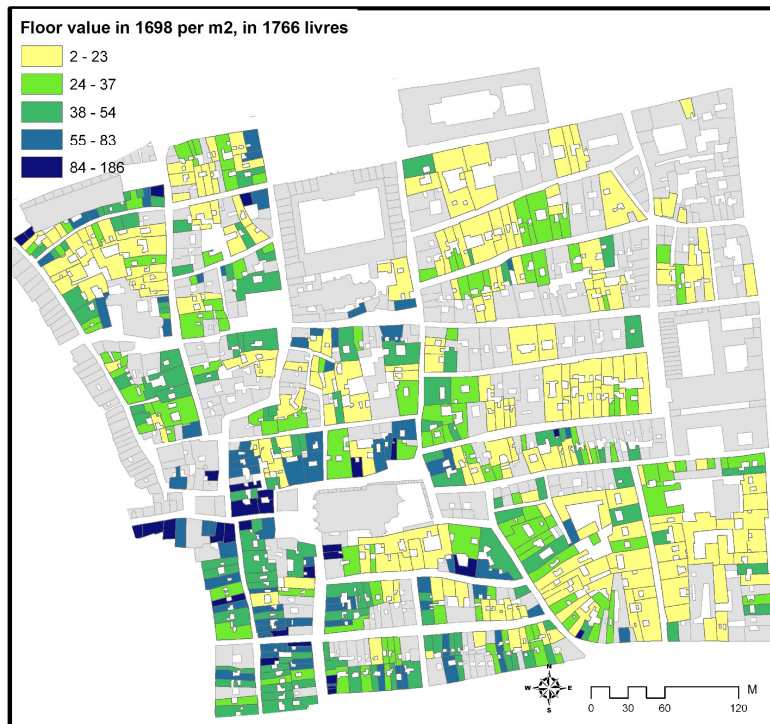
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<sup>22</sup> The exact number of floors can be difficult to define precisely, as the roof can be partly used. This was increasingly the case through the 18<sup>th</sup> and 19<sup>th</sup> centuries, with the addition of roof windows. It was generally a space not used previously, as the roof slope is low.



of a building's value estimated as a whole, which is interesting when considering the estate market and the rebuilding logic). The storey number can be inferred from the 1840 census and is sometimes mentioned in the 18<sup>th</sup> century maps. It had been corrected by using the building permits, when they are authorizations for adding one or two stories.

In such a way, notwithstanding the incertitude due to uncertainties about the actual height and existence of the relevant buildings and calculating the areas including walls and stairs, it has been possible to map the floor values for  $\frac{1}{4}$  of the city of Lyons in 1698, 1766 and 1840. The result produces information about the estate values polarities at a given date, and their dynamic evolution through about one and a half centuries. In the three maps, all the values have been translated into the 1766 *livre* value in order to correct the bias due to the inflation.

