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BOTTLED NATURAL MINERAL WATER IN CATALONIA: ORIGIN AND GEOGRAPHICAL EVOLUTION OF ITS CONSUMPTION AND PRODUCTION

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To my wife-to-be.

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Abstract

Bottled mineral water has managed to become a commodity and can be found virtually anywhere in the world. However, even if it is a very common and well recognized product, little it is known about its history, about how, when and why it came to be. The origins of bottled water can be found in mid-19th century Europe and America, when spas started selling their waters outside their facilities. However, soon other springs which had not relation with traditional hydrotherapy started bottling their waters as well. Four conditionings have been found which explain why bottled water started being produced at that point in time and not before. Those factors are the existence of an adequate container, the invention of an efficient transportation method, a cultural/social predisposition and lack of salubrious water. When those four conditionings occurred at the same time, the bases for a thriving mineral water bottling industry were established. By exploring each of these factors in Catalonia for the period that has been found to encompass the first golden age of bottled mineral water (1840-1930), the general hypothesis is proven, meaning that all the aforementioned conditionings were necessary for the commoditisation of bottled water. Only when all those four factors took place at the same time it was possible to have a thriving mineral water business, not before. Accordingly, when in the 1930s some of those conditionings changed, the bottled market sector started a sudden downturn period, which did not stop until the all four factors coincided in time again.

Keywords: Bottled mineral water, packaging, hydrotherapy, history of transport, history of water distribution systems, Catalonia.

Resum

L'aigua mineral embotellada ha aconseguit convertir-se en una mercaderia habitual que es pot trobar pràcticament arreu del món. No obstant això, tot i tractant-se d'un producte comú i reconegut, poc se sap sobre la seva història: com, quan i per què va arribar a ser el que és actualment. L'origen de l'aigua embotellada es remunta a l'Europa i l'Amèrica del segle XIX, moment en què alguns balnearis van començar a vendre aigua fora de les seves instal·lacions. No obstant això, aviat altres fonts que no tenien cap relació amb la hidroteràpia tradicional van començar també a envasar-ne. S'han descobert quatre condicions que expliquen per què l'aigua embotellada va començar a ser produïda en aquest moment i no un altre. Aquests factors són: l'existència d'un envàs adequat, la invenció d'un mitjà de transport eficient, la manca d'aigua salubre i una predisposició cultural i social. En coincidir aquestes quatre condicions en el temps, es van donar les circumstàncies perquè s'establissin les bases que desenvoluparien una indústria pròspera d'embotellament d'aigua mineral. Al mateix temps, en explorar cadascun d'aquests factors, s'ha trobat que la primera Edat d'Or de l'aigua mineral envasada a Catalunya va ocórrer aproximadament entre 1840 i 1930. En analitzar la hipòtesi general aplicada a aquest període i lloc, s'ha pogut provar la seva veracitat, la qual cosa vol dir que tots els condicionants abans esmentats són necessaris per a la comercialització de l'aigua embotellada. Només quan aquests quatre factors són coetanis és possible desenvolupar un sector d'aigua mineral envasada pròsper. En conseqüència, quan a la dècada de 1930 alguns dels factors esmentats van canviar, el mercat d'aigua envasada va entrar en un període de crisi que no es va aturar fins que les quatre condicions van tornar a coincidir en el temps.

Paraules clau: aigua mineral envasada, envasos, hidroteràpia, història del transport, història dels sistemes de distribució d'aigua, Catalunya.

Resumen

El agua mineral embotellada ha logrado convertirse en una mercancía común que puede encontrarse prácticamente en cualquier parte del mundo. Sin embargo, aun tratándose de un producto habitual y reconocido, poco se sabe sobre su historia: cómo, cuándo y por qué llegó a ser lo que es actualmente. El origen del agua embotellada se remonta a la Europa y la América del siglo XIX, momento en el que algunos balnearios empezaron a vender sus aguas fuera de sus instalaciones. Sin embargo, pronto otras fuentes que no tenían relación alguna con la hidroterapia tradicional comenzaron también a embotellar sus aguas. Se han descubierto cuatro condiciones que explican por qué el agua embotellada comenzó a ser producida en ese momento y no otro. Estos factores son: la existencia de un envase adecuado, la invención de un medio de transporte eficiente, la falta de agua salubre y una predisposición cultural y social. Al coincidir en el tiempo estas cuatro condiciones, se dieron las circunstancias para que se establecieran las bases que desarrollarían una industria próspera de embotellado de agua mineral. Asimismo, al explorar cada uno de estos factores, se ha encontrado que la primera Edad de Oro del agua mineral embotellada en Cataluña ocurrió aproximadamente entre 1840 y 1930. Al analizar la hipótesis general aplicada a este período y lugar se ha podido probar su veracidad, lo cual quiere decir que todos los condicionantes antes mencionados son necesarios para la comercialización del agua embotellada. Sólo cuando estos cuatro factores son coetáneos es posible desarrollar un sector de agua mineral envasada próspero. En consecuencia, cuando en la década de 1930 algunos de los factores mencionados cambiaron, el mercado de agua embotellada entró en un período de crisis que no se detuvo hasta que las cuatro condiciones volvieron a coincidir en el tiempo.

Palabras clave: agua mineral embotellada, envases, hidroterapia, historia del transporte, historia de los sistemas de distribución de agua, Cataluña.

Table of contents

Figure list

Table list

Introduction

Foreword

Some years ago, I knew I wanted to do a PhD but I was unsure about which topic I should choose. Obviously, due to my background as a geographer, I knew it had to relate to my area of expertise, but it was not clear which geographical sub-discipline I should go for. My MSc was in Geographical Information Science (GIS), so an appropriated option would have been to take my MSc dissertation about public participation GIS in Kingston (Jamaica) one step further and pursue an in depth study of the computing and Caribbean world. Furthermore, I would have had part of the work done, as I already had research experience in the topic. However, I am not one for easy options.

Instead, I decided I wanted to do something completely different to what my MSc dissertation had been about, but also something I enjoyed. During my time as an undergraduate geography student some of my favourite subjects had to do with old school cultural geography, since finding out why people ate and drank what they did was something which I found amusing and engaging. Therefore, I decided I would dedicate the following years of my life investigate about the history and distribution of food and drink. The problem was, I did not know which product I should study.

As I was unsure, and I needed a PhD supervisor anyway, I contacted professor Nadal – my former cultural geography lecturer- to ask him if he would like being my supervisor. He immediately accepted, but when he asked me what topic I had chosen silence filled his office. Something about food I said, but I did not have a better answer. We brainstormed for a while, but discarded most options. Wine, oil or wheat perhaps? The Mediterranean triad was quite relevant if our Catalan origins are taken into account, but they were also products which have been thoroughly researched already, so it would be difficult for me to find something new to research about them. Most products have been object of research, but we finally found one that had been left aside by the scientific community, bottled water.

Even if I was a neophyte when I started, the world of bottled water has ended up being fascinating. Its study has allowed me to learn about a wide array of topic, from ancient water distribution systems to the use of radioactivity as a marketing tool. So even if the motivation to study this subject was not initially a vocational one, the course of the research has turned out to be more interesting and exciting than I ever expected.

Studying bottled water has allowed me to do fieldwork in locations of outstanding beauty across the world. Since many mineral water brands have links with spa towns or are located in environmentally protected areas visiting them has given me the chance to visit remote and stunning places. Also, bottled water is so ubiquitous across the world that wherever I have gone, I have had the chance of finding interesting places to visit which were related with this PhD.

I should say I am not a consumer of bottled water. This is not because I prefer to drink tap water or for environmental reasons, I just usually prefer drinking other beverages. Consequently, I do not have any favouritism towards a certain type of water or brand and therefore I have been able to study bottled water as a study object with no personal bias. This personal indifference towards water has also meant that throughout the process I have greatly learned about all the types and characteristics of different waters, something which has enriched my gastronomical and cultural baggage. Overall, the research process which has led to the production of this thesis has been a challenging one, but also highly fulfilling, both professionally and personally.

General introduction

Obtaining water for human consumption has been problematic since the beginning of the Neolithic Revolution (Redman 1978). The rise of large cities and areas of high population density led to the progressive pollution of clean water sources due to the uncontrolled disposal of faecal waste of human and animal origin (Markham 1994). Also, waste from traditional industries and crafts, such as tanneries or slaughterhouses put aquifers under strain (Borda, Popescu et al. 2008). As a result, springs, rivers and lakes located near large cities were, until well into the 20th century, a focal point for the dissemination of important epidemics like cholera, typhoid fever or dysentery. As an example, the city of Barcelona suffered in 1914 a severe typhoid fever epidemic, causing hundreds of deaths as a result of the contamination of one of the main water sources to the city (Claramunt i Furest 1933).

One of the solutions used since antiquity to solve this serious public health problem was the consumption of alcoholic beverages (cider, beer, wine and others). This alternative was the most widespread in Western Europe for centuries, but the consumption of such beverages can be socially problematic (Olson, Gerstein et al. 1985). Other cultures, such as the Chinese, largely solved the disadvantages presented by consuming alcoholic drinks by using tea instead (Macfarlane, Macfarlane 2004). The infusion of tea leaves helps consuming boiled water, by giving it a pleasant flavour. The process of boiling water helps reduce the number of waterborne pathogens, thus sterilising water for human consumption. In fact, nowadays infusions like tea or coffee are amongst the most consumed beverages in the world (Macfarlane, Macfarlane 2004).

Bottled water can be included among the means used by humans to obtain safe hydration and it is the main object of study of the present thesis. It currently is a multimillion multinational business that employs thousands of people across the world, but nobody has yet been able to explain how, when and why this business started. Therefore, a lot of work is necessary to elucidate which processes led to the apparition of this product. This is why almost all theories, ideas, examples or explanations are original research, because this is the first piece of work which thoroughly studies mineral water as a cultural product, not as a business or an environmental concern.

Even if a PhD thesis is a large body of work, it cannot be expected that it will cover all the aspects of an area of knowledge, so some constraints to the research topic have been established. The study area has been limited to the area within the current Catalan borders for several reasons. First of all, Catalonia is one of the largest producers of bottled water in Europe and the largest in the Iberian Peninsula. Secondly, no study has been carried out to explain the market in the country, so by choosing Catalonia a gap in knowledge is being filled. Finally, the Catalan case can be used as a starting point for future studies as it is prime example of an area where different types of water bottling companies have coexisted during the last two centuries.

Preliminary research also arose two issues which constrained the research topic further, not all bottled waters are equal and the history of bottled water is not linear, so a decision was taken to limit the chronological scope of this thesis. According to European law, there are three types of bottled water, mineral water, spring water and other waters (European Union 2009a), all of them with different legal features. Due to the characteristics of mineral water –it is linked to a single spring- and its importance in the country –96% of the bottled water market is mineral (Associació Catalana d'Envasadors d'Aigua 2011)-, it was decided to limit the study to mineral water only.

About the non-linearity of mineral water’s history, it could be observed that three different periods existed in the history of bottled water in Catalonia. A first period went from its first occurrences –around the 1840s- until the beginning of the 1930s. This initial stage was characterised by the profusion and popularisation of the bottled water market not only in Catalonia, but elsewhere in Europe. During these years, dozens of brands were inaugurated and mineral water became a commodity, a period which could be baptised as the “golden age of bottled water”. However, from 1930s onwards the bottled water market in Catalonia suffered a severe downturn, with only a handful of brands being able to continue in business and many others being forced to close. This period of darkness in the sector progressively ended between the late 1970s early 1980s, when surviving and new brands slowly started being able to sell their produce to a larger customer base. This third period has continued until nowadays, when bottled water has become profusely present in media, society and shops.

Investigating in a detailed manner all three periods would have supposed a mammoth task equal to producing three different theses. Therefore, it was decided that since not many studies exist about the history of bottled water, the ideal starting point was the begging, i.e. the first period when bottled water appeared and became successful. This is why the study period of this thesis is from the first found examples of bottled water in Catalonia -1840s- until the year 1930, when the last mineral water plant belonging to this age opened its doors. However, these dates are not rigid, as many times throughout the thesis it is necessary to cross them to properly test a hypothesis. Therefore they should be taken as guidance, not fixed dates.

On the whole, this thesis is the first of its kind as it explains the historical and geographical conditionings which lead to the development of a sector which had been left aside by the scientific community. By focusing in the starting stages of its history, and by constraining the study area to Catalonia, a general theory has been formulated and tested, giving a solid starting point for future research.

Literature review

Existing literature relating to bottled water is quite scarce. It is rather surprising that a multibillion global business has had so little research focusing in its origins and history. Even the current situation of the sector is severely underrepresented, as little independent research exists about it. The main issue with most of the existing bottled water related literature is that it is either endorsed by industry or by organisation which oppose to the environmental issues caused by the trade. This means that, even if relevant to the purpose of this thesis, the information provided by these sources should be taken cautiously as it is likely to be biased.

Environmental groups have published books and research about the drawbacks of bottled water. One of the most important critical publications about bottled water was sponsored by the Canadian Centre for Policy Alternatives with a quite revealing subtitle "exposing the bottled water industry" (Clarke, Canadian Centre for Policy Alternatives 2007), This book, while being absolutely key to the understanding of the trade, has certain aspects which render it as not completely objective, meaning that it cannot be considered totally unbiased. Another relevant book to the study of the current situation of bottled water is "Bottled and sold: The story behind our obsession with bottled water" (Gleick 2010). In his book, Gleick defends that bottled water is superfluous in many areas of the world and tap water should be consumed instead. Being a renowned freshwater specialist his opinion should be taken into account, but he does not really explain the origins of the trade. On the other hand, from the same author's webpage it is possible to obtain valuable data about the current international bottled water market, something usually difficult to obtain from by the industry (Gleick 2011).

Other researchers, even if following the scientific method and publishing in peer review journals, have studied bottled water from a quite critical perspective, some of them even sponsored by environmental organisations (Ferrier 2001). Some titles like "Eliminate bottled water" (Trinque 2009) or "Bottled water under scrutiny" (Erickson 2009) indicate that some authors have a belligerent attitude towards bottled water. This is not bad in itself, as if scientifically proven that bottled water is negative to the environment it should be explained. However, other opinions or pieces of research should be considered.

The counterpart of negative views towards bottled water can be found in producers' associations. Whether being American (IBWA 2012), European (EFBW 2012), Spanish (Asociación Nacional de Empresas de Aguas de Bebida Envasadas 2012) or Catalan (Associació Catalana d'Envasadors d'Aigua 2011), producers do provide a broad and relevant source of information about the trade. Obviously it has to be regarded as potentially biased, but some data or statistics can only be obtained from them, so using their webpages and publications as a source of information is mandatory to draw the market's general picture.

Furthermore, some bottled water companies have published books regarding their history and the trade's evolution. A number of them are blatant publicity (Lapitz 1999), but others have hired historians to research their archives and have published books based on traditional research. A prime example of this policy of company driven research can be found in the Catalan company Vichy Catalán. They have published books written by historians and other scientists about the company's history (Piernas 2009, Piernas, Vichy Catalán 1997) or the history and properties of their waters (Grupo Vichy Catalán 2001, Grupo Vichy Catalán 1998).

A third source of information about mineral water is guides written by connoisseurs and sybarites of the drink. Books about the organoleptic properties of different mineral water from all over the world, bottle collectors or spa clients also provide facts about the trade. Perhaps the most influential one is "Fine waters" by Mascha (Mascha 2006), which has an associate webpage which works as a meeting point for mineral water fans. Other guides and books help to complement the information about the business (Green, Green et al. 1994, Von Wiesenberger 1988, Munsey 1971, Altman 2000). Even if not strictly a connoisseurs guide, the book published in the year 2001 by the Insituto Geológico Minero, a public institution which has a great influence in the subsurface water management in Spain presents a collection of all mineral water bottling plants present in Spain at the time (Baeza Rodríguez-Caro, López Geta et al. 2001). The introduction of the book gives a good overview of the history and evolution of the market, but it is so brief that it is unable to explain the topic in depth.

It is therefore difficult to find fully objective and unbiased literature regarding bottled water, with historical explanations being almost inexistent. In this sense, the work by Chapelle is extremely relevant and useful, as his book “Wellsprings. A natural history of bottled spring waters” provides a historical rapport of the initial stages of the mineral water business in the United States (Chapelle 2005). However, to achieve a full explanation Chapelle uses examples from all over the world and shows a broad knowledge of the subject. While part of the book focuses in the hydrological characteristics of mineral water –he is a hydrologist-, the historical account is an excellent starting point to understand the origins of bottled water. However, his book has certain blanks that hopefully this thesis will be able to fill, this time for a European country, Catalonia.

The North Catalan historian Nicolas Marty has also dedicated efforts to explain the historical evolution of bottled water. Starting with the story behind the success of Perrier (Marty 2006), Marty followed by carrying an outstanding comparative between the legislative processes that regulated the production of bottled water in Europe (Marty 2009). Lately, he has also studied more in depth the evolution of the mineral water legislation in southern Catalonia (Marty 2010). While his work is inestimable to the development and understanding of bottled water, it has a legal and historical focus which does not take into account geographical factors. However, his opus can be considered as an ideal complement to fully understand the issues arisen in this thesis.

The last source of information which deals directly with bottled mineral water are laws and regulations. Mineral water is one of the most controlled foods in Europe, so a large body of rules have been written at all levels –EU, state and regional- to regulate its extraction, production, distribution, sale and marketing (European Union 2009a, European Union 2010, European Union 2003, Ministeri de la Presidència 2011, Ministerio de la Presidencia 2002, Martinez Anido 1927, Figuerola 1870, Gisbert 1869, Boletin Oficial de la Provincia de Barcelona 1913).

Since current specific literature about the earliest stages of the mineral water bottling business is quite scarce, original sources of information must be sought. Archives hold material which was written coetaneously to the studied period, which is an invaluable source of information as it reflects the views of the time. Amongst archival information, mainly three different sources have been used; annual directories, spa reports and the press. Apart from those three specific types of documents, as with any other historical research, older books and laws have also been used to depict the initial bottling water business.

As bureaucracy has been traditionally important in Catalonia, it is possible to follow a paperwork trail which can go significantly back in time. Amongst all available sources, annual directories have proven to be very useful as they hold statistical information for certain economic sectors. The main annual directory used to find the history behind the starting stages of bottled water has been those published by the Catalan Chamber of Commerce (Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985), which have information about the imports and exports of mineral water, together with a list of the towns which had mains water distribution. Other useful annual directories have been those published by the Barcelona City Council (Barcelona 1902; 1921) or those that regarded the use of spa towns (Taboada, Carretero y Muriel 1898). In addition to annual reports, tax and revenue documentation also hold relevant information about the beginnings of bottled water.

The second historical source of information relevant to bottled water is spa reports. Either when a source was discovered, when a spa started its business or at regular intervals, analyses were carried out to prove or disapprove the therapeutic properties of water. Those analyses were then published as reports, commonly known as "memorias", many of which have survived to our days and can be found in libraries and archives. Memorias were not limited to the explanation of the chemical composition of a source; they also explained the climatic, geographical, demographical, environmental or architectural surroundings of it. A lot of information about the source can be therefore obtained from those reports, including if it was used to fill bottles and if so, how were the bottles sold. Many memorias have been used to write this thesis, most of them about Catalan sources (Font i Sagué 1904, Martí Sanchís 1904, Mas Ministral, Torres 1894, Montserrat y Archs 1889, Poudevida 1874, Poudevida 1859, Menós i de Llena, Cid et al. 1791, Menós i de Llena, Abadal i Girifau et al. 1790, Menós i de Llena, Abadal i Girifau et al. 1787, Gelabert Caballería), but also from Spanish springs (Murillo 1910, Balneario de Quinto (Zaragoza), Viñolas y Borrell et al. 1854, González y Crespo 1840, Cabanes 1832, Ayuda, Ibarra 1794, Puerta 1884, Unknown author 1886). Apart from memorias, another historical source of information were treaties and lists of mineral waters published by doctors as guides to those wanting to use hydrotherapy as a medical treatment (Ayuda, Ibarra 1794, María Rubio 1853). They do not usually have explicit information about the bottling of mineral water, but sometimes a reference to water exportation is made.