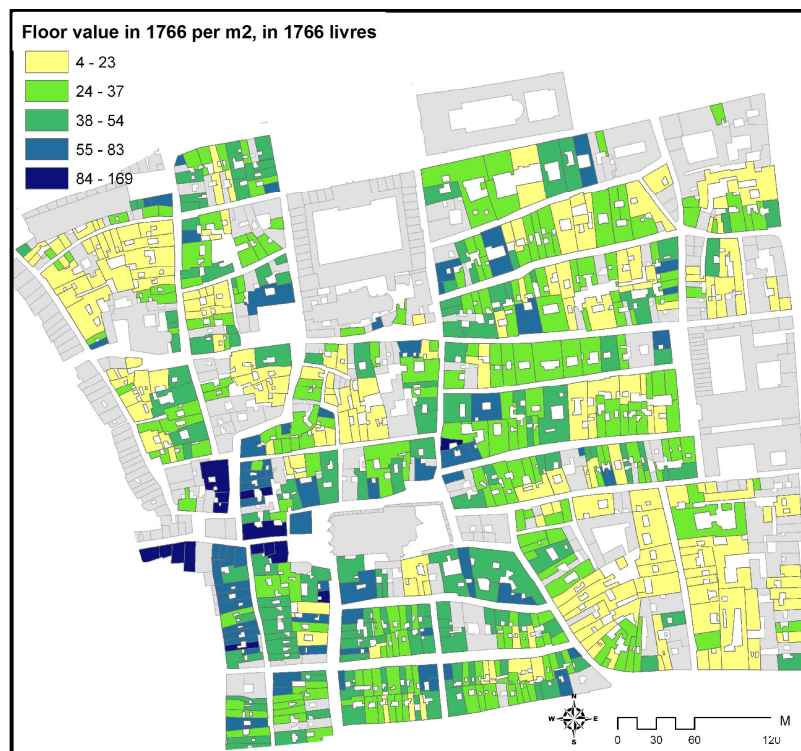


**Fig. 6.** Floor  $m^2$  values in the center of Lyons in 1698 (converted into 1766 *livres*). (B. Gauthiez©2013)

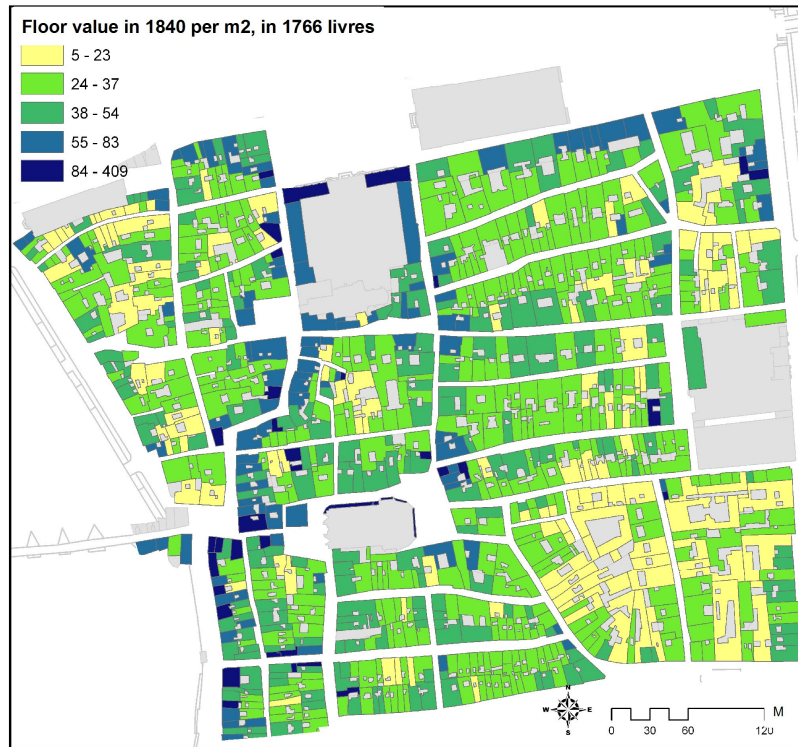
The 1698 values (Fig. 6) show a clear polarity of the highest values around the eastern extremity of the Saône river bridge, an ancient situation, as this bridge had long been the only one crossing the Saône at Lyons. The sector of Mercière Street, to the south of the bridge, was also of high value. This street led to the bridge crossing the Rhône river to the south eastern part of France. The great difference



between the groups of lowest and highest estate values, more than four times in a space of less than two hundred meters, is very striking. The 1766 values (Fig. 7) reproduce the same pattern, but a new area of high value appears between St-Nizier church and the town hall (Hôtel de Ville), more centrally situated, along another street (Clermont Street), and clearly associated to a large renewal of the built up fabric of the quarter, as shown on figure 4. The highest values are also linked to the street widening, particularly around the extremity of the Saône river bridge and the streets running West-East at the center of the figure (Mulet, du Bat-d'Argent, de l'Arbre-Sec, Pizay streets). The 1840 map (**fig. 8**) shows a strong evolution, although the built-up fabric had undergone little change. The middle values are more diffused, but the highest ones are neatly concentrated on a few main streets, one from des Terreaux square to the Saône bridge and southwards to the quay opened in 1719, two, to a lesser degree, situated around the town hall and Clermont Street, which had been already developing. The Grenette quarter (low centre of the figure) was losing some of its value, which means of course some of its former economic importance. One can clearly see the importance of the traffic and of dealing with it by widening the streets and creating improved links. The high values, however, are concentrated in only a few streets.