Finally, the third specific historical source of information used has been newspapers from the time. In the 19th and 20th centuries a plethora of publications were sold in Catalonia, and from time to time they included information or advertisements about bottled water. However, searching thousands of issues to find information regarding bottled water would have been extremely time-consuming. Fortunately, some newspapers have digitised all their past issues, allowing the systematic search for certain keywords. Due to its age and relevance, La Vanguardia newspaper has been heavily used in this thesis (La Vanguardia 2011g). This newspaper, published since 1883, has proven to be an invaluable source of information, as many mineral water bottlers chose its pages to publish their advertisements. In addition to that, the newspaper regularly published news about the trade, making it even more relevant. Apart from La Vanguardia, the ABC (ABC Periódico Digital 2011), the Campana de Gràcia (La Campana de Gràcia 1885) or L'Esquella de la Torratxa (L'Esquella de la Torratxa 1914) have been used. However, one of the best newspapers to extract information from in a Catalan context, the Diari de Barcelona (Diario de Barcelona 1850), has not been broadly used. Even if it is the oldest Catalan newspaper, it has yet to be digitised, so it was impossible to do rapid queries to find information. Either when it becomes digitised, or when a researcher has the time and will to search through thousands of issues, it would be interesting to see what information about bottled water holds.

Even if it is very difficult to find literature regarding exclusively bottled water, it does not matter if it is historical or current, there are other sources which hold related information (Planhol 1995). Books, articles or webpages focused in other cognate disciplines do offer from time to time information about the history and evolution of bottled water. Works regarding other drinks like sodas (Jordà Garcia, Capel Sáez et al. 2010, Standage 2006), beer (Standage 2006, Calvo 1993, MARM-Cerveceros de España 2012), wine (Boulton 1999, Martín Cerdeño 2006, Pan-Montojo, Espanya 1994, Wiesenthal, Navarro et al. 1990, Unwin 1991) or infusions (Macfarlane, Macfarlane 2004, Rubin, Gold 2002, Chow, Kramer 1990) are very relevant to the research of bottled water because they can be used as a benchmark to compare and extract information about the history of the product.

Medical literature about the benefits or drawbacks of drinking water (Napier, Kodner 2008, Rusconi, Forte et al. 2004, Hamilton, Crossley 2004, Food Standards Agency 2004, Martín Sánchez, Rubio Montero et al. 1999, Canter 1997, Pouderoux, Friedman et al. 1997, Ufrecht 1997, McCasland, Trautmann et al. 1985) and engineering explanations about how water should be treated and managed (Hendricks 2011, Nemerow 2009, Logsdon 2008, Martín Pascual 2007, American Water Works Association 2006, Chin 2006, Parsons, Jefferson 2006, Pearse 2003, Matsuo 2001, Senior, Ashurst et al. 2001, Hansen 1983) also give another view and many times additional information about the bottled water world.

Finally, the multidisciplinary work involving the study of bathhouses (Altman 2000, Hembry 1990, Hall 2003, Maraver Eyzaguirre 2006, Ferrer i Santaló, Gay 2003, Unknown author 19uu, Mitjà i Sarvisé, Associació Balneària et al. 1999, Balneario de Panticosa 192?, La Vanguardia 1914, Escomel 1913, San Pedro Martínez 1993) and the history and use of water (Martín Pascual 2007, Lanz, Rentsch et al. 2008, Rosa, María Carmen de la, Mosso, María de los Ángeles 2004, Banco Urquijo 1969, Oller, Suárez Fernández et al. 2008, Vicedo i Rius, Aldomà i Buixadé 2006, Martín Pascual 2005, Herrero i Baró, Centre d'Estudis de Sant Pere de Vilamajor et al. 2003, Seubas 2004, Jofre i Torroella, Institut d'Estudis Catalans 2003, Font, Mateu Gasquet et al. 2002, Argemí, Deu i Baigual et al. 1999, Latorre i Piedrafita 1998a, de Ramon i Vidal 1996, Garcia i Fuertes, Fundació Salvador Vives Casajuana 1990, Bouza Vila, Cifuentes et al. 2002) also provide a broad and at times very relevant source of information about the topic at hands. Furthermore, many other disciplines not mentioned here are potential sources of information about bottled water; even cooking books can become relevant (Wiesenthal, Navarro et al. 1990, Ribera i Gabandé 1994).

The main issue about bottled water literature is therefore the atomisation of different sources of information, as a centralised source of information does not exist. Many researchers from all periods and origins have dealt with bottled water in one way or another, but none have actually tried to explain the full story in a single work. The inexistence of an oeuvre of reference makes the research about bottled water highly challenging to scholars. Hopefully, this thesis will become a good referent when trying to understand the complex world of the bottled water business.

Objectives

With the information gathered during the literature review process, a general research question was formulated, together with a series of secondary or derived objectives.

The research object of this thesis is the origin of mineral bottled water in Catalonia. Even if under current legislation mineral water is precisely defined, this work uses the concept in a looser sense; any water that has its origin in a spring and was bottled in the past is included as the object of study. However, with current brands, the European definition is used, so only those bottlers which have been defined as natural mineral water are taken into account.

In order to explain the origin of mineral water the following questions were formulated:

- Why did people start producing/consuming bottled water?
- When did the trade start?
- How did the mineral water business begin?
- Where were bottling plants located? Did they follow a pattern?
- Why, when and how did the market grind to a halt?

To answer to all of these questions a general theory, inspired by what was found during the literature review stage, was formulated:

> *In order to have a thriving mineral water business, four factors are necessary:*
>
> *A. An adequate container*
> *B. An efficient transportation method*
> *C. A cultural/social predisposition*
> *D. Lack of salubrious water*

To demonstrate or disproof the validity of this theory, a series of secondary research questions were formulated and answered in the thesis:

A. *An adequate container*
    1. How did the availability of different materials used to fabricate containers influence bottled water?
B. *An efficient transportation method*
    1. Did the improvement in transportation methods positively affect the bottled water business?
C. *A cultural/social predisposition*
    1. How did hygienism, hydrotherapy and balnearism influence the perception of bottled water by consumers?
D. *Lack of salubrious water*
    1. Did the industrial revolution have an effect in the origin of the water trade?
    2. To what extent did waterborne illnesses impact tap water? Did bottled water benefit from them?

A hypothetical answer to all this research questions was given before an in-depth research was done by formulating three hypotheses:

- Until the necessary technical, social and economic conditionings to the bottling of mineral water are not met and coincide in time, the sale of bottled water is not possible because it lacks consumer demand.
- When the aforementioned conditionings exist coetaneously, a mineral water bottling market appears and blossoms.
- When any of the four conditionings explained in the general theory changes, the mineral water market begins a downturn period unless a substitutive alternative is found.

The application of the theory to the starting stages of bottled water in Catalonia has allowed contrasting the validity of these three hypotheses and answering the main research topic and all derived questions. However, even if only applied to one country and one period of time in this thesis, the proposed hypotheses and theory should also be able to explain the situation of the current bottled water market or its situation in other countries. But that is something which should be not covered in subsequent pieces of work.

Methods

The main methodological framework used in this thesis has been based in the process defined by Crawford (1990) as a typical research project (Figure 1.1). The first step is the inception of the idea, a process which has been explained in the preface section of the prologue, but in short, it was induced by this thesis' supervisor. The following step, as with most mainstream scientific designs, was to formulate the hypotheses, but in order to define appropriate premises, an in-depth literature review was necessary. After researching all available relevant literature, and after a reflection period, several hypotheses/objectives were formulated[1].

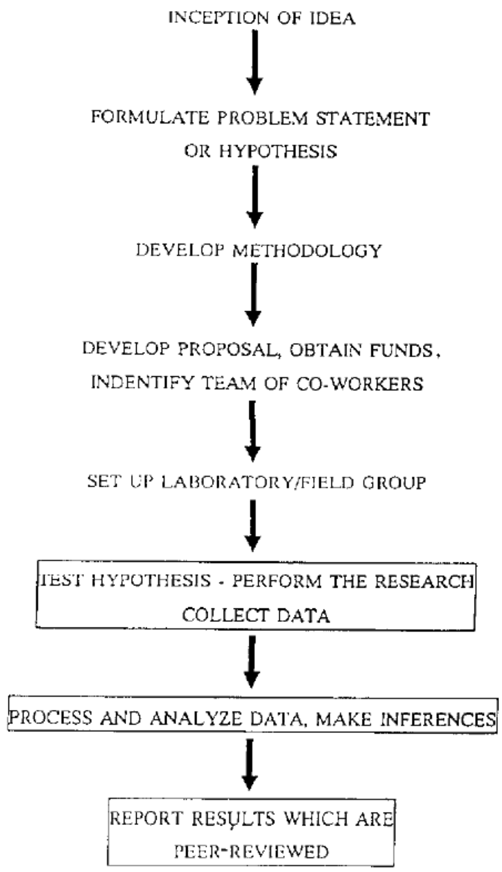


Figure 1.1. Stages of the scientific method.
Source: (Crawford, Stucki 1990:224)

[1] They are explained in detail in the previous section

The methodology developed test the proposed hypotheses can be divided into four parts with five subsections:

- Historical research
    - Bibliographical review
    - Archival research
    - Newspaper analysis
- Fieldwork
    - Visit to spa towns
    - Interviews
- Creation of a list of Catalan water bottlers
- Geographical analysis

The first step was to carry out a historical research to find information which either corroborated or negated the validity of the formulated hypotheses. This stage of the research consisted of three parts. The first one was a bibliographical review of those sources which contained relevant information about the starting stages of the bottled water industry. Many libraries were visited during this process, including several universities' libraries, the Library of Catalonia[2] or the Spanish National Library[3], just to mention a few. Also, many electronic databases were consulted during this stage. The second stage consisted of archival research, which allowed accessing a plethora of unpublished information –many times manuscript - and intensely increased the amount of available information. Amongst others, Foment del Treball's archive, the Aragon Crown's Archive[4] or the Municipal Archive of Barcelona[5] were visited. Finally a systematic analysis of newspaper historical issues was carried out. The most thorough search was done with the La Vanguardia and ABC newspapers, but also issues from La Campana de Gràcia, L'Esquella de la Torratxa or the Diari de Barcelona were analysed.

During the historical research stage of the methodology, the historical source criticism method formulated by Bernheim and Langlois and Seignobos was used (Howell,

[2] Biblioteca de Catalunya
[3] Biblioteca Nacional de España
[4] Arxiu de la Corona d'Aragó
[5] Arxiu Històric de la Ciutat de Barcelona

Prevenier 2001). This method states that a historical fact can be considered true if all sources agree about an event, a critical analysis of texts is carried out, sources are confirmed by outside authorities, eyewitnesses exist and, if two sources disagree, the one with a major authority should be preferred. In the many occasions where two sources of similar authority are opposed, both of them have been explained and the pros and cons of accepting each one of them as true have been exposed. By following these rules, the reader can be confident that all historical sources have been critically filtered to ensure that they reflect what it is known about the reality of the time.

Once most of the historical research was completed, the second stage of the research process, fieldwork, could start. Fieldwork consisted in visiting many spa towns and bottling factories, both in Catalonia and outside. Amongst the Catalan towns which have a relationship with the mineral water bottling sector and have been visited, it is worth mentioning those located in Caldes de Malavella, Tona, Sant Hilari Sacalm, Caldes de Montbui, la Garriga, Caldes de Boí, Cardó, Ribes de Freser, Amer and Osor, just to list some. In addition to Catalan examples, Spanish -Bezoya, Sigüenza, La Toja or Carabaña--, French –Vittel, Evian, Perrier, Volvic or el Boló-, English –Buxton, Harrogate, Royal Leamington Spa, Bath, Morphet or Woodhall Spa-, Italian –San Pellegrino-, Bosnian –Olympia- and Israeli –Ein Gedi- bottling towns and companies were visited. Visiting all those locations allowed learning the particularities of each site and comparing the different ways in which each city or country approached the bottled water business. This approach led to the characterisation of several common elements all locations had, allowing to extrapolate them and complement the elaboration of the proposed hypotheses.

A second type of fieldwork consisted in the elaboration of interviews with several important agents in the bottled water business. Maybe the most relevant was a meeting held at the Oliver Rodés Laboratory headquarters with the owner of the company, Dr. Benito Oliver-Rodés. His company analyses around 90% of all bottled water produced in Spain, and he has spent his life working in the sector, so he is one of the persons who knows more about the market. In addition to that, he owns which probably is the best collection of mineral water bottles and labels in Spain, an invaluable source for researchers in the field. The meeting held with him allowed redefining several aspects of this thesis and it supposed a significant qualitative increase. Other interviews included mineral water brand owners and managers, public water distribution network administrators, academics and other experts in the field. Some interviews were planned and structured, but others were spontaneous and occurred during or after meetings and conferences regarding the sale and production of bottled water. Both types of interviews provided new information and different views on the topic which were incorporated to the hypothesis and contents of the thesis.

Throughout the bibliographical research, the interviews and the fieldwork, a systematic collection of information about historical water bottlers was carried out. As it has been mentioned, a list of all Catalan mineral water bottlers did not currently exist, so a thorough research was necessary in order to create one. Each time a new bottler was found, many times by chance when looking for a different topic, it was added to a list, and a search for more relevant information about it was systematically carried out. This process has lasted throughout all the research period and has been highly successful. If when the research process started only those brands which were currently bottling water were listed -26-, currently 89 are known, and 52 of them started production before 1930 (Appendix 2). Even if this list is the most complete to date, it is highly probable that some bottled water producers have managed to bypass the sieve, so the list of water bottlers is subject to increase. The missing information in the table is also likely to be improved in the future.

Once the most complete bottled water list possible was created, a geographical analysis, comparing and testing it to other variables and factors, was carried out. With the use of advanced GIS techniques, new information about the geographical patterns of bottled water was obtained. Apart from the bottled water list, some generated maps include information created ad hoc for this thesis like earthquake frequency, religious buildings, springs, historical population density or historical transportation systems. The large amount of cartographical information present in this thesis is very useful to understand the geographical conditionings which lead to produce bottled water in some areas and not in others.

All the explained research methods, together with some other minor additions, were used to validate or disproof the theory and hypothesis formulated in the previous section and to answer the formulated research questions.

Structure of the thesis

The thesis has been constructed as a way of proving or disproving the proposed hypothesis and as a means to answer the research questions asked at the beginning of the research process. All chapters bar four try to explain a factor from the theory proposed in the thesis. The only exceptions are the introductory and closing chapters and chapter one and five. Each chapter has been designed to be understandable as a standalone piece of work, so even if they relate with other sections of the thesis they can be considered as singular pieces of work. However, when all chapters are presented together they complement each other and give a broader picture which illustrates how, why and where did bottled mineral water start in Catalonia. The thesis can therefore be read as a whole or per chapters depending on the interests of the reader.

The introductory chapter consists of six sections which introduce the thesis and its bibliographical and methodological framework. It is formed by a foreword which deals with the motivations which have led to the elaboration of the thesis, a general introduction of the topic, a literature review, which methods have been used and how the thesis is structured.

Chapter one gives contextual information which is relevant to provide a fully understanding of the theories, facts and concepts explored throughout the thesis. This chapter is subsequently divided into a first section which very briefly depicts the problems humanity has faced to hydrate using water and explains some of the alternatives people have found to overcome them. The second subheading gives current information about the importance of the mineral water bottling business at different scales.

Chapter two is the first chapter which directly explains one of the factors considered in the proposed theory. It covers the necessity of having an adequate container available in order to have a thriving water bottling business. To do so, it explains how humanity has managed to store liquids throughout history, from ancient times to the 19th century. The chapter's internal structure follows a chronological approach by explaining different materials which have been used to store liquids during history; ceramic, wood, metal and glass. A brief history of each material is presented and then its suitability as a water container is explored.

The third chapter deals with how the lack of salubrious water spurred the mineral water bottling business in Catalonia. It starts by providing some contextual information about the history of water distribution systems in Catalonia and continues by explaining the problems the Industrial Revolution caused to urban population, both in terms of water quality and water quantity. The third section of the chapter explains how thanks to the unreliability of public water distribution systems mineral the use of mineral water changed from being a therapeutic treatment to become a preventive drink, transforming its use from medicine to commodity. Finally, the chapter concludes by comparing the price and popularity of bottled mineral water with other drinks of the time, like lithium water, soda water or sterilised water.

Chapter four explores the social disposition to drinking mineral water. In order to have a thriving water industry it is necessary to have a consumer base which has an interest in the product. The chapter explains how this predisposition came to be in Catalonia by exploring two different origins; mythical and medical reasons. The first section explains how since preterit times mineral water springs have had an aura of sanctity which has had continuity through time and has been integrated into different cosmogonies. The second section, on the other hand, follows how hygienist theories and hydrotherapy helped to give a scientific justification to the benefits of mineral water. Both approaches are linked with the blossoming of bottled water before concluding the chapter.

The two final chapters of the thesis' main body, five and six, are focused into explaining the geographical conditionings necessary to find out why some springs succeeded into having their water used industrially while others did not. Geographical conditionings have been divided using the traditional human/physical divide, so a chapter has been dedicated to each aspect.

Chapter five of the thesis is an exception because it does not directly deal with any of the factors proposed in the general theory. Instead, it explains the physical conditionings necessary to have a successful bottling plant in Catalonia. To do so, several factors are analysed, like the spring's flow, the geology of the area and the environment. Included in this chapter is an explanation of the relationship between earthquakes, pollution and nature and bottled water. Also, an explanation about how the evolution of perception about radioactive water by the public has changed throughout time is given.

The human conditionings for the production of bottled mineral water are explained in chapter six. They include the last factor given by the general theory to have a flourishing market, the need to have an efficient transportation method. To explain how bottled water relates to transportation methods, an intensive GIS approach has been carried out, providing several maps about the evolution of the network and the proliferation of new bottling plants. However, the chapter is not limited to transport. The figure of the entrepreneur that starts the business is also explicated, together with the geographical distribution of production and consumption centres in Catalonia in the late 19th and early 20th centuries. Finally, the international exportation and importation of mineral water during the study period in Catalonia is explored.

The last chapter of the thesis, the conclusions, wraps everything up and concludes the work. It starts with a very brief explanation of how a prosperous business like bottled water had such a dramatic downturn in Catalonia right before WWII. Afterwards, the limitations of the research are exposed, together with the potential future lines of research with may stem from this piece of work and the implications this thesis has had. Finally, a general final conclusion is given.

1. Contextual considerations

Introduction

Before starting the development of the main body of the thesis, it has been considered necessary to provide some contextual information about more general topics which are nonetheless related with the thesis' theme.

The first contextual consideration regards the difficulties humanity has found when drinking water. Contrary to what most people think, drinking water was not an everyday practice in many areas of the world due to the potential presence of waterborne pathogens and it was therefore necessary to find alternatives to keep hydrated, some of them explained in the first subsection.

Secondly, to provide a grasp of the current situation of the mineral water business, several figures referred to the world, Spain and Catalonia are provided. This way, the reader can get an idea of the current relevance of the sector.

1.1 Drinking water: a difficult choice

All living creatures need water to live, and so do humans. Unfortunately, since the Neolithic Revolution, when humans from different areas of the world started settling and stopped their nomadic way of life (Redman 1978), access to clean drinking water became a major issue to society. Many factors, including a more consistent source of food or the need to live close to the fields, contributed to a fast increase and densification of human communities. This meant a lack of need to roam around looking for new sources of nourishment, and led to the appearance of a new type of settlements: permanent towns and cities (Diamond 1997). With relatively high population densities and permanent settlements the problem of water pollution from human activities and wastes appeared. Since the immense majority of cities which appeared right after the Neolithic Revolution grew organically, that is without any formal planning, water pollution became inevitable in the surroundings of the first settlements.

The pollution of drinking water in the first cities forced their inhabitants to find other ways of obtaining a clean source of liquids in order to keep themselves hydrated. The first solution was obtaining water from clean fountains and wells, but this usually meant walking for a while with heavy pottery vases which were even heavier in the way back to the city or village. This solution, which has vividly lasted to our days in many areas of the world, was quite inconvenient because of the amount of effort and time dedicated to it –a duty that often only the women and children of the household would do. If the city became large enough, fountains and wells could become polluted as well, which meant that citizens could fall ill, forcing them to look for new sources of water further away. This meant that even more effort and time had to be used to obtain the daily amount of water for all the family.

1.1.1 Boiled water

A widely spread solution around the world still used today in many areas, was to boil the water in order to kill most of the pathogenic germs (Schlager 1994), but this generated a new problem. Most people do not enjoy the taste and feel of very warm water; they tend to prefer the flavour of crisp and fresh water. In order to bypass the bad flavour hot water has many cultures would steep aromatic herbs into their boiling water to improve its flavour (Macfarlane, Macfarlane 2004). A positive side effect of this technique is that many herbs, roots and plants used to give better flavour to hot water do have medicinal and/or psychotropic properties, so in addition to cleaning water, they can heal some stomach and body pains or alter the state of mind of consumers (Rubin, Gold 2002). These properties where known since early times in history and inbreeded into the popular culture of many areas and religions. For example, a legend tells that Bodhidharma, the founder of Chann Budism, slept for nine years while meditating, and after waking up he was so upset about his laziness that he cut his own eyelids so he would never fall asleep again (Chow, Kramer 1990). Once the eyelids fell to the ground a tea plant grew from them[6]. As it can be deducted, this legend tries to explain why tea leaves have a stimulant substance, theanine, which helps to keep awake with greater ease.

Another legend which tries to explain the origins of drinking tea says that around the year 2740 BC, the mythical Chinese emperor Shennong discovered tea when some tea leaves were blown by the wind and fell into his hot water cup which he usually drank because he considered it to be healthier than standard water (Yang, An 2005)[7]. If we take into account that according to Chinese tradition Shennong was the father of agriculture –in fact his name means “the divine father”- (Rubin, Gold 2002) it is easy to see the relationship that traditional Chinese culture made between agriculture, water pollution and the appearance of tea. In fact, traditional Sino-Japanese culture regarded cold drinks as unpleasant, trying always to drink hot or at least lukewarm beverages such as tea (Planhol 1995). Even in areas where tea was too expensive people would boil water in order to drink it warm instead of fresh at it would surge from the spring (Doolittle 1865),

[6] As many legends and myths, there are many versions of the story, but the essence of the story remains the same
[7] Ibíd.

even when they were travelling abroad (Hsing-chun 1953). This attitude towards hot beverages in ancient Chinese culture may be explained by some cultural and environmental conditions which made drinking unboiled water a potentially dangerous activity. For example in many towns public latrines were located close to wells, which in many cases had cracked walls, so faecal matter and water could mix, which increased the risk of dinking foul water, something which could be lethal unless the water was boiled before consumption (Simmons 1991).

Infusions have been an extremely successful way to make water potable throughout history and the world, so much tea is the second most consumed beverage in the world after water (Macfarlane, Macfarlane 2004). In fact, in many areas of the globe it is the most consumed liquid because of the lack of easy access to potable water. But tea is not the only plant humankind has massively used to avoid drinking foul water, other plants and seeds include coffee, camomile, menthe, lemon verbena, anise, yerba maté, rosemary or thyme amongst many others. All these plants have been used, and in many places still are, for their therapeutic properties, but also to give better flavour to hot and safe water.

1.1.2 Alcoholic beverages

Even though infusions became one of the main solutions to avoid drinking potentially unhealthy water, many cultures also used alcoholic beverages to decrease the risk of poisoning themselves by dinking foul water. Alcoholic beverages include a mix of other liquids with different amounts of ethanol, a substance that inhibits the growth of bacteria, a property well known by biologists wanting to preserve their specimens from putrefaction (Hill 1975, Packard 1888). Ethanol helps quite successfully to preserve liquids from rotting or becoming foul, making them durable, easier to store and to transport (Vallee 1998).

How to obtain alcohol from the fermentation of sugar -glucose, lactose or fructose mainly- into ethanol via the use of yeast has been known since the Neolithic Revolution (Pearson 2003), so once again we can observe the existing coincidence in time between the appearance of agriculture and a solution to make liquids potable. The first alcoholic beverage found in archaeological sites was mead, which appeared in many areas of the old world making it a multicultural beverage and the predecessor of all other fermented drinks (Toussaint-Samat 2009). The discovery of mead was so culturally important that it has been stated that it was one of the markers that moved humanity from nature to culture (Lévi-Strauss 1966). This discovery was followed by the elaboration of many alcoholic drinks which have been of capital importance in the history of civilisation like beer or wine (Underhill 2002). Many societies either developed or incorporated alcoholic beverages into their culture, adapting local ingredients to the process of fermentation which created the large number of alcoholic drinks which exist today.

Another process, which was used to obtain higher percentages of alcohol, was the distillation of fermented liquids. Even though distillation was already used in Babylon from the second millennium B.C. (Levey 1956), it was not until the 8th century that the Arabic or Persian[8] alchemist Gabir ibn Hayyān al-Sūfī –also known as Geber- invented the alembic used to obtain pure alcohol (Holmyard, Russell 1997). This new technique permitted distillation and the appearance of many new drinks increasing its variety (Table 1.1) and allowing an even better preservation of the liquid’s antibacterial properties (Shibasaki 1982), something that became quite an important advantage during the Age of Discovery.

Albeit its efficiency, preserving liquids by the use of alcohol had a big drawback; its intoxicating effect which caused health and social conflicts (Peele 2009). Drinking liquids with high alcoholic content may cause intoxication, which can lead to social boldness and arguments. Also, on the long run, people can become addicted to alcohol, suffer from alcohol related illnesses like cirrhosis, or die from alcohol poisoning, which results in higher mortality rates (Olson, Gerstein et al. 1985). Ancient Greeks and Romans used to dilute wine with water (Standage 2006) in varying proportions –for example Greek poet Hesiodus, who lived around the 8th century BC, recommended a proportion of 1 part of water per 3 parts of wine– which was intended to, on one hand, reduce the amount of alcohol ingested and, on the other hand, reduce the economic cost

[8] The ethnic origin of Geber is disputed.

of drinking only wine the addition of standard drinking water (Longo 2009). Also, the alcoholic content in wine helped to reduce the potential pathogens drinking water could have, reducing the risk of falling ill when both liquids were mixed together (Chapelle 2005). The practice of diluting wine and water became so culturally powerful that society saw people who drank only wine as barbarians who were not civilised or culturally advanced (Longo 2009).

Table 1.1. List of some fermented drinks and their distilled counterparts[9]

Source	Type	Fermented Drink	Distilled Drink
Grains	Barley	Beer	Whisky
	Rye	Rye Beer	Rye Whiskey
	Corn	Chicha	Bourbon whiskey
	Sorghum	Sorghum beer (Burukutu, Pito,…)	Maotai
	Wheat	Wheat beer	Vodka
	Rice	Rice beer (Sake, Huangjiu,…)	Shochu, Soju,…
Fruits	Grapes	Wine	Brandy, Arak, Pisco,…
	Apples	Cider	Calvados, Applejack,…
	Pears	Pear Cider	Pear Brandy
	Plums	Plum Wine	Plum Brandy
	Wolfberry	Gouqi Jiu	Gouqi Jiu
	Coconut	Arrack	Old Arrack
	Red Bayberry	Yangmei Jiu	Yangmei Jiu
	Pomace	Pomace Wine	Pastis, Orujo,…
	Berries	Berrie wine	Eau-de-Vie
Vegetables	Potatoes	Potato beer	Vodka
	Sugarcane	Basi	Rum, Cachaça
	Agave	Pulque	Tequila, Mezcal,…
Other	Honey	Mead	Distilled Mead
	Milk	Kumis, Kefir,…	Distilled Kumis

Source: Author's Work.

Different societies, cultures and religions have reacted differently to alcohol. A well-known example is the different tolerance towards alcohol which can be observed between the two largest credos of the world; Catholics and many Christians consume alcohol as part of their liturgy and are highly tolerant towards its utilisation, while Muslims loathe alcohol consumption (Spilka, Hood et al. 1985). Therefore, the use of alcoholic drinks as a source of hydration, whether mixed with water or by themselves, was controversial as their side effects can be antisocial.

[9] This list does not intend to contain all the alcoholic drinks available in the world; it is just an example of the variety of the ingredients used to make them and how they increased in number with the diffusion of the modern distillation techniques.

1.1.3 Milk

An additional liquid used in many cultures is milk, but under natural circumstances can go foul faster than water and not everybody can drink it because some people are lactose intolerant (Samour, Helm et al. 2003). In fact, while in some human communities most inhabitants are lactose tolerant, there are others where only a little percentage of the population are tolerant to lactose, so most of their inhabitants cannot drink milk (Table 1.2), making milk a drink only useful to certain communities in the world. For example some cultures, mainly nomadic like the Sami in northern Europe, used milk as one of their main drinking sources (Koerner 1999).

Table 1.2. Percentage of lactose tolerant people in different countries.

Country	Lactose tolerance (%)
Sweden	99
Denmark	97
Germany	88
Spain	72
India	36
Japan	10
China (Shanghai region)	8
Singapore	0

Source: Author’s work. Data obtained from (Garrett, Grisham 2005:602).

Drinking milk has been more difficult in sedentary societies and in areas with higher average temperatures until the appearance of Ultra-High-Temperature (UHT) processing in the 1960s (Bylund 2003) which allowed to preserve milk for longer periods of time without going foul. Previously to the invention of UHT processing, the need to have the source of milk –cows, goats, sheep or other mammals- close to the consumption areas meant that those animals had to live inside the cities, which became a sanitary problem due to the odours, pests and the amount of waste they generated (Segarra 1986). All these factors -tolerance to lactose, climatic conditions and population density- meant that some areas were more prone to drinking milk than others. For instance, as the Adventures of Asterix comic books sarcastically show, ancient Romans did not usually drink milk and saw those who did as barbarians, while Celtic and Germanic tribes drank it often (Pliny the Elder 1890). This ancient cultural difference follows the geographical factors already mentioned since Celtic and Germanic tribes had better tolerance to lactose, lived in less dense villages (some of them even were nomadic) and originally lived in colder areas than Rome. A more recent example is that in Barcelona a significant market of milk in its liquid form did not appear until 150 years ago (Ràfols i Casamada 1998) and in Europe the average consumption of milk in 1933 was much lower in Mediterranean cities than in northern cities (Figure 1.2) or cities with a cooler climate.

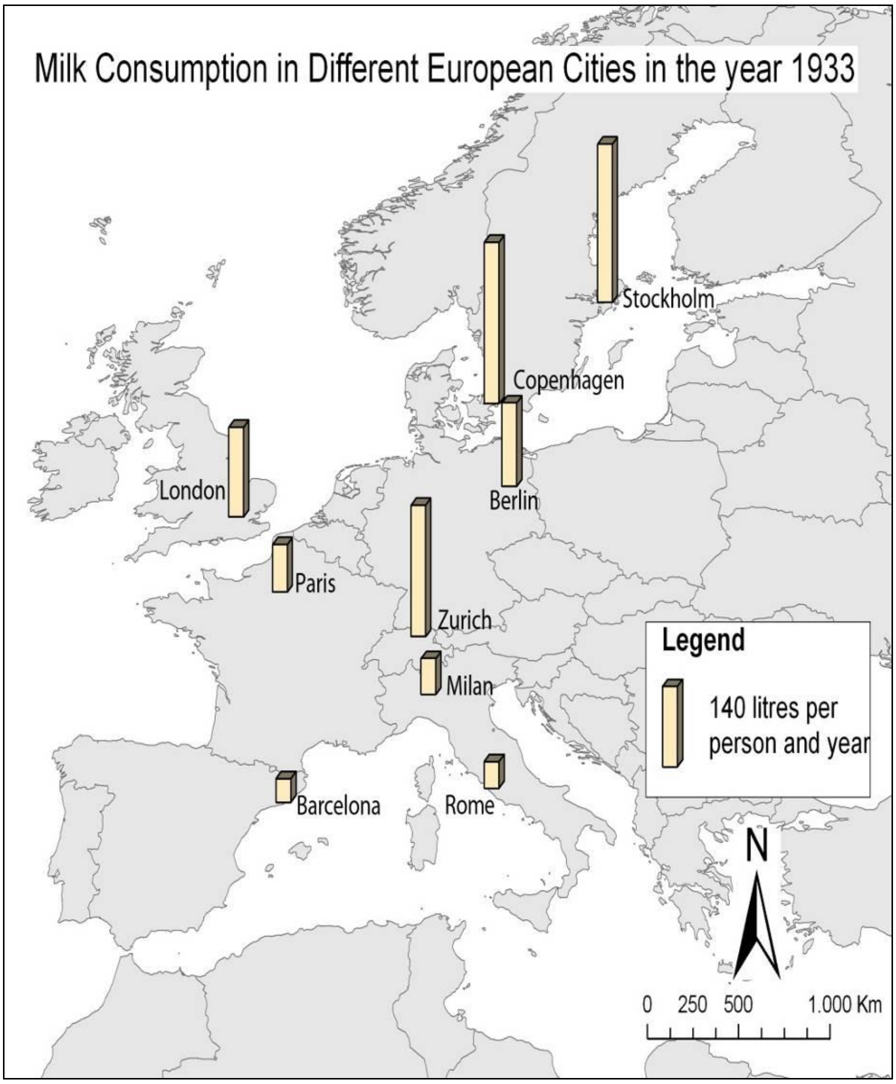


Figure 1.2. Milk consumption in different European cities in the year 1933.
Source: Author's work. Data obtained from (Hernández Adell).

This meant that a significant part of Europe's population could not habitually drink milk. However, other dairy products like cheese were commonly consumed, but that supposed dehydrating their milk contents, so they could not fill their daily liquid intake by the consumption of milk derivates. Although this limitation, cheese and other dairy products became an optimal way of processing milk in order to transport it, preserve it and drastically reducing the amount of lactose, making it easier to digest for people who were lactose intolerant (McSeweeney, Fox 2004).

The invention of powdered milk by Russian chemist M. Dirchoff in 1832[10] (Massachusetts Medical Society, New England Surgical Society 1833) partly solved how to commercialise milk in those countries which had difficulties transporting and storing it. Thanks to powdered milk transport costs were dramatically reduced due to the resulting loss of weight caused from the dehydration of the milk, while if hermetically stored powdered milk could remain unaltered for months allowing long haul trips from production areas to consumption centres. Even if powdered milk broadened the range where milk could be consumed, it did not solve the problem of lactose intolerance and created a new problem, the need of using potable water to prepare powdered milk, which, as it has been already explained was not easy to obtain. When in the 1960s UHT processed milk was popularised, it allowed to bypass this last problem, and meant that only those who were lactose intolerant –around 18% of the Spanish population- could not drink milk. The importance UHT milk had in the increase of liquid milk consumption in Mediterranean countries and the lack of repercussion it had in northern European countries can still be traced to nowadays. If figure 1.3 is observed, Spain, Portugal, France and Belgium consume almost only UHT milk, while Scandinavian and other northern countries prefer to drink fresh milk, which has to be kept cooled and consumed within days. A notable exception is Greece, a Mediterranean country where most of the consumed milk is fresh.

[10] Marco Polo describes a product which could be dehydrated milk being used by the troops of Kublai Khan (Polo 1858), but this is uncertain and nevertheless it did not become of popular use in Europe until early 19th century.

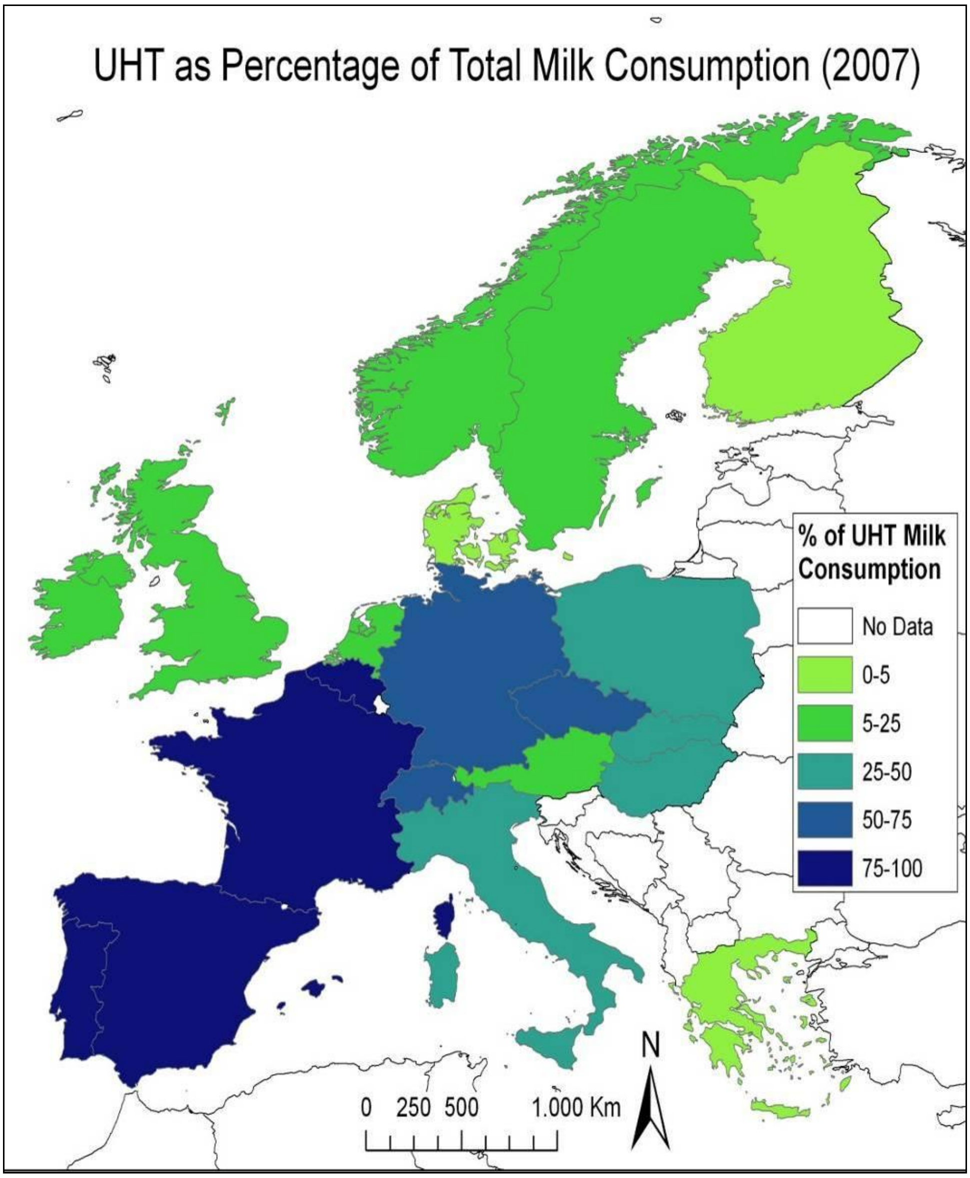


Figure 1.3. UHT as percentage of total milk consumption.
Source: Author's work. Data obtained from (Elliott 2007).