**Fig. 7.** Floor m<sup>2</sup> values in the center of Lyons in 1766 (into *livres*). (B. Gauthiez©2013)



**Fig. 8.** Floor m<sup>2</sup> values in the center of Lyons in 1840 (converted into 1766 *livres*). (B. Gauthiez©2013)

One should be prudent about the social significance of these values, taken as a whole for each building. Actually, the highest dwelling values are not superimposed on the highest activity values, which can be differentiated only in 1840 (map not shown), thanks to the census, and could be also mapped from the 1790 data used in Gardens's study, but only, at that time, at a non significant scale. As a consequence these maps show mainly the concentration of the high value activities, notably the luxury trades, workshops, and shops. The 1840 census indicates that the new buildings between the town hall and St-Nizier church were principally housing upper class people, because of their large apartments with high rent values, but a value per m<sup>2</sup> not so high on average.

## Perspectives on urban history

### *Rhythms, spaces and the makers of built-up urban fabric and new developments*

Placing the building permits according to the successive proprietors and the informed buildings (still extant or thanks to iconography) makes it possible to identify the more dynamic areas, as an object of gentrification or renewal, and the stagnant ones, growing older because they were not replaced and became lower in value and more pauperized for that reason (Gauthiez 2004). An important transformation can have a big induction effect on their direct neighbors and on their area. This can be due to a public or a religious building, but also to a private one. Some of these looked palatial and were undoubtedly impressive. Investors could act according to familial property holdings logic, by applying micro-scale speculation. Some investors, especially builders and architects, often acted as entrepreneurs, already in the mid-17<sup>th</sup> century, a process more present when they developed, with the aid of the companies they had formed, several new areas in the 18<sup>th</sup> century (Zeller 1995; Gauthiez 1995). But financial aspects were not the only ones, as technical and esthetical aspects of *commoditas* greatly improved and changed in the period, and as symbolical and social status were also factors of transformation, be it by fashion.

### *Mapping rent values*

The *Contrôle des actes* (public register of notarial deeds), an archival record carried from the early 18<sup>th</sup> century, enables the rent values to be mapped for many buildings kept under the regime of *location principale*, which means that a main tenant contracted with the proprietor for the whole building and then sub-contracted with the sub-tenants of the apartments and shops. The total of these secondary rents was generally superior to the contracted primary rent when the main tenant was successful, but sometimes inferior and thus to his detriment. For the previous period, one has to work through partial surveys in the notarial records. The rent variables, age and repair state of the building, comfort level, size and location can then be studied. Information on the social statuses of the dwellers is of great importance. The changing relation between masters and workers, from lodging at one's master's home to owning an apartment accommodating wife and children, contributed to the development of socially segregated areas, especially where the workers could find low rents, in former increasingly derelict suburbs (Pierre-Scize, St-Georges and Grand'Côte streets for example at Lyons). On the *longue durée*, the general trend from 16<sup>th</sup> to 19<sup>th</sup> century is that owners used to live

in their property, then in a neighboring one, then farther and farther away, so the control of the tenants became more and more financial and abstract.

### ***Mapping social space fundamental variables***

Some other perspectives have been pursued: wealth levels, geographical origins, profession specializations, religious minorities, women-led families (especially widows)... But the question of male and female habitats has to be more closely examined, bearing in mind their life course in space (even the vertical space of the stories). It was at least partly socially and professionally conditioned. Mapping at the building scale, health professions, inns and pubs, dangerous, noisy, unrespectable activities, assistance places, will be certainly quite significant, which is also true for control points for commerce and people coming in and out of the city through ports and gates, and for places associated with travel by road and rivers (Rau and Zeller 2007).

### ***Mapping economical activities***

Mapping cities at the scale of quarters or parishes can be also improved by changing scale. Building scale mapping makes it possible to examine in detail how activities are distributed around specialized markets, for instance around slaughtering halls (skinner, butchers, candle makers...), weighing places, ports, colleges, justice halls, book making and selling (paper sellers, printers, writers...). Some specialized zones appear, where particular activities, sometimes in association are located.