Other historical alternatives humans used to obtain safe liquids apart from well and source water, infusions, alcohol or milk include fruit juices –which need plenty of juicy fruits available and once they were made they were difficult to preserve so they had to be consumed soon- or blood –a taboo in many cultures and not very digestive.

1.2 Mineral water nowadays

Even if the object of this thesis is to explain the starting stages of the bottled mineral water business in Catalonia, it is worth briefly contextualising the current situation of the product, both globally and nationally. Mineral water is currently a major transnational commodity which can be purchased virtually anywhere in the world, so it could be argued that the sector is living a second golden age. While at first being a local business with a much atomised industrial distribution, it has evolved into a successful sector coveted by several major multinational companies which compete for a larger share of the market. Four of the largest alimentation firms, Nestlé, Danone, PespsiCo and Coca-Cola now control a significant share of the market by using a strategy which consists in buying already existing and well known sources (Gimeno 2012). The interest of alimentation giants in the bottled water market shows that it is a thriving and profitable sector which publicises its products constantly and globally.

1.2.1 Global scale

Globally, the bottled water sector sold in 2001 a total of 115,000 million litres of product, which generated 68,000 million US dollars of revenue (Gimeno 2012). It is therefore an important and relevant market within the alimentation sector, but it is growing at different speeds across the world. As figure 1.4 shows, between the years 1999 and 2004 most countries for which there is available data saw their per capita bottled consumption increase, in some cases quite dramatically. The only country that during the five year period saw the consumption of bottled water decrease was Colombia, but the rest of the considered countries increased their per capita consumption. The increase however, was not homogenously distributed across the world. Most European countries and some South American ones had marginal increases, while North American countries had more significant augment. The most dramatic change, however, took place countries with an emerging economy, like Russia, China, India or Pakistan, were consumption more than doubled in five years.

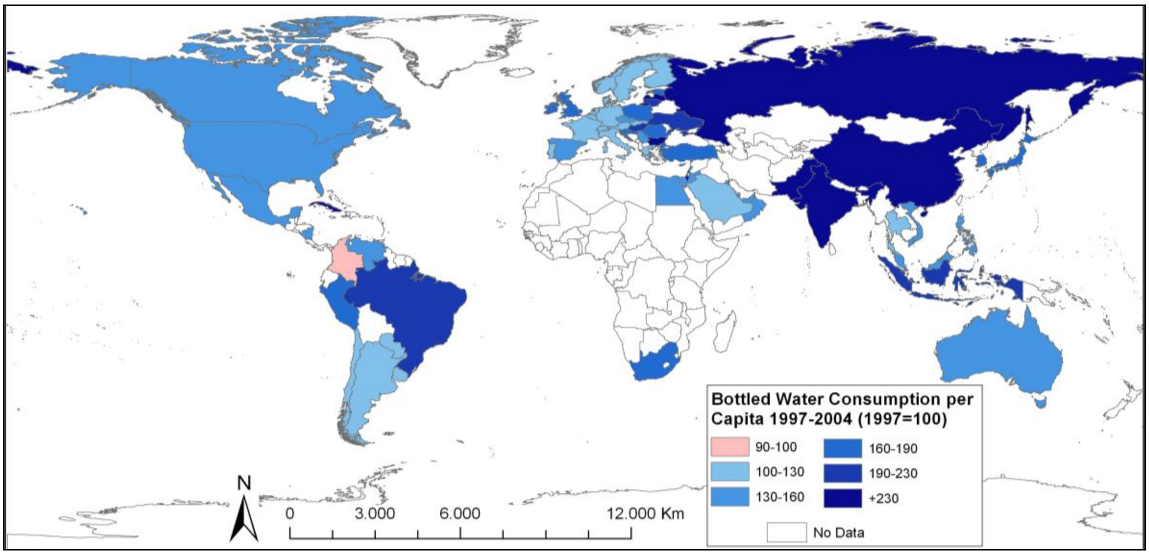


Figure 1.4. Evolution of bottled water consumption in the world (1997-2004).
Source: Author's work. Data obtained from (Gleick 2011)

Even if European countries had on average low increases in the amount of bottled water they consumed, they remained as the largest consumers of the world. The reason why they did not have large increases was that their markets are saturated (Gimeno 2012), so growing is more difficult. On the other hand, countries which had stronger increases still have very low consumption rates, so any little change has a relatively dramatic effect (Figure 1.5). Europe has some of the countries where bottled water is most consumed due to historical reasons, as many famous brands originated there. The largest consumers of the world are the Italians; with an average yearly consumption of 184 litres per person, but Belgium, France, Spain, Germany or Switzerland also have consumption rates of over 100 l/person/year (Gleick 2011). However, not all countries present in the top ten in terms of bottled water intake are European, as Mexico, with 169 l/person/year is the second consumer in the world, while the UAE are third. The only other non-European country present in the list of larger bottled water consumers in the world is the Lebanon (Gleick 2011).

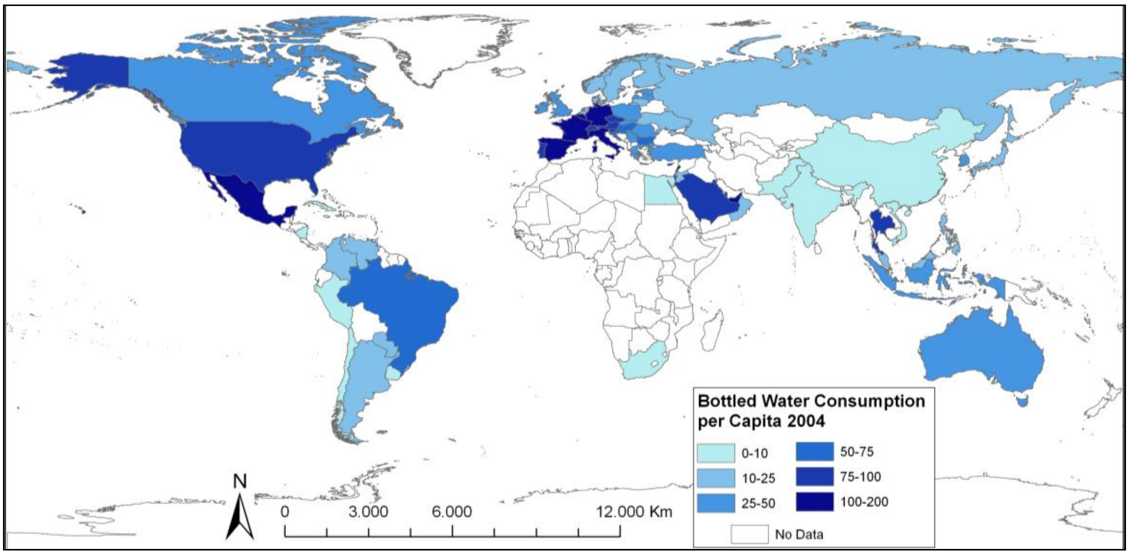


Figure 1.5. World bottled water consumption per capita distribution (2004).
Source: Author's work. Data obtained from (Gleick 2011).

Production wise, and if absolute numbers are used, the importance of European countries in the international bottled water market context is not as important. Out of the top five bottled water producers, only one, Italy, is European. The USA is the largest producer of bottled water in the world, followed by Mexico, China and Brazil (Table 1.3). However, even if European countries are not the largest producers in the world, their relevance is notorious, not only because of their relatively important production volume, but also for the reach their water has. Brands like Perrier, Evian or San Pellegrino are well known outside of their respective countries of origin and can be considered global brands.

Table 1.3. Largest producers of bottled water by country (2004)

Country	Litres (millions)	Country	Litres (millions)
United States	25.893	Thailand	4.962
Mexico	17.683	Turkey	2.460
China	11.894	Saudi Arabia	2.270
Brazil	11.598	United Kingdom	2.205
Italy	10.661	Korea, Republic of	1.957
Germany	10.313	Russia	1.944
France	8.550	Poland	1.873
Indonesia	7.362	Japan	1.566
Spain	**5.506**	Belgium	1.532
India	5.126	Philippines	1.414

Source: Author's work. Data obtained from (Gleick 2011).

The European Union has a specific legislation for bottled water which establishes the different types of water which can be found in the continent (European Union 2003). In the EU three types of bottled water can be found, potable bottled water, spring water and mineral water, however, this thesis only focuses in the latter. Mineral water can only be obtained from a specific source and ideally it should not be treated in any way (European Union 2009a)[11]. The level of control regarding mineral water is such that only those springs previously listed by the EU can be sold as mineral water. This has led to the elaboration of recognised mineral waters lists by the EU (European Union 2010), which are usually released twice a year. The information contained in those lists can be used to map the distribution of the mineral water business in Europe.

In the year 2009, the EU recognised 2,023 brands from the same number of springs as being mineral water (European Union 2009b). These only include sources which are contained within the Union's borders, as member states can recommend the inclusion in the list of sources from third countries. Figure 1.6 shows the distribution of recognised sources, both in the EU and outside. As it can be seen, European countries have recognised sources from as far away as New Zealand, India or Canada, so certain brands from those countries can be sold in EU. Countries which belong to the European Economic Area –mainly Norway and Iceland- are in an intermediate situation, were they do not appear in official EU lists but instead have a separate list each where they declare their recognised springs (European Union 2009a).

Figure 1.6 also shows the amount of sources recognised per member state. The EU country with most recognised springs is Germany, which holds almost half of them -811. Italy with 415 classified sources, Spain -148-, Hungary -122- and the UK -96- complete the top five countries by number of sources (European Union 2009b). It may result surprising that France, a country which holds some of the world's most famous springs is not amongst the countries which have more sources. This can be explained because France has more concentrated production that, for example, Germany, with fewer sources producing more water. In this sense, each French bottler produced in the year 2004 on average around 120 million litres of bottled water, while in Germany they produced 12

[11] Under certain conditions, minimal treatments may be allowed (European Union 2009a).

million litres per bottler, ten times less (European Union 2009a, Gleick 2011). On a side note, it is worth remarking that Malta is the only country of the EU which does not have a recognised mineral water bottling plant (European Union 2009b).

The internal distribution of mineral water per state presents significant differences depending on the country (Figure 1.7). Germany, Italy and Hungary have sources scattered within their borders, with a tendency in Germany to have many sources in a single town which is not as strong in Italy and very weak in Hungary. Spain presents a somewhat even distribution of sources across the country, with a concentration of springs in Catalonia, the Canary Islands, the Mediterranean coast and the Picos de Europa and Iberian mountain ranges. The UK has an important concentration of sources in Wales and Scotland, while in England they are more scattered but spread across the country but with a higher concentration in the Pennines. The French case is quite special because it has a great concentration of plants in the main mountain ranges, while in other areas their presence is secondary. Other countries have less recognised sources and therefore less significant in the European context. It can be concluded that the bottled mineral water business in Europe is quite relevant, as a strong legislation exists and production and consumption figures are amongst the highest in the world.

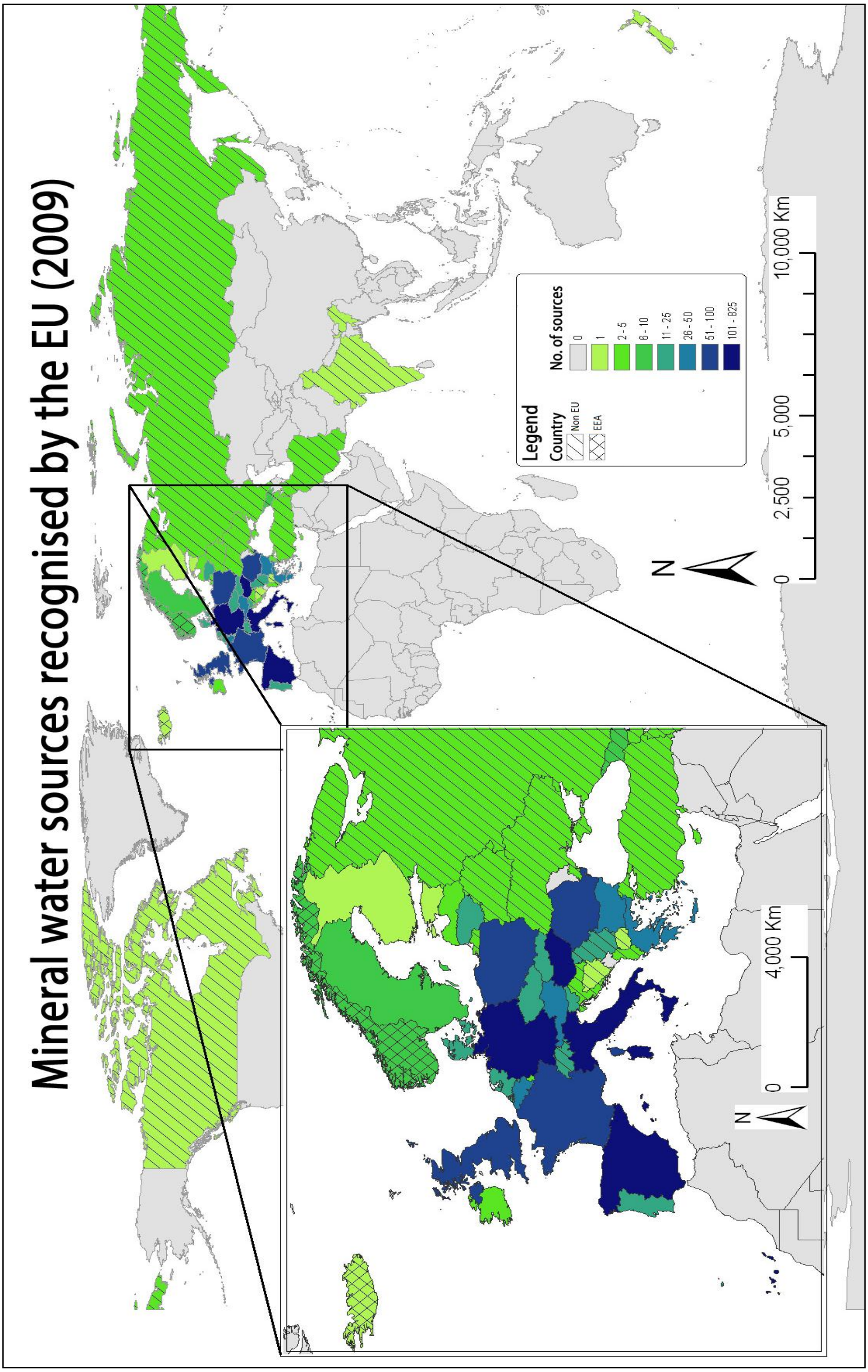


Figure 1.6. Mineral water sources recognised by the European Union (2009).
Source: Author's work. Data obtained from (European Union 2009b).

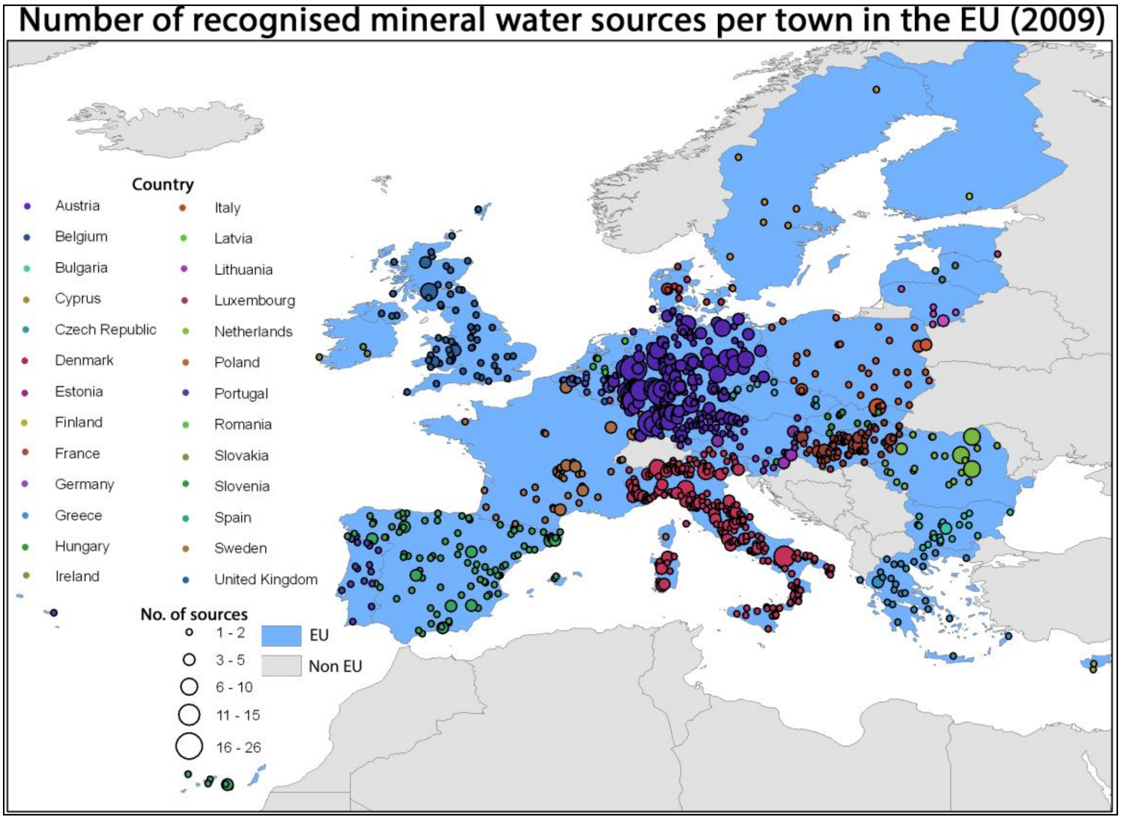


Figure 1.7. Number of recognised mineral water sources per town in the European Union (2009).
Source: Author's work. Data obtained from (European Union 2009b).

1.2.2 Catalonia and Spain

Bottled water is the most consumed non-alcoholic drink in Spain -44%-, more than sodas -40%-, juices -10%- or squashes -6%- (Asociación Nacional de Empresas de Aguas de Bebida Envasadas 2012). The bottled water business is therefore highly relevant both in terms of production and consumption. The evolution of mineral water production steadily increased between the years 1998 and 2006, when it reached its maximum with almost 6,000 million litres (Figure 1.8). Between 2007 and 2010 the production has decreased, possibly due to the recent economic downturn. When compared soda pops, it can be observed that at the beginning of the period bottled water had a smaller production, but that it soon overtook them and became the most produced non-alcoholic drink, a situation which is still true nowadays (Instituto de Desarrollo Económico del Principado de Asturias 2012).