### ***Occupation densities***

The diversified use of urban space is linked to the greatly varying rent values, and corresponds to varying densities and incomes, from mono-familial houses in rural looking areas, then built in rows in the suburbs' main axes, to the multi-familial up to 6-7 stories buildings constituting the interior of the city and (at Lyons) where sometimes more than 100 people lived, blending huge apartments for the richest (400 m<sup>2</sup> and more) and mono-room ones of the poorest under the roof (less than 10 m<sup>2</sup>). Censuses make it possible to map two fundamental variables, the number of people living in the same apartment or house, and the cohabitation coefficient (number of households living in the same dwelling unit). It is possible to study the neighborhood at its true scale, according to which measure the members of a formal sociability group, a professional one, or a confraternity, or the mi-

litia men were in the mean time close neighbors. It is also possible to scrutinize the informal social groupings, for example by examining the invitation lists (Zeller 2005). In a similar way, the study of estate patrimonies, from the tiniest to the largest ones, is of prime importance. The paradigm of socially determined behaviors is precisely mirrored by large speculative properties located according the opportunities of the market, patrimonies of artisans, traders and shopkeepers resulting partly from a homo-endogamy, concentrations of nearby buildings linked to a lineage, and the multi-ownership of buildings generally in the poorest areas; all being under the contingency of real estate values.

### ***Socio-spatial relationships and urban geopolitics***

Dwelling densities, neighboring relationship networks, proximity of the other: solidarities, and the conflicts likewise, are in part conditioned by the physical built-up environment. From this one, more curiosity emerges based on the police records: what is tolerated or forbidden in the uses of public space and shared spaces of multi-familial buildings (entrances, corridors, staircases) (Zeller 2005); what is known of the great riots and revolts, in a perspective of staseology contextualizing socially and spatially the transgressions. Obviously, people's reactivity, similar to that of the London mobs, is proportional to the dimensional structure of built-up and public spaces, and to traffic intensity in streets and squares.

Classifying each street according to the value of its bordering buildings and the nature of traffic helps us to understand the way institutional districts (quarters) were drawn. Generally, the quarters at Lyons were not made of assembled blocks, but mainly composed from street sections, connected sometimes to a small square where the militia could regroup. First of all to avoid the development of riots by implementing efficient supervision of the population, and then to repress them more effectively, the militia quarters were drawn in order not to isolate potentially dangerous popular areas. In the *longue durée* of the modern period, strategic modifications took place (Zeller 1990). The study of these changes is greatly facilitated by the use of GIS, as each building is associated to social and economic data on its proprietors and tenants.

### ***Qualitative aspects***

A last possibility examined here is the possibility to confront written literature, travelers' narratives, reports, medical and administrative memoirs, planning decisions, in order to form a precise physical and quantitative knowledge of the city. Visible aspects of the architectural landscape and ambience of the street, smells, sounds, lights, may have conditioned these to be all the more interesting and informative as they are not isolated from reality.

## Conclusion

Being able to locate at the building's scale, dwellings, activities, values, and space uses, opens immense new perspectives of research. Without precise plot and building plans, the social geography studies have remained somewhat crude, closed in a heuristic given, impossible to deconstruct. It was generally possible to process the data only at the parish or quarter scale, according to sources (Michel 1974; Pascal 1994; Junot 1997, Cabantous 1994, etc.). One can object that sometimes the administrative sections are small enough to constitute homogeneous social units, mainly when the spatial segregation was efficient and the dwelling mono-familial, but this is not very frequent, and the heterogeneity of the space use modes is obvious when one deals with the available sources. The social and economic signification of the quarters' areas is a postulate, a hypothesis that was methodologically disqualified (Cabantous, 1998). The GIS allows determining the right study scale for a given question.

The spatialization at the building's scale, as it has been shown, actually opens up new research fields. It is certainly possible, in some source contexts, to attain to a spatialization at the dwelling or apartment scale, in three dimensions when considering the different floors. This is possible from the 19<sup>th</sup> century censuses, but the architectural documentation is very scarce, and allows generally only for some single building studies. This could lead to a solid study of vertical segregation and of gender repartition. The 1709 census strongly suggests a difference between a 'male city', at the level of the shops and workshops, and a 'female city' at the upper floors. Some 1677 buildings were clearly inhabited only by females, be it with a male at the ground floor, whose role can only be guessed, perhaps protection, or control.