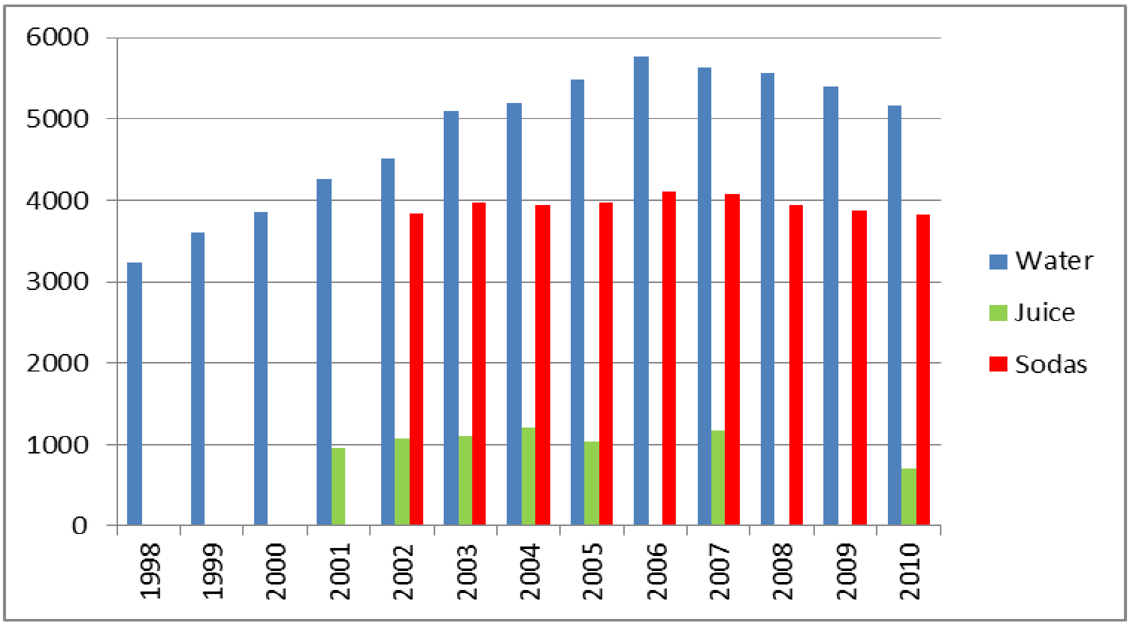


Figure 1.8. Evolution of water, juice and soda production between 1998 and 2010 (millions of litres).
Source: Author's work. Data obtained from (Instituto de Desarrollo Económico del Principado de Asturias 2012).

The importance of the bottled water sector in Spain can be seen in the economic figures which describe its activity. In the year 2010 the business of bottling water directly employed more than 5,000 people and tens of thousands more had their jobs linked to the sector (Asociación Nacional de Empresas de Aguas de Bebida Envasadas 2012). The production of bottled water had a total turnover of 900 million Euros which in part had an impact in rural areas –where most springs are located- (Asociación Nacional de Empresas de Aguas de Bebida Envasadas 2012). It is therefore an important economic sector that provides employment and revenue to many people and to areas where not many alternative economic activities exist. Being in the European Union, Spanish plants also have to comply with European legislation regarding bottled water. Therefore, there is a legal distinction between mineral water, spring water and treated bottled waters. The Spanish bottled water production system is clearly biased towards the production of mineral water with around the 95% of the water bottled in Spain being of this type (Table 1.4). Spring water and treated water productions are much smaller, this being the reason why this thesis mainly focuses in bottled mineral water.

Table 1.4. Proportion of mineral, spring and treated water production in Spain (2005-2010)

Year	Mineral water (%)	Spring water (%)	Treated water (%)
2005	94,78	3,04	2,18
2006	95,03	2,76	2,20
2007	95,68	2,37	1,95
2008	95,80	2,50	1,70
2010	95,04	2,10	1,86

Source: Author's work. Data obtained from (Instituto de Desarrollo Económico del Principado de Asturias 2012).

The geographical distribution of the production of bottled mineral water is quite unequal across Spain. Catalonia holds the largest concentration of recognised mineral water bottling plants in Spain, as 18% of them are located within its borders (Table 1.5). The only other Autonomy which can compare to it in terms of mineral water bottling plant density are the Canary Islands, which have over one water production centre per 1,000 square kilometres. Unsurprisingly, the three largest Spanish Autonomies hold the largest concentrations of bottling plants after Catalonia, but due to their big surface they have low recognised source densities (Table 1.5).

Table 1.5. Number of recognised bottling plants in Spain per Autonomous region (2009)

Autonomous Region	Sources	Sources/ 1000km^2	Autonomous Region	Sources	Sources/ 1000km^2
Catalonia	**27**	**0,84**	Murcia	5	0,44
Castilla y León	20	0,21	Extremadura	4	0,10
Andalucía	17	0,19	Balearic Islands	3	0,60
Castilla la Mancha	17	0,21	Basque Country	2	0,28
Aragón	13	0,27	Cantabria	1	0,19
País Valencià	13	0,56	La Rioja	1	0,20
Canary Islands	10	1,34	Madrid	1	0,12
Galicia	8	0,27	Navarre	1	0,10
Asturias	5	0,47	Ceuta & Melilla	0	0,00

Source: Author's work. Data obtained from (European Union 2009b)

Even if a relationship between the number of recognized sources and the production of mineral water exists, it is not as straight forward as it may seem. In the year 2010, Catalonia had both, the largest number of mineral water bottlers and the largest production of the product (Figure 1.9). However, the second highest producer was the

País Valencià, which in the same year occupied the sixth position in terms of number of mineral water bottling plants. This can be explained because some sources have higher production rates than others. Another reason is that not all recognised springs have active bottling facilities, but all of them have the potential to be bottled. As it can be seen in figure 1.9, the Mediterranean coast has the highest concentration of recognised springs and the highest production of bottled mineral water, while the area composed by the Basque Country, Navarre and La Rioja produce comparatively less water. Even if Madrid has one recognised source, no information has been found about its production levels.

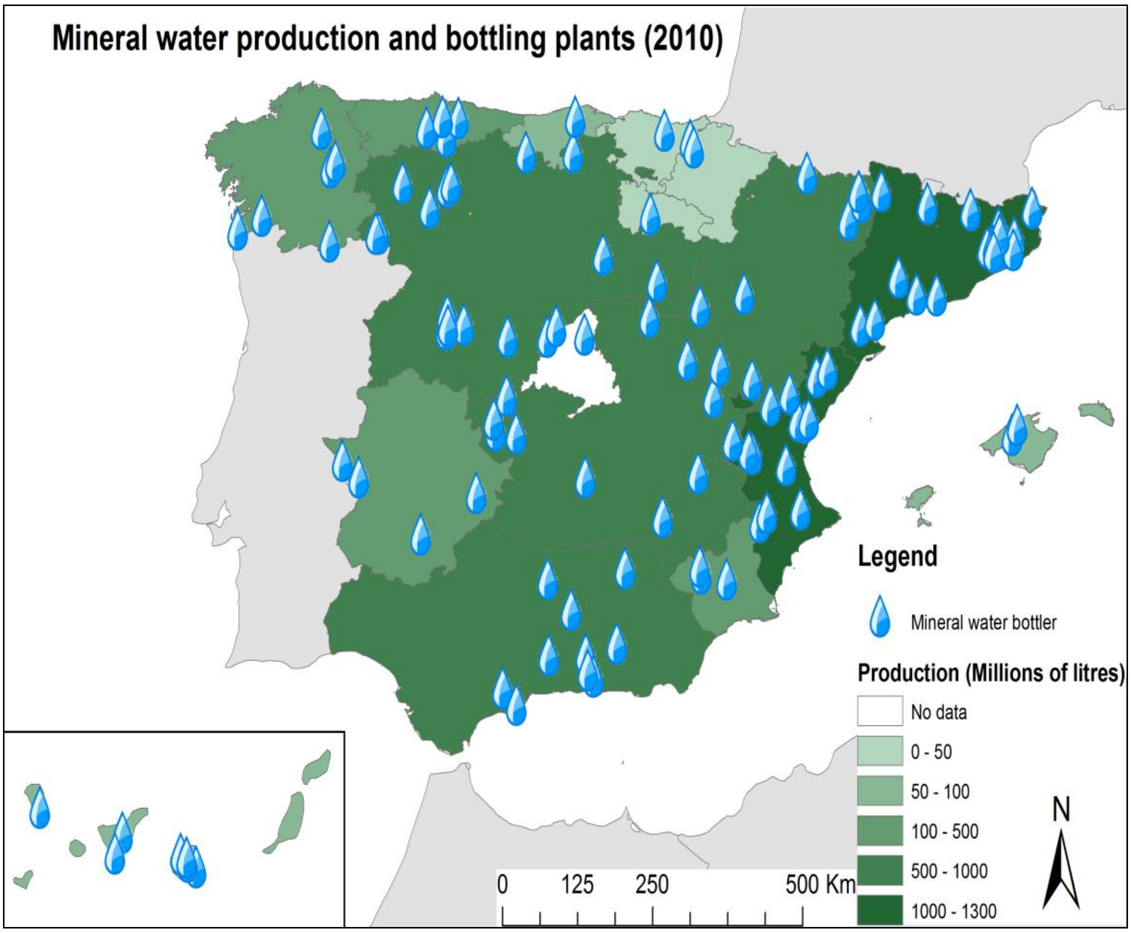


Figure 1.9. Location of recognised mineral water bottling plants and production of bottled water by Autonomous Community (2010).

Source: Author's work. Data regarding bottling plants location from (European Union 2010). Production data obtained from: (Instituto Geológico Minero de España 2012)

The evolution in the production of bottled mineral water in the last decade has had an overall upward tendency, even if in the last four years the amount of water bottled and sold has decreased (Instituto de Desarrollo Económico del Principado de Asturias 2012).

However, the way in which bottled water has evolved in recent times has been quite different depending on the region. Several Autonomous Communities like Extremadura, País Valencià, Murcia, Aragón and Castilla y León have had dramatic increases since production of bottled mineral water there has rocketed during the last decade (Figure 1.10). Other regions have maintained relatively stable production rates, while others like Cantabria, La Rioja or Navarre have seen their mineral water production reduced. In the Catalan case, production has fluctuated, but if only initial and final years are taken into account, it has decreased overall. However, it still remains the largest manufacturer of bottled water in Spain (Instituto Geológico Minero de España 2012).

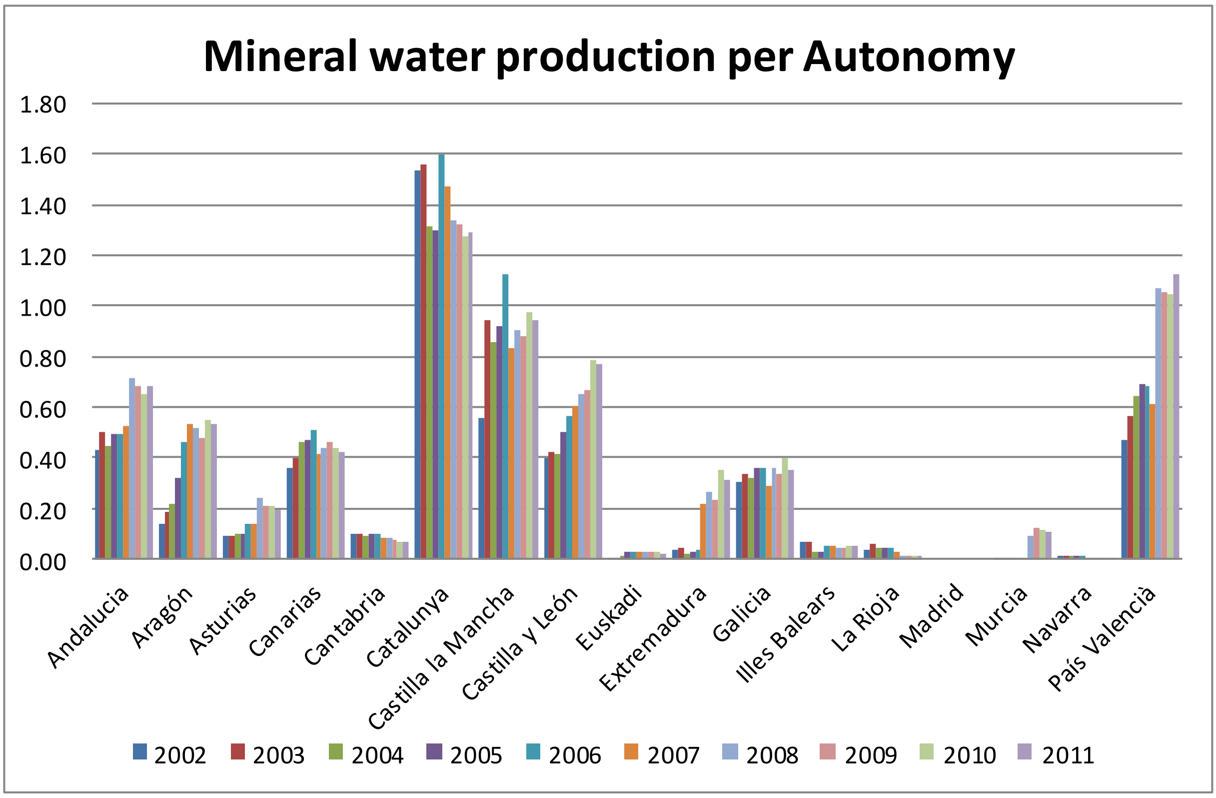


Figure 1.10. Evolution of mineral water production per Autonomous Community (2002-2011).
Source: Author's work. Data obtained from (Instituto Geológico Minero de España 2012)

Consequently Catalonia has a preponderant role in the Spanish bottled water production, but distribution within Catalonia is not homogenous. The as the province of Girona concentrates 20 out of the 27 Catalan recognised sources, with Lleida and Tarragona having three each and Barcelona only one (European Union 2009b). In fact, Girona is by far the province with more bottled sources in Spain; while none of the other Catalan divisions makes it into the top ten (figure 1.11). Mainly thanks to the disproportioned size of the mineral water bottling sector in Girona, Catalonia produced in the year 2010 24% of all litres bottled in Spain (Associació Catalana d'Envasadors d'Aigua 2011). If only sparkling mineral water is considered, the percentage increases to 45%, almost all of it being produced in the Girona province (Associació Catalana d'Envasadors d'Aigua 2011). The importance of the sector in Catalonia, and especially in the province of Girona, is key to understanding the Iberian market, and can be considered as a mineral water production pole in the Western Mediterranean coast.

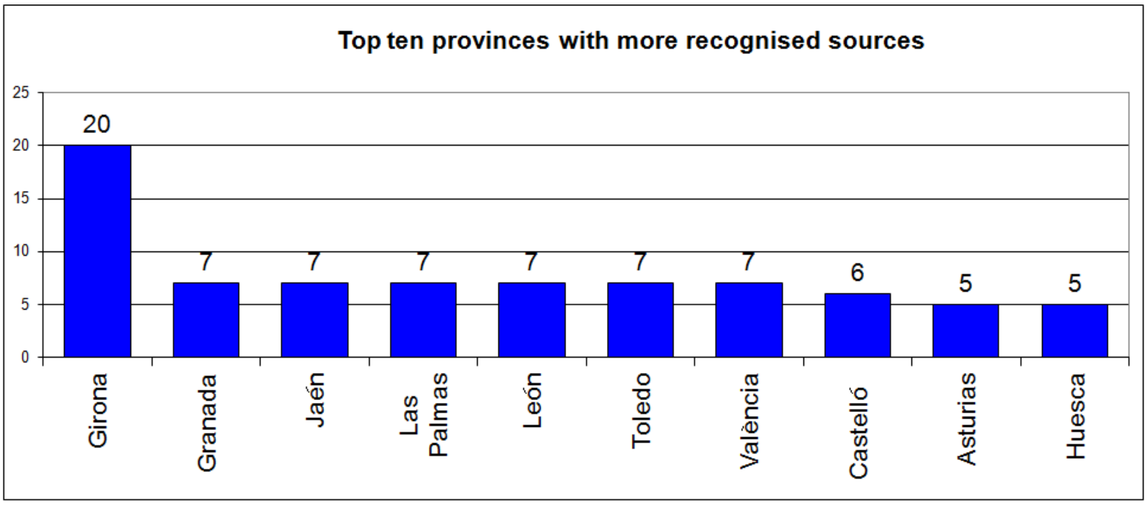


Figure 1.11. Top ten provinces with most recognises mineral water springs (2009).
Source: Author's work. Data obtained from (European Union 2009b)

From what it has been explained, it can be inferred that the Catalan distribution of mineral water bottlers is biased in the Girona province, and while being true, the intra-provincial distribution is far from homogeneous. The most important concentration of mineral water bottling plants is located in a mountainous area known as Montseny-Guilleries (Figure 1.12). This area is a cluster which produces most Catalan bottled mineral water, and therefore a large proportion of the Spanish total output. Production is specially concentrated in several towns, like Caldes de Malavella, Sant Hilari Sacalm or Arbúcies, all of them mentioned many times throughout the thesis due to their importance.

The second area where an important amount of mineral water producers can be found are the Catalan Pyrenees, with five bottling plants found from the border with Aragón to where the mountains meet the sea. Finally, the rest of bottlers can be found in the southern part of the country, but they are not as renowned as their northern counterparts since their production levels and pre-eminence is not as successful as of those located in the Montseny-Guilleries area (Figure 1.12).

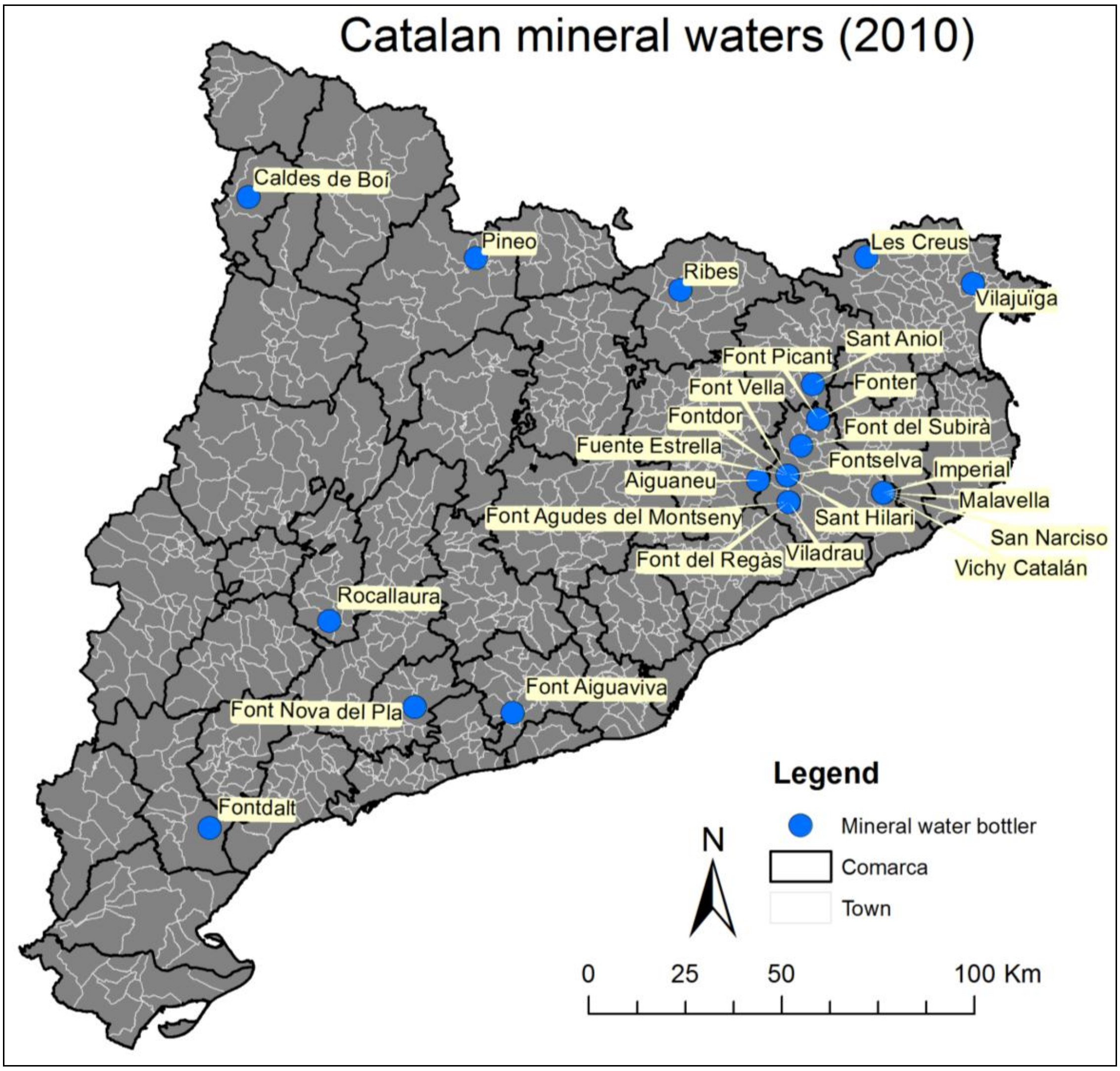


Figure 1.12. Location of recognised mineral water bottling plants in Catalonia (2010).
Source: Author's work. Data regarding bottling plants location from (European Union 2010).