The spatialization according to the buildings does not answer the needs of the open and public spaces studies that require other methods and a different cartography (Rau and Zeller 2007). But the GIS makes it possible to study the path of people in town through their successive apartments, and the evolution of the proprietors' residences, which tend to shift from inside their own building to the proximity, then to elsewhere according to an increasingly abstract mode of ownership, dictated by financial managing, and less by proximity with the tenants and the building considered as a familial patrimony. This is another aspect of a *longue durée* evolution becoming visible when comparing the situations for a quarter in 1677 and in 1853 for example (rue Buisson sector). The various moves of the silk workers are also quite interesting to follow, as the 1745 register records all the subsequent transfers of silk masters.

Historical studies have mainly dealt with parishes or quarters, but they are rarely concerned in detail the social space of a whole city (Concina 1984, Chauvard 2005, Chauvard 1998). This is due to the heavy investment required by a *micro-storia* extended to a whole city. It is true that this is somewhat paradoxical, but only the scale enlargement makes the change in the object mapped possible, according to a better correspondence between the registering scale in the sources and the buildings. The use of data along more than two centuries was necessary at

Lyons because we cannot rely on better preserved sources (certainly a possibility in some other cities), but it makes nonetheless possible a better understanding of the trend scales, economic cycles of a few years, great historical context changes, *longue durée*.

A new paradigm emerges from the perspectives this use of the GIS opens. The spatiality of urban space cannot anymore be limited to 'a city' or 'a quarter', or 'a moment' determined by a given plan or a given source. The actual facts are too complex to be efficiently reduced to such generalizations or simplifications, and a way to overcome this generalization is possible. Urban space is not isomorphic, and has to be studied at the pertinent scale of the intervening events that shape it, nor is it fixed and knowable only at fixed dates, but it is transforming through time, which particularly the building permits show. This implies a multiplication of a factor 100 of the spatial units used for mapping, one quarter comprising, at Lyons, about 100 buildings, but the results are quite rewarding.

Nonetheless, mapping cannot be a scope *in se*. Making maps as a simple illustration of a discourse is naïve and obsolete, but mechanically transferring pre-built mass data on a map is no longer a good method, because no deconstruction is processed according to the right scale of phenomena and their right spatial nature. Text and map dialectics are to be placed at another level. The precise location of phenomena is essential information. It is the only way to contextualize according to land values, social occupations, and architectural structures. It is also a way to compile isolated information spread in many written sources, meaning nothing as long as it is not reunited and linked to precise place and time. Dynamic mapping allows a crossing of synchronic and diachronic data. Let's compare this to a textile frame, the weft threads being made of synchronic data, censuses, tax records giving a static state, the warp threads being diachronic data, architectural modifications, property mutations, changes of use. Diachronic cross-mapping clearly shows the shared logic of transformations. The real estate behaviors ("*comportements immobiliers*", Chauvard, 2001), the transmission and transformation of the property values (Lepetit, 1994), can only be studied efficiently through a precise spatial knowledge, only allowed for by the iteration between the map and the text.

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A case of a complicated route, explained by the passing from door to door between the two sides of a same street. (B. Gauthiez©2013)

Fig. 2: Route of the administrative agent, Lyons, *quartier* Cordeliers, 1677.

An example of a rationalized route, examining the properties going around the same block, one at a time. (B. Gauthiez©2013)

Fig. 3: The map of the Lyons central quarters in 1789, from the 20<sup>th</sup> tax. (B. Gauthiez©2013)

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The map shows in blue a concentration of new constructions (the raisings are hatched) between St-Nizier church and the Hôtel de Ville, where the land value grew steadily during this period. This concentration contrasts with a sparser renewal elsewhere in the area. The red spaces indicate the street widening operated during the same period and the opening of the quay on the Saône bridge extremity in 1719.

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Fig. 7: Floor  $m^2$  values in the center of Lyons in 1766 (into *livres*). (B. Gauthiez©2013)

Fig. 8: Floor  $m^2$  values in the center of Lyons in 1840 (converted into 1766 *livres*). (B. Gauthiez©2013)