In conclusion, the bottled mineral water sector is currently a thriving industry both in Spain and in Catalonia, with dozens of recognized mineral water brands producing and selling their bottles to customers eager to purchase them. Catalonia is the largest producer both in terms of quantity of recognised springs and in litres bottled and sold. This regional pre-eminence principally stems from the Montseny-Guilleries area, which could be considered as the bottled mineral water cluster of Catalonia. However, this relevant role in the market did not materialize overnight; it comes from a long tradition which started over 150 years ago. This thesis will explain how this thriving industry had its origins in a series of factors which came to be at the same place at the same time, starting by the invention and adoption of a suitable package to transport and sell water.

2. Water packaging

Introduction

Water, as all liquids, needs to be kept in containers in order to store it, transport it and use it. Since prehistoric time humans have dealt with the problem of how to store water with the best solutions they could find, from sewn skins to PET bottles. Water consumption is extremely bonded to the container available at each point in history, even today when we buy a plastic bottle full of water we are mainly paying for the storage, transport and marketing of the bottle, not the water it contains. So the availability of different materials has conditioned the popularity of water, as well as other liquids as a commodity. Before the invention and widespread of plastic bottles, water transport was a difficult matter, so the first mineral water distribution companies had to choose between an array of materials which existed in the 19th century, which was when the industry hatched.

The materials available back then included animal skins, earthenware, wood, metal and glass, so the first manufacturers had to choose between them taking into consideration variables like the price, its resilience, its availability or its capacity to keep the water clean. The present chapter explains why they were or were not chosen by the manufacturers as the ideal containers to sell and transport mineral water in its beginning stages.

2.1 Ceramic

Apart of animal skins, horns and wooden pottery, which had been used since prehistoric times, the first elaborated containers for liquids where made from heated and subsequently cooled clay. This improved previous storage systems because by the heating of the clay organic matter is removed from the container, which decreases the risk of the growth of microorganisms which would foul the water. In addition to that, once a clay has been manufactured into ceramic will not chemically interact with water, so water will be able to remain inside a ceramic vessel indefinitely without being altered (Chapelle 2005).

The main problem of this system was the excessive weight of ceramic containers, which added to the weight of the water content –one litre of water equals one kilo of weight-, meant that transporting large quantities of water from the source to the village meant a large amount of effort. As it has been explained earlier on, this effort was increased by the fact that clean water sources usually were far away from populated places, unless a public water distribution service was available. This meant that in order to obtain the required daily amount of water many trips to the source had to be made, often by young ladies or boys (Figure 2.1), carrying many kilos on their backs to supply their families with water to drink, cook or wash.

In Catalonia, and most of Spain, special ceramic water containers called *càntirs* in Catalan and *botijos* in Spanish (Figure 2.2) are still used, even though their popularity is declining because of the proliferation of domestic running water and the increase in the use of plastic bottles. Even with this decline in use, some important artisan manufacturing centres still produce them in Catalonia in towns like La Bisbal d’Empordà, Verdú, Breda or Argentona, where a *Càntir* Museum exists. Càntirs have been very popular throughout history because of their cooling effect on water. In dry and hot climates càntirs are able to cool the water they contain significantly by what is known as “breathing”, that is the evaporation of the water thru the porous surface of ceramic helps to cool the content of the càntir. By the use of a formula a theoretical maximum cooling effect of a càntir can be calculated (Zubizarreta, Pinto 1995), but a couple of examples can help to obtain an idea of the potential cooling effect of a càntir:

Figure 2.1. Statue of young boy carrying earthenware water containers (*Càntirs*) at Plaça Urquinaona in Barcelona.
Source: Author's work

Example 1. If 3.2 litres of water are introduced into a càntir at 39ºC and the air temperature is also 39ºC with a relative humidity of 42% in seven hours the water temperature will have decreased 15ºC. (Zubizarreta, Pinto 1995)

Example 2. If a càntir is located in a place with an air temperature of 31ºC, a humidity of 20% and an air pressure of 1000 mbar the temperature will potentially decrease to 16,5ºC[12]. (Linés Escardó 1983)
Example 3. If the air temperature is 24ºC and the relative humidity is 80% the potential decrease in temperature will only be of two degrees[13]. (Linés Escardó 1983)

As these examples show, the càntir has lower efficiency rates in cooling water if the temperature is lower or the relative humidity is closer to saturation than with hight temperatures and low relative humidity. This is why càntirs and botijos are popular in places with Mediterranean climate like the Iberian Peninsula, where during summer months daytime temperatures are usually higher than 30ºC and relative humidity can be quite low, especially in the hinterland further away from the sea (Sacasas i Lluís 2007).

Figure 2.2. Càntir at the town of Folgueroles. [14]
Source: Author's work

[12] This value is theoretical; the real value will be slightly higher because of heat conduction.
[13] Ibid.
[14] The indents seen at the top of the bench are to capture the transpired water and transport it to a plate located on the floor. The water would then be used as drinking water for the household pets.

So if càntirs are so good and popular in cooling water, why did they not become the origin of mineral water transport, sale and distribution in Catalonia? The answer to this has three factors, the already mentioned weight, their fragility and their porosity. Most pots made from clay are quite heavy, which limits quite sharply the amount of them a person, wagon or ship can carry. Their fragility is also a problem when transporting them, because with the vicissitudes of pre-Industrial Revolution travel it was likely that some of them would break and lose their contents during the trip before reaching their destination. Even though, the most important drawback was its best characteristic, porosity.

As it has been explained earlier, clay pottery has the advantage of keeping water fresh when it is hot outside of the recipient, which is the reason why it was so popular in Catalonia for centuries. Even though, water becomes fresh via evaporation, which means that water will eventually disappear from the càntir which, in addition to the weight, means that the amount of effort put into transporting mineral water from the source to the consumption place would be scarcely worth. As an example, the water càntir used as example would lose almost all its 3.2 litres of content in only three days.

Different solutions to avoid losing so much liquid were to add a slip glaze made from silica or increase the temperature at which the clay is heated. These solutions allowed maintaining the quantity of water almost inalterable for longer periods than with low-fired (~1000ºC) pottery, but meant losing the cooling effect of these containers. In Catalonia these solutions were used by ancient Greeks in the colonies of Empúries and Roses (Miró i Alaix, M. Teresa 2006), but were spread across the country by the Romans (Tremoleda i Trilla 2000). Even though these improved techniques to store and transport liquids settled in Catalonia for centuries, they were not the beginning of mineral water transportation in a big scale for the same reasons as low-fired ceramic did not, excessive cost and too much weight. Water transport as a commercial business was quite exceptional because in order to be profitable liquids had to be sold at a very high price, so only expensive ones like wine or olive oil were transported across Europe and Catalonia (Freixas Dargallo 1966) because they were worth the effort.

Another possible solution was porcelain pottery, but apart from being also heavy and fragile it was not manufactured in Europe until the 18th century, so previous porcelain products had to be imported from the Far East, which meant that it was an extremely expensive and luxurious product (Doherty 2002). Since it was so expensive it was unlikely that a merchant would risk breaking a porcelain pot to carry something of the value of water, so it was not used for distributing large quantities of water. Even after the discovery of how to produce porcelain in Europe by Ehrenfried Walther von Tschirnhaus and Johann Friedrich Böttger in the early 18th century, porcelain remained expensive in Europe (Dillon 2008) and Catalonia discouraging its use as water transport material.

In conclusion the use of ceramic materials to transport and store water had some positive points but also many drawbacks which limited considerably how far water could be distributed or for how long it could be stored. Even with these limitations ceramic pots have been extremely common as water storage and transport containers in Catalonia since Roman times until recent years, but because of their characteristics their use has been limited to short distances. So even if ceramic pottery was adequate for transport from the local water source to the home of a family, it was not a satisfactory solution for long distances, which meant that other water storage containers had to be used to start a profitable mineral water distribution business.

Albeit all those drawbacks, the first bottlers of mineral water did use ceramic containers to sell their products because they were the cheapest and most convenient receptacles available at the time. These bottles can be considered an anecdote because they were used only by the bottled water pioneers –mainly in Germany- and were usually substituted by new materials as soon as they became available. Some early examples can still be found in the hands of private collectors (Figure 2.3) or museums, but they are quite rare and sought after.

Figure 2.3. Stoneware mineral water bottles from Germany
Source: Author’s work. Picture taken at the Oliver-Rodés collection.

2.2 Wooden Barrels

An alternative to ceramic pottery was to use wooden barrels to transport liquids over long distances. Wooden barrels are lighter than the equivalent clay products, and in places with plenty of forests like Catalonia they are not difficult to manufacture, but they were not the appropriate solution to transport water either.

Even if some controversy exists about where wooden barrels were invented, it is quite probable that wooden barrels were invented by the Gauls (Toussaint-Samat 1994), a pre-Roman group of people who approximately lived in what is nowadays France, Belgium and parts of northern Italy. Notable Romans, like Cato the Elder (234-149 BC) or the Greek Strabo already mention barrels in their works, but one of the first descriptions of Gaul barrels is made by Julius Caesar (100-44 BC) in his Gallic Wars (Book 8, XLII), although not as a liquids container but as an attack weapon:

> *"Alarmed at this calamity, the townsmen fill barrels with tallow, pitch, and dried wood: these they set on fire, and roll down on our works"*[15] (Caesar 2009:179)

Pliny the Elder (23-79 AD) also describes a Gaul barrel in his Natural History (Book 14, XVII, 132) and finds them singular, so it was a novelty to him, and this time describes its use as a wine storage place (Pliny the Elder 1998:268):

> *"In the vicinity of the Alps, they put their wines in wooden vessels hooped around, during their cold winters, they even keep lighted fires, to protect the wines from the effects of the cold. It is a singular thing to mention, (...)*[16]*"*

Wooden barrels were soon adopted by Romans as a means of transporting liquids because they are more resilient and lighter than their earthenware counterparts. In

[15] The same text in its Latin original version reads like this: *"Quo malo perterriti oppidani cupas sebo, pice, scandulis complent; eas ardentes in opera provolvunt eodemque tempore acerrime proeliantur"* (Caesar 1869:119).
[16] The same text in its Latin original version reads like this: *"Magna et collecto iam vino differentia in caelo. circa Alpes ligneis vasis condunt tectisque cingunt atque etiam hieme gelida ignibus rigorem arcent. rarum dictu, (...)"*(Pliny the Elder 1890:272).

addition to those advantages, since they have bowed sides, barrels can be rolled over by pushing them, making them easier to manhandle once they are outside of the wagon or the ship that transported them. An example of how fast Romans integrated barrels to their culture is that Pliny the Elder described barrels as “a singular thing to mention” around the year 78 AD, but they already appear as a standard liquids container used in ships in Trajan’s column (figure 2.4), which was built around the year 113 AD. This means that it took less than thirty five years for Romans to incorporate barrels to their armies, which meant that they were spread across the Empire, which included what is nowadays Catalonia.

Figure 2.4. Trajan’s Column detail. Sailors loading barrels into ships.
Source: Edited from (Rome-Roma 2009)

Barrels were more convenient than ceramic amphorae and vases, so they were soon used to transport wine and other liquids across the Empire, which amongst other regions included Catalonia. Wooden barrels were widely used during the following centuries to transport liquids and other bulk goods like nails, powder or coins. For instance barrels were quite important during the Age of Discovery, when they were used to contain the supplies needed to travel during weeks across oceans. Many contemporary chroniclers describe in their books the use of barrels to carry powder, sand (Fernández de Oviedo 1851)[17] or even stowaways (López de Gómara 1922). But even before, during and after the Age of Discovery barrels were mainly used to transport wine form the production areas to the consumption places (Hidalgo Togores 2003). A good example of that traffic

[17] Fernández de Oviedo describes in the year 1535 that a barrel transported in a transoceanic ship had a capacity of between three or four *arrobas* which roughly equals to 48-65 litres.

was the transport of wine between the Atlantic coasts of France, Spain and Portugal and England first and the United Kingdom later.

The relationship between wine, liquor and forests and wood has been well studied, especially in France, where this relationship has been quite strong throughout history (Corvol 2002). The main wood type used to build barrels in France is obtained from sessile oak (*Quercus petraea*) and peduculate oak (*Quercus robur*) because they fulfil all the requirements needed to elaborate quality shooks, like absence of knots, small rings or little heartwood (Lacroix 2002). In Catalonia those species of oak are rarer than in France, they only grow naturally in very humid areas (Bolòs i Capdevila, Oriol de 2001), which in Catalonia can be found in relatively high areas and the Olot area (Solé i Sabarís 1958). As can be seen in figure 2.5, peduculate oak can be found only in some areas of the Val d'Aran, where climate is influenced by the Atlantic Ocean hence it is humid, and Olot, an area with a peculiar micro-climate famous in Catalonia for its high precipitations. Sessile oak can be found in mountainous areas between 1.500-1800 metres above sea level, and the Montseny and Prades ranges (Institut Cartogràfic de Catalunya 2009).

This means that barrels in Catalonia had to be manufactured using other types of wood not as valued, like chestnut trees (*Castanea sativa*) and certain types of pines (genus *Pinus*), so best wines were stored in barrels or built from shooks imported from France (Rico Boquete 2002). Barrels built using autochthonous Catalan wood were built in many places of Catalonia to store different materials and liquids. Some notable uses of the Catalan barrel industry was the storage of salted anchovies and herrings in the coastal towns of l'Escala (Boix 2007), Tossa de Mar, Lloret de Mar or Blanes (Llovet 1984), the storage of "aiguardents" (like brandy or cognac) in areas like the Penedès, the Camp de Tarragona, and the Maresme regions (Giralt i Raventós 2008) and obviously wine.

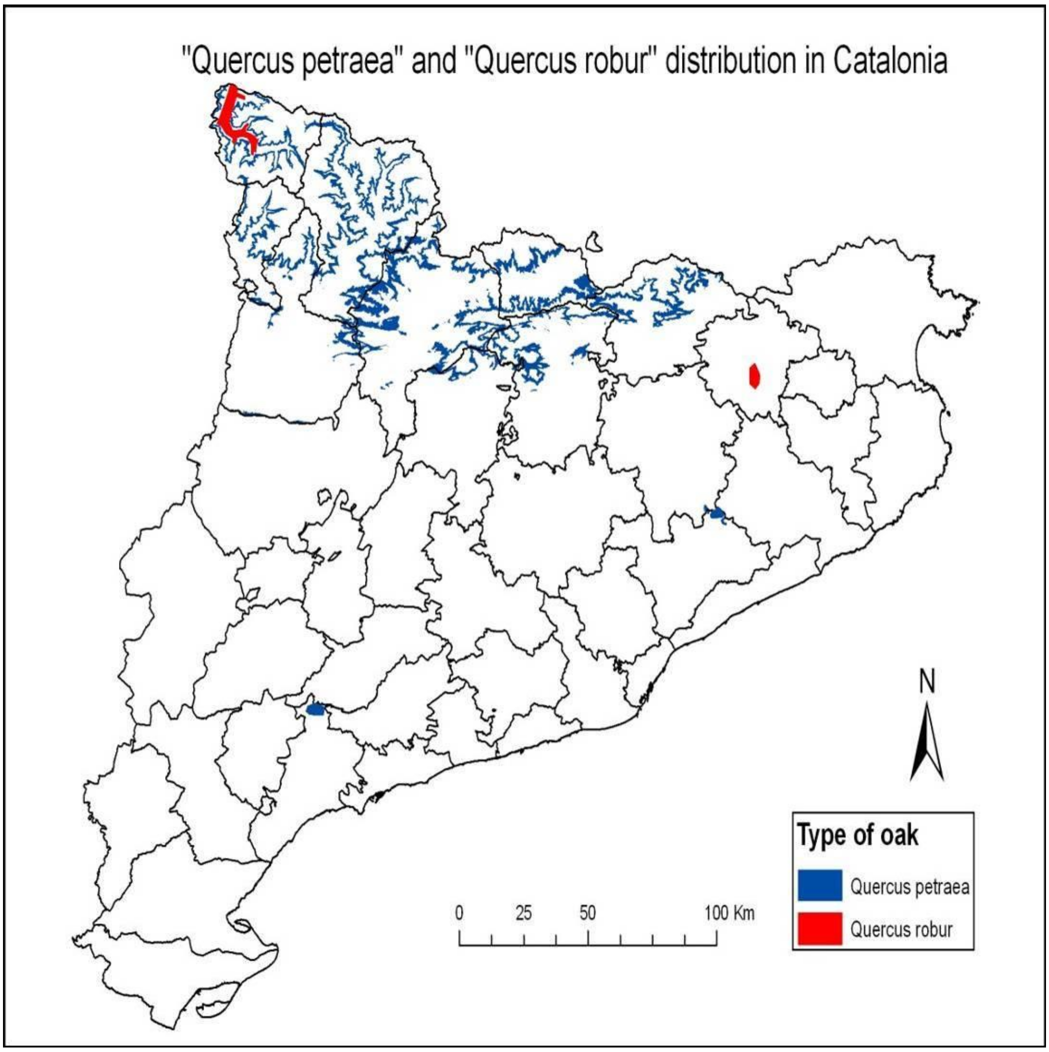


Figure 2.5. *Quercus petraea* and *Quercus robur* distribution in Catalonia
Source: Author's work. Data obtained from (Institut Cartogràfic de Catalunya 2009)

Barrels were used to transport water as well; there are references of barrels being used to carry water in the ships that crossed the Atlantic Ocean towards the Americas. For example Fray Bartolomé de las Casas mentions how in the 16th century the Spanish sailors sought water when they arrived to America and how they used barrels to store it once they found it (Casas, Fray Bartolomé de las 1875). Even if barrels were used to transport water, it was not a common commercial practice as the transport of other liquids or bulk goods. In order to transport goods up to a certain distance, the final price of the good has to be higher than the cost of transporting it plus a quantity for the middleman and the owners (Rus Mendoza, Campos et al. 2003). This means that only merchandise with high value could be transported over long distances using traditional means like carts, wagons or sailing ships. Some examples of goods transported over medium and long distances up until the end of the Ancien Régime were wine, oil or spices, all of them products that could be stored in barrels, but most importantly they were goods that could be sold at high price in areas where there was a lack of them. On the other hand, water is a very common good which can be easily found in most populated places, so even if it is necessary to sustain human life its monetary value is quite low. Adam Smith already stated this apparent contradiction when he stated the paradox of value (Smith 1776):

> "*The things which have the greatest value in use have frequently little or no value in exchange; and, on the contrary, those which have the greatest value in exchange have frequently little or no value in use. Nothing is more useful than water; but it will purchase scarce anything; scarce anything can be had in exchange for it. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it.*"

So even though water is indispensable to human communities, it was not worth the cost of transporting it. In fact, water is so necessary and human communities need so large amounts of it that in the event of a persistent lack of it, people tend to abandon their settlements and look for another place to live, because buying all the water needed not only to drink but also wash, clean, irrigate or sustain domestic animals would be economically unsustainable over time. This means that even if water is necessary it was not worth the effort of transporting it due to the lack of monetary value and to the amount needed to sustain human life.

As it has been mentioned earlier on, notwithstanding this drawback water was stored and transported using barrels for own consumption or for very specific uses and needs. The problem when using barrels to store water was that barrels change the flavour and properties of water, so water could only remain in them for short periods of time before being consumed. How wooden barrels change the properties of water can be explained by observing the more studied process wine suffers when inside a barrel. When wine is poured into a barrel a process which mingles the wine, the wood and the outer air starts, and leads towards the aging of the wine, and a similar process happens when instead of wine water is poured.

As figure 2.6 shows, wooden barrels act as a permeable barrier between outer air and the liquid inside. Wooden barrels allow the penetration of air into their receptacle thru the wood, between the shooks or through the barrel's cap, which affects the characteristics of the liquid inside. Imperfections in the barrel's manufacture also allow some liquid to leak between the shooks, which means that some of their content is lost. The loss of liquids can be up to 5% per year under standard circumstances, but it may vary depending on the climatic conditions, being higher in low relative humidity areas (Hidalgo Togores 2003). Since wood is an organic and up to an extent porous material the liquid it holds and the wood interact in a bidirectional way. Another phenomenon is that liquid filters into the shooks up to a depth of 5mm or 6mm creating a layer of saturated wood called fibres saturation point (FSP) where all the fissures of the wood are filled with liquid. But not only the FSP layer is affected by the fluid, the shook suffers from the influence of the liquid all the way up to the exterior of the barrel, but the level of humidity of the shook declines progressively being as low as 15% towards the outer parts of the barrel. The inverse effect also occurs when wooden particles precipitate and mingle with the contained liquid changing its characteristics. The last phenomenon which happens when a liquid is stored in a wooden barrel is that since wood is an organic material microorganisms find it a proper place to grow, so if a non-alcoholic liquid is stored it can be contaminated by them.

All these phenomena are a major input when making good wine, but they can convert perfectly potable water into foul water. The main difference between storing wine and water in a wooden barrel is alcohol, which prevents the growth of microorganisms guaranteeing the healthiness of wine when storing it for a long time. On the other hand, water is a good environment for the growth of microorganisms which can harm human health. The entrance of air into a wooden barrel filled with water gives bacteria and algae nourishment to reproduce them and make water undrinkable. The infiltration of water into an organic material like wood also produces adequate conditions in which microorganisms can grow. This can be avoided by varnishing the shooks and creating a protective layer that impedes the direct contact of water and wood, the infiltration of water into the shooks and the precipitation of wooden particles into the water, holding back the proliferation of bacteria. This can be a provisional solution which slows down the water infestation of microorganisms, but it does not properly impede the flow of air into the barrel and requires a good preservation of the protective layer, because in case of degradation water can become quickly foul again. In fact, when water is stored in wooden barrels it rapidly turns into a greenish and frothy liquid unsuitable for human consumption (Ritchie 1986). This was a problem especially for sailors travelling amongst tropical areas, because while diseases and plagues became less common as the boat spent more time offshore, sailors suffered from yellow fever epidemics even weeks after departure. This was because insects that transmitted the disease would lay their eggs between the barrel's wood and the water before departure and infect sailors some time afterwards (Ritchie 1986).

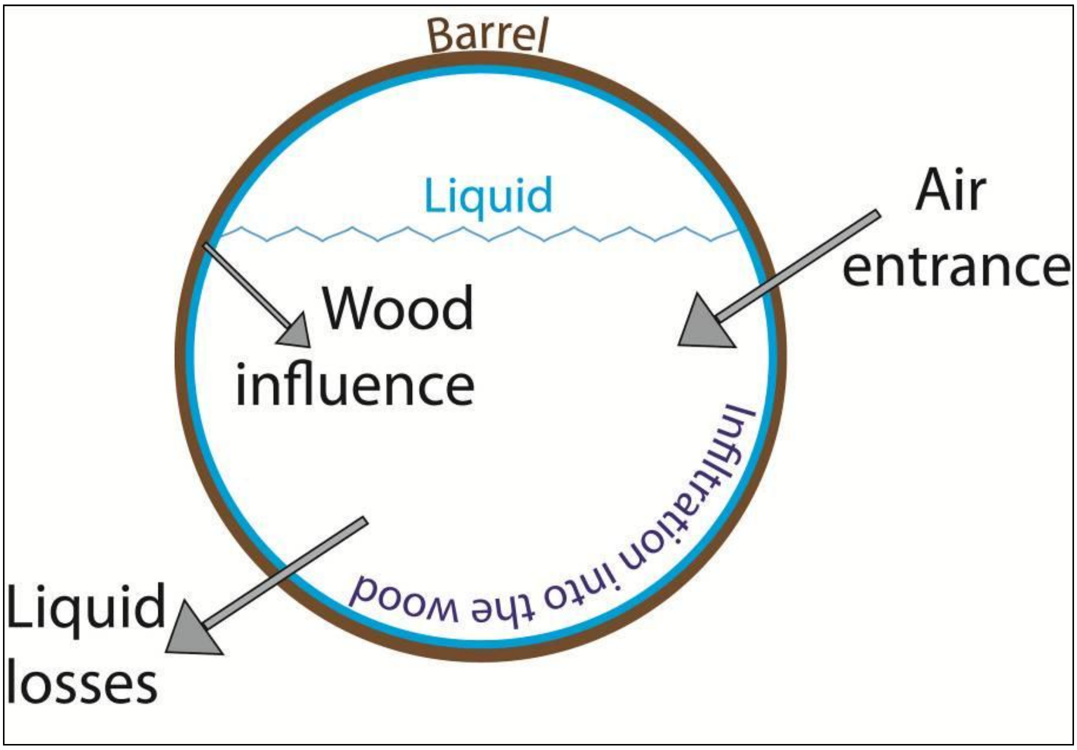


Figure 2.6. Diagram of the processes which happen to a liquid when inside a wooden barrel
Source: Adapted from (Hidalgo Togores 2003) by the author.

In addition to all these drawbacks barrels, as càntirs, have losses of liquid, which even if minor, could mean that transporting water from the production fountain to the consumption area became economically unreliable because it could mean that the price would have to be risen by the already mentioned 5%. Apart of health and economic reasons, barrels were not an idyllic solution because unlike earthenware, which keeps the water crisp and since it is a cooked inorganic material does not transmit any flavour to the water, wooden barrels transmit a wooden flavour to the liquids they contain nor do they keep it especially fresh. This flavouring characteristic, highly appreciated in the elaboration of wine, brandy or whiskey can be unpleasant when it is applied to water. All this meant that the same characteristics which made wooden barrels ideal for storing wine made them unsuitable to store water for a long time or transport it over long distances since the discovery of barrels in Roman times, so the trade of potable water was not boosted by them.

However, some Catalan companies did use wooden barrels to transport water from the source to distribution centres located in cities where glass bottles were filled. This practice was usually carried out by lesser quality brands or counterfeit mineral waters and was highly criticised by traditional mineral water companies, who complained arguing that this practice was unhealthy (La Vanguardia 2011f). Instead, they insisted in advising consumers to avoid those untrustworthy brands and purchase water which had been packaged directly into the bottle.

2.3 Metal

The use of metallic containers to store and transport liquids is quite recent compared to earthenware and wood because of the price of treating metal before the Industrial Revolution, its weight and the oxidation some metals suffer when in contact with liquids. Even if some metal containers, like silver jars, were used to serve water and other liquids since ancient times, liquids storage and transport systems made from metal was quite limited until the end of the 19th century.

Amongst the different reasons why metal containers were not as popular as ceramic or wooden ones one could find the higher price of metal, its excessive weight or the oxidation process some metals suffer when in contact with the oxygen water has. The origin of modern metallic containers dates from the Napoleonic wars, when Napoleon organised a contest with a succulent prize to the person who could invent a way of preserving food for long periods of time (Weeks, Alcamo 2007). This was of paramount importance for him, because during the invasion of Spain and Portugal first, and the failed conquest of Russia later, his armies could not gather enough food to keep the soldiers nourished and this led to the demoralisation of the troops (Clausewitz 1992). Many solutions were sought, but who found the answer was a Parisian patissier called Nicolas Appert (Figure 2.7), who won the 12.000 francs of the prize. His innovation consisted in introducing food inside a glass flask, boiling it in a pot filled with water and after a while closing it with a cork tap which hermetically sealed the contents allowing their preservation (Appert 1831). As a condition of the prize, he was asked to write a book explaining how to preserve food, so he wrote *The Art of Preserving Animal and Vegetable Substances*, which was the first publication about food preservation and a reference for the following authors and inventors in the field (Barbier 1994).

Although being a great step forward in food preservation, Appert's invention had a big drawback, the use of glass as the food container. Glass, as it will be explained in the following section, is an inorganic material, which prevents the proliferation of pathogens, and it cannot be oxidised unlike many metals, but it's very fragile. This meant that soldiers and hauliers had to be very careful, because in any moment glass could break and lose its contents or just crack and allow the entrance of bacteria which could spoil the food.

Figure 2.7. Statue of Nicolas Appert at Massy, France. The plate below says "Inventor of the food preservation process".
Source: (Pagnier 2008).

At this point in the history of food preservation is when metallic containers first appeared as a mass preservation system with the invention of the can. It was the British merchant Peter Durand who copied Appert's technique, but together with the use of glass, he patented the technique using also pottery, metals or tin coated iron cans (Repertory Office 1811). These tin containers were popularly known as "iron canisters", which with time evolved to the nowadays common word "can" (Costenbader 2001). Even if it was Peter Durand who invented preservation using tin cans, it was not until 1812 when he sold the patent for £1000 to Bryan Donkin and John Hall that tin cans became popular.

Bryan Donkin was a British engineer who helped improving a popular paper-making machine known as the Fourdrinier machine (Clapperton 1967), but he diversified his interests into food preservation when he bought Durand's patent. Donkin and Hall were more interested in creating a market for iron sheets than food preservation, but they achieved the popularisation of cans as a means of keeping victuals edible for long periods of time (Clow, Clow 1992). To popularise canned food Donkin contacted some important figures like Admiral Crochane –who would become the tenth Earl of Dundonal and was in charge of the West India Naval Station- or Sir Joseph Banks, president of the Royal Society (Clow, Clow 1992) and offered them to try canned food as a means of feeding sailors. Their influential testimonials granted Donkin's firm a contract to supply canned food to the British Navy in 1818, making tin coated iron cans popular as an effective way of storing food for long periods of time. As soon as the 1820s canned food was a recognised article of commerce in Britain and France (Robertson 2006).

This success was soon followed by the manufacture of tin water containers to store water in ships and avoid the health hazards that involved the use of wooden barrels (Ritchie 1986). The use of tin coated iron as a material to build water containers quickly spread across Europe because it was a relatively cheap material, it was lighter than the equivalent earthenware containers, it was healthy and, as importantly, it was a material of the time. The Industrial Revolution was based on coal, water and iron (Kohlmaier, Sartory et al. 1991), so metallic containers where a technological innovation prone to be fashionable as well as more convenient than other materials. In Catalonia, one of the few places in the Iberian Peninsula where a proto-industrialisation process took place (Maluquer de Motes Bernet, Jordi 1998) and a very important industrialisation centre (Thomson 1994), metallic containers were promptly adopted. There is photographic evidence of metallic containers being used in Barcelona by water carriers as figure 2.8 shows. Even though being used to freight large quantities of drinking water for commercial uses, domestic water consumption was still being carried with traditional ceramic càntirs. As can also be observed in Figure 2.8, the women in the background store water from the fountain using ceramic pottery to obtain their domestic share of public water.

Figure 2.8. Water carrier in Barcelona (unknown date, between 1905-1911).
Source: (MARTÍN PASCUAL 2007:1).

Metallic cans and barrels were more resilient than glass, so that was big plus, but by the time most bottled water companies were founded metal for carrying water was still not popular. Tinned cans, which as it have already been explained, became popular around the 1820 and were mainly used to store solid food. For example, the first canned soup was manufactured in the United States in the year 1897 (Robertson 2006), when many water bottling companies had already been established. As figure 2.9 shows, this new method to preserve food was manufactured by hand one can at a time, which meant that sometimes mistakes were made. The can itself was not the trouble; the problem was that many times the welded seam –usually lead- that united the lid with the can was not properly sealed and bacteria and other pathogens were able to enter the can and pollute the contents. Another problem was that some times, if the food inside the can was not properly boiled and spores of bacteria like *Clostridium botulinum* –the bacteria that causes botulism- could enter the can before being sealed and reproduce in the anaerobic conditions which led to many dead over the years (Rosaler 2003). In order to minimise the occurrence of botulism it was necessary to boil the can and its contents at 121.1ºC for 3-4 minutes and quickly seal the lid to the can (Holdsworth, Simpson 2007).

Figure 2.9. Worker welding the lid and the can by hand.
Source: (Fitch, Halperin 2007)

Metallic receptacles became almost omnipresent by the end of World War II, when industrial techniques became highly efficient and allowed to mass produce canned food.
Cans became more secure when instead of having three parts, the side, the bottom and the lid, they were simplified by using only one piece of metal to construct the bottom part and the side. It increased security because it reduced by half the number of soldiering needed to elaborate them, achieving at the same time higher production rates thanks to the fewer parts involved in the manufacturing process.

Even if cans had become popular it was not until the introduction of easier ways to open them and access their contents, together with the arrival of new materials –aluminium and stainless steel- that they were commonly used to store liquids (Fitch, Halperin 2007).

At the beginning, cans had a cylindrical shape with sealed covers at both ends. This meant that in order to open them the consumer needed a can-opener, and without one getting the contents out of the can was an arduous task making them not as handy as bottles to carry around. In addition to that, a can opened using a can-opener has sharp rough edges which make it impossible to drink directly from them without the hazard of cutting the consumer's lips. The necessary innovation to definitely popularise the metallic can as a means of containing liquids was the invention of the detachable ring-pull tab figure 2.10 in 1963 by the American Ermal (Ernie) Fraze, who at the time was working at the Dayton Reliable Tool Company (Priest, Stewart 2006). During a picnic Ernie struggled to open a can because he had forgotten a can opener, so he decided a solution had to be sought (Petroski 1998). This innovation made canned drinks immensely popular and millions of them were produced across the globe, which meant that millions of ring-pulls could be found across the streets and roads because consumers were prone to throw them to the ground instead of using bins, becoming a big environmental problem. This changed when in 1974 Daniel Cudzik, an employee of the aluminium manufacturing company Reynolds Metals form Virginia, patented the stay-tab figure 2.10. The mechanism used a lever to push a part of the top part of the can inside while remaining attached to the main body, hence not leaving any parts detached. This modernization of the can opening mechanism allowed minimising the environmental impact of opening the can, it increased convenience and security and it meant the preponderance of metallic cans as the most common way in which drinks were sold and consumed in a single serving's format. But the success of the can was not only due to the opening mechanism, without the appropriate materials cans would have never become as popular as they have been since the end of World War Two and nowadays.

As it has already been explained, original metallic cans were made from tin coated iron. This made them relatively cheap and rustproof (Ahmad 2006), but not as secure as desired. The tin protective coverage could be scratched leaving the iron core exposed, which meant that it could become oxidised and pollute the can contents. Even though, while lacking a better alternative, cans were produced by the use of tin-plates from the can invention in the 1810s until the appearance of two new materials, stainless steel and aluminium.

Figure 2.10. Two ways of opening a can. Detachable ring-pull tab (left) and stay-tab (right).
Source: Unknown author

Stainless steel was first discovered during the first quarter of the 19th century by Pierre Berthier, a Frenchman who also discovered the existence of alumina in bauxite, but during the 19th century metallurgists were not able to mass produce it because they were unable to produce the combination of low carbon and high chromium steels needed to achieve commercial stainless steel (Inc Icon Group International 2008). It was not until 1911 that the German Philip Monnartz reported the relationship between high chromium content and corrosion protection in alloyed iron and only two years later the first cast of stainless steel was produced in the British city of Sheffield (Cardarelli 2008). This new material allowed to elaborate cutlery which was resilient to the acids some aliments have, but also allowed to create cans which were light, durable, mouldable and most importantly apt to store food and drinks without interacting with them, which made it a good choice to elaborate cans with.

The other new material was aluminium, which was known by the ancient Greeks but in an impure form. It was not until 1821 that Pierre Berthier discovered that a reddish rock was partially made of alumina that the primary source of aluminium was found. Brethier discovered this rock in the French town of Les Beaux en Provence, and this is why the rock from which aluminium is obtained is called bauxite (Kogel, Trivedi et al. 2006). Four years later, the Danish chemist Hans Christian Oersted was the first person who obtained pure aluminium from bauxite (Consejo Superior de Investigaciones Científicas 2010), but the process he used to obtain it made aluminium too expensive. It was not until the decade of the 1880s that two major innovations in the aluminium manufacturing process took place. On one hand Karl Bayer described in 1887 a two step method to obtain alumina from bauxite by washing it with a hot solution of sodium hydroxide and heating at 1050ºC the resulting material to evaporate the remaining water and achieve alumina. This process is known as the Bayer process (Habashi 2005):

Step 1, obtain aluminium hydroxide: $Al_2O_3 + 2\ OH^- + 3\ H_2O \rightarrow 2\ [Al(OH)_4]^-$
Step 2, evaporate water and obtain alumina: $2\ Al(OH)3 \rightarrow Al_2O_3 + 3\ H_2O$

Alumina has a melting point of 2050ºC (Allied High Tech Products, Inc. 2010), too high to be commercially viable. To bypass this limitation, almost at the same time as Bayer described his process, Hall in the United States and Heroult in France independently discovered that by the use of cryolite and electrolysis alumina could be transformed into aluminium. The material obtained by this method has a melting point of around 1000ºC, which can be achieved in an easier way making the manufacture of aluminium utensils cheaper and therefore more profitable. All these innovations allowed producing large amounts of aluminium without making it too expensive by the beginning of the 20th century (Valeton 1972).

Once stainless steel and aluminium were cheap to produce they became the main metals used to produce cans to store food and liquids, becoming the preferred means to store and transport sodas until today. They do not easily interact with their contents and consequently they are safe for storing food. In addition to that they are opaque, which means that no light can penetrate into the can and help the growth of microorganisms, and they are quite resilient, it is quite hard to break them accidentally, which is useful when transporting them. So if aluminium and stainless steel are so good to store liquids why were they not used by the early bottling industry to store and distribute their products? In fact, why are there so few brands which use metallic containers to sell their water nowadays if cans are produced faster and cheaper than current PET bottles[18]? The answer has to do with unfortunate timing.

As it has been explained, metallic cans were first popularised during the first quarter of the 19th century, and it was around that time that the bottled water industry started in the United States and Europe. This could have led to the use of cans to store water, but water was not as valuable as, for example, meat or vegetables, so this new technology was first used with solid food which could be sold to armies and navies to feed the troops. This meant that originally, and until can manufacture became automated, cans were more valuable to store other foods than plain water, so the main drawback metallic containers had was that by the time they became really popular water was already sold and consumed using the material that will be explained in the following section, glass.

But this raises a new question; if nowadays cans are so popular to store cheap liquids why are they not so popular to store mineral water? The answer is because of culture. People have seen bottled water for over a century in transparent or translucent containers, either made from glass or plastic, so consumers tend to associate mineral water with transparency. A similar thing happens with wine bottles made from glass, even if there are alternatives like tetrapak, plastic or cans only low quality wines tend to be stored using those materials.

Both phenomena are caused because consumers irrationally associate glass or transparency with quality, when it would be better for the preservation of wine and water to safeguard them from any light. In the case of water another problem comes into place when it is stored in a can. Metal is usually associated with industry, not nature, so the first reaction when a consumer is asked to drink water from a metallic can is prudency. This reaction may not be only because a prejudice towards opaque water containers, it

[18] A modern can assembling machine can produce up to 33 cans per second (Fitch, Halperin 2007).

may be that deep in the sub-consciousness of citizens water in touch with metal is dangerous, it may rust the recipient. As it has been already explained that is not true for stainless steel or aluminium, but consumers are wary of it even if they are not conscious about it. The other reason why opaque water recipients are not popular is that consumers cannot see thru them, meaning that if the water is foul they would not notice until they tasted it, while if the container is transparent they can quickly judge if the water has a healthy colour or not. One could argue that soft drinks and beer are commonly sold in opaque cans and consumers buy them by millions without trouble, but water is not like soft drinks or beer. Sugar and alcohol preserve food, so it is more difficult for a soft drink or beer to become foul, so consumers do not need to be so wary about seeing the contents before drinking them. It should be also stressed that water can be stored in modern cans without the contents being influenced by the metal, so flavour is not an issue that impedes the distribution of canned mineral water.

Finally, it should be mentioned that canned mineral water is currently being sold, but it does not represent a big share of the mineral water packaging market. Some important brands like Perrier, La Croix (Sundance Beverage Company 2010) or very recently Vichy Catalán (Figure 2.11), together with some minor manufacturers do sell canned mineral water. They are usually sold in vending machines, and that is why they are canned, to be able to put them in traditional vending machines. Canned waters are usually sparkling, like Perrier and La Croix, because consumers are used to drink carbonated beverages from cans, so they do not find it as strange to drink them as it would be to drink still water from a can. In any case canned water as we know it today did not appear until new convenient cans appeared in the 60s and 70s[19].

[19] The first company to use cans as we know them today in Europe was Ben Shaws in 1959 from Huddersfield, England. They produced both sodas and mineral water, but used the cans to store sodas only.

Figure 2.11. Canned sparkling water.
Source: (Aragirona.cat 2012)

2.4 Glass

Natural occurring glass like obsidian has been known since Neolithic times, but at first it was used mainly to produce working tools like bladelets or end scrappers (Yellin, Levy et al. 1996) since it was a quite rare material. It was so rare that some of the first trade routes and cities appeared to trade with natural occurring glass (Conolly 1999).

The first manufacture of human made glass started in what is now modern Syria and, according to Pliny the Elder (Pliny the Elder 1890), it was discovered by serendipity:

> *"In Syria there is a region known as Phoenice, adjoining to Judea [...] The story is, that a ship, laden with nitre, being moored upon this spot, the merchants, while preparing their repast upon the sea-shore, finding no stones at hand for supporting their cauldrons, employed for the purpose some lumps of nitre which they had taken from the vessel. Upon its being subjected to the action of the fire, in combination with the sand of the sea-shore, they beheld transparent streams flowing forth of a liquid hitherto unknown: this, it is said, was the origin of glass."*

Even if the story may be a legend, the place Pliny describes as the birthplace of glass making seems confirmed by archaeological records. The first manufacture of modern human made glass started in what is now modern Syria (Pliny the Elder 1890), where the blown glass manufacture process was invented, and it was spread across the Mediterranean by the Roman Empire. Even if producers did not rely in having to find natural glass and could fabricate it, glass still was an expensive product which, when shaped into a bottle, was used to store more expensive liquids and ointments, like wine or perfumes, but not water. Early examples of glass bottles can be found in Greece (Platz-Horster 1995), Anatolia, the Levant, Egypt or Rome but since it was a manual craft demanding high temperatures to elaborate the final result it remained as a luxury product. In addition to the price, when the Roman Empire crumbled the manufacture of glass shrank and became rarer, turning into an even more exclusive product (Pittaro 2010).

After this dark period in glassmaking, Venice and its neighbour island of Murano became the European reference in glassmaking in the Late Middle Ages (Lanaro 2006), but the bottles they produced where not suitable to store liquids for a long period of time, not even wine, and were used as serving recipients or to store special products like medicines or scents. The breakthrough that allowed the storage of wine in wine bottles was the innovation developed by Sir Kenelm Digby in 1652 and patented by John Colnett in 1661, who invented a darker and thicker bottle with a longer neck and a ring near the mouth to hold the cork properly. These bottles became known as the “English bottle” and they started the glass bottle wine preservation (Pittaro 2010). They were followed by many kinds of glass wine bottles like onions, mallets, cylinders or squat cylinders, which meant that as years went by glass bottles became better, more reliable and cheaper, but they were still too expensive to be used in something as mundane as water, so they were used to store wine and liquors like brandy or cognac. So even if wine was one of the liquids which pushed forward the research needed to manufacture cheaper and more regular bottles it was not this liquid the one which led to the appearance of a glass bottle cheap enough to make bottling water profitable.

It was the invention of gin by Francisco de la Boe, a 17th century Dutch professor of medicine, which helped to improve the elaboration of cheaper glass bottles (Munsey 1971). Gin was invented as a medicine but soon after its invention became a cheap and sought after beverage consumed by people from the lower classes (Figure 2.12). Since many medicines were sold using glass recipients, gin was sold using glass bottles, so gin manufacturers had to discover ways of decreasing the price of the bottles. This led to the discovery of the dip mould technology which allowed creating cheaper bottles (Chapelle 2005). As technology improved during the 18th century glass bottles became increasingly cheaper and around the second quarter of the 19th century bottles made from this material became cheap enough and began being used to store, transport and sell water from the source to the consumption areas (Chapelle 2005). In addition to the progressively cheaper manufacture processes, several innovations made glass bottles even more appealing to mineral water producers. One of the most relevant innovations in glassmaking was the invention of Codd-neck bottles in 1873, which were designed to store carbonated drinks, so sparkling waters could be sold without losing their properties (Polak 2005).

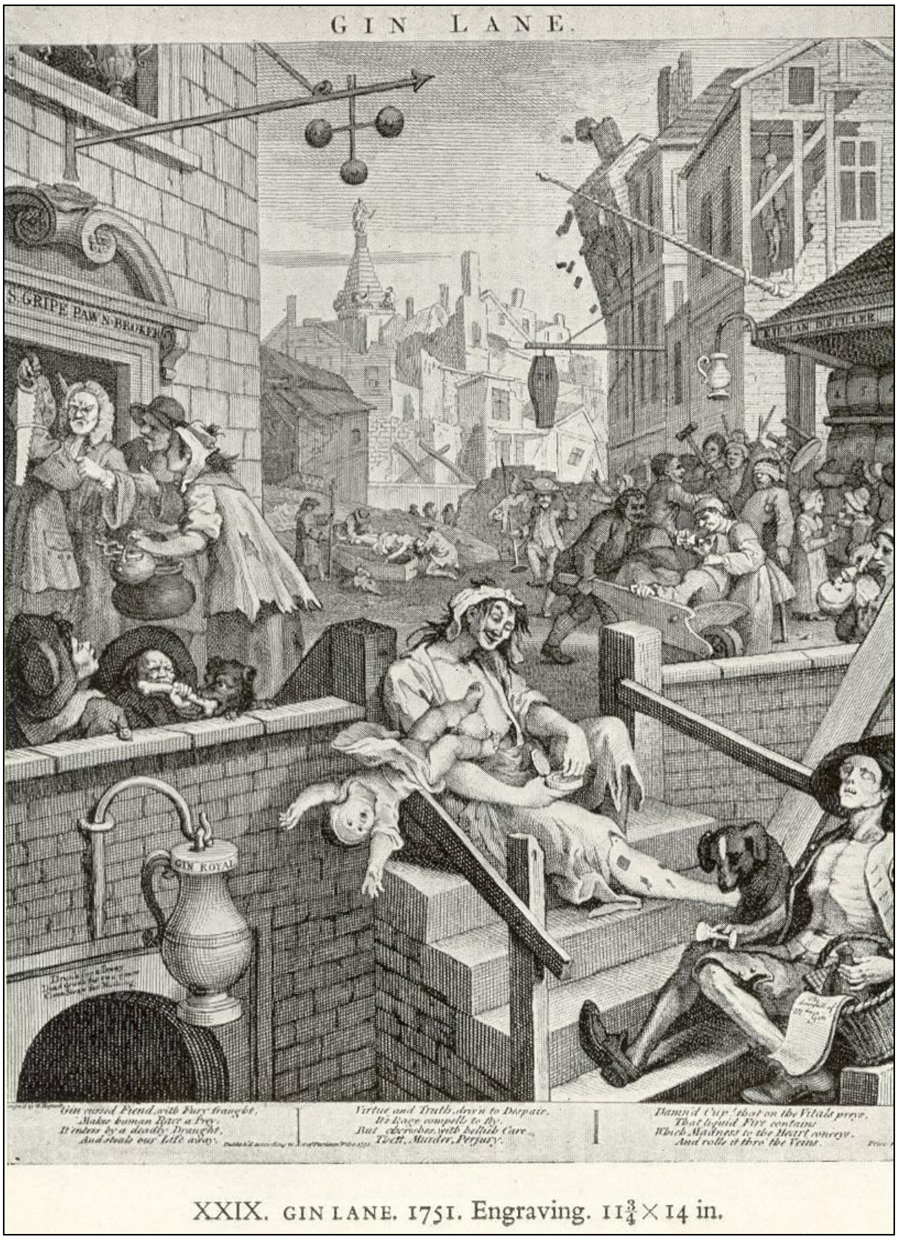


Figure 2.12. "Gin lane" painting by William Hogarth (1751), where the evils of gin are shown.
Source: Public domain.

The emergence of a cheap, healthy -since glass is chemically neutral it does not interact with water, this is why it is used in chemistry or medicine-, relatively light and malleable material meant that mineral water could finally be transported and sold, which led to the emergence of a new industry which successfully lasted in Catalonia between mid 19th century and the Spanish civil war. As it has been explained in the prologue, the origin of the industry cannot be explained only by the use of cheap glass to sell bottled water, other factors where just as important, but it can be said that without glass bottles the bottled water industry would have been marginal until, at least, the second quarter of the 20th century, when metallic containers started becoming popular.

A parallel story happened in the 1970s, when the bottled water industry was languishing and the appearance of plastic bottles, again amongst other factors, meant a new youth for the industry and allowed the increase in consumption and production that has lasted until nowadays. However that is a chapter of the mineral water which does not fit into this thesis temporal limits, so it will have to be explained in future research.

3. From treatment to commodity: public water supply and bottled mineral water

Introduction

One of the geographic requirements when a human population settles in a specific place is having easy access to water (Aldomà i Buixadé 2007). Sedentary communities not only use water to drink, but also to irrigate crops so the next harvest is assured, maintain their domestic animals, wash clothes and run industries or workshops. As it has already been explained, permanent populations, unless properly planned, lead to water contamination because of the concentration of domestic, agricultural and industrial waste in a limited amount of space. Therefore, one of the challenges humans have faced from the times of the Neolithic Revolution has been to provide clean and abundant water to permanent settlements. When it was impossible to meet the necessary water requirements demanded by the population, towns, cities or even empires could collapse (Medina-Elizalde, Rohling 2012).

Easy and reliable access to potable water is consequently a fundamental requirement to maintain progress. However, as climatic and demographic conditions do change, places which were once properly supplied with water may have to endeavour large scale projects to maintain the necessary supply of water to their cities. In Europe, one of the historical times when water resources were stressed was during the Industrial Revolution, when population grew (Kremer 1993) and moved from the countryside to industrial cities (Williamson 1990). Catalonia was not oblivious to this pattern, and as the Industrial Revolution blossomed in many cities, population density increased putting traditional water distribution networks under strain. The result of this process was that waterborne epidemic episodes became recurrent, killing thousands and making clean water a sought after product.

The present chapter explains the relationship between the availability and quality of public water supply and bottled mineral water between the start of the mineral water bottling business and the year 1930. It starts by introducing a brief history of public water distribution in Catalonia and afterwards the effect of the Industrial Revolution is explored in greater detail. The second part of the chapter explains how mineral water gained popularity and became a commodity which substituted tap water and analyses the competition which mineral water faced at the time.

The present chapter mainly focuses in the city of Barcelona and uses it as an example for two reasons. Barcelona is a prime example of the problems –and opportunities- the Industrial Revolution brought to Catalonia, and therefore many of the explained issues can be extrapolated to other Catalan industrial cities. Secondly, bottled water was mainly sold and commercialised in Barcelona due to several issues with tap water and as it had a critical mass which allowed the commercialisation of variety of brands and types of drinks. However, even if mainly focused in the capital of Catalonia, the chapter is not uniquely concentrated in Barcelona as examples and references to other Catalan cities are made.

3.1 Water distribution in Catalonia until the Industrial Revolution[20]

The struggle to provide clean water to human settlements has been constant throughout history. Once cities became large enough, obtaining clean water and keeping it separate from foul water was a goal most rulers had to deal with. In Catalonia, the Ancient Romans introduced the foundations of public water management systems which transported water into settlements and which helped to mitigate the polluting effect human waste produced into potable water by keeping them apart (Pons i Sala, Mayer 1994).

Ancient Romans were famous for their civil engineering works, many of them related with water management. A good example is the *Cloaca Maxima* (Greatest Sewer), which was built in Rome around the year 600 BC by the fifth king of Rome, Tarquinus Priscus (Tapia Gómez 2005). This underground canal, which can be considered one of the oldest of the world, was built to drain the wastewaters of a young Rome by collecting wastes and transporting them underground thru a stone tunnel towards the Tiber River. However, as the city grew the need for water became greater, so not only the city had to dispose the wastewater in a different place, but obtain water from further away. A possible solution would have been to use the Tiber River as a water source, but by the time Rome became a republic it was contaminated to a great extent (Krech, McNeill et al. 2004). Rome, with its great engineering skills managed to obtain spring water located at around 16.4 kilometres from Rome via the use of the Appian aqueduct, built by Appius Claudius Caecus in the year 312 BC (Ashby, 1934). According to the Roman water commissioner Sextus Julius Frontinus by the year 95 AD nine aqueducts supplied water to the city of Rome, adding a total length of over 421 kilometres and bringing water from as far as ninety-one kilometres away from the city (Lanciani 1967).

[20] The intention of this part of the chapter is to put into perspective and give a general approach to the history of water distribution in Catalonia, by no means it intends being an exhaustive rapport of the topic. For more information a good starting point is: (Latorre i Piedrafita 1998b)

But sewage systems and distant water catchments were not only available in the city of Rome, with the expansion of the Roman Empire roman solutions reached all the areas Rome conquered, including what today is modern Catalonia. Romans knew of the importance of keeping foul and clean water apart, even during war time. Roman generals would assure that their camps had a proper source of potable water and designated a separate area where soldiers would relieve themselves, assuring the healthiness of the camp (Goldsworthy 2007). The importance Romans gave to the supply of clear water to their settlements has some of its most spectacular examples in the aqueducts, which, as it has been mentioned before, transported clean water from the source to the cities. The quality of the construction of these aqueducts was such that nowadays many examples remain scattered all over the area that one day was the Roman Empire. Some good examples are the Pont du Gard in southern France, the Aqua Claudia near Rome or the aqueduct of Segovia in central Spain. Even though the most visible part of aqueducts were the bridges that helped to avoid large ravines, Roman aqueducts were mainly built underground to preserve the water quality and freshness by avoiding direct contact with sunlight and air and had vertical shafts for inspection and cleaning (Hansen 1983). Bridges and siphons where used to transport water across valleys and gorges while keeping the gradient as low as possible so water would flow without the need of pumping it all the way from the source into the city (Figure 3.1).

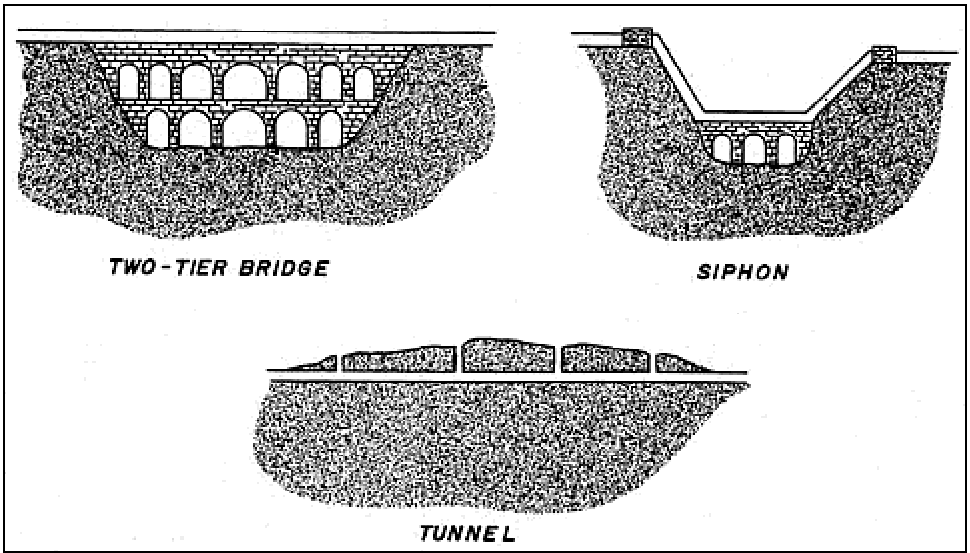


Figure 3.1. Roman aqueduct structures.
Source: (Hansen 1983:266)

Catalonia was part of the Roman Empire for several centuries, so it consequently had its share of roman aqueducts and engineering works. The capital city of the Hispania Citerior province first and the Tarraconensis province later, Tarraco –modern Tarragona- was an important city with around 25,000 inhabitants (Arrayás Morales 2005) that needed water to bath, cook, drink and run industries. Amongst other water related constructions in the surrounding area of Tarraco, the most important aqueduct of the city that has lasted to our days is the elevated bridge of the *Aqueducte de les Ferreres* (Figure 3.2), located four kilometres north of the city. This aqueduct conducted water from the Tulcis River –nowadays known as Francolí- from a point located at fifteen kilometres north of Tarraco, where water was cleaner than near the city (Jordà Fernández 2006).

Figure 3.2. The Aqueducte de les Ferreres today.
Source: Author's work.

Another example of a Roman aqueduct in Catalonia can be seen in Barcelona –*Barcino* in Latin-, which had around 3,500 inhabitants during Roman times (Arrayás Morales 2005). This aqueduct obtained water from a source at the foothills of the Collserola range near the modern town of Montcada (Museu d'Història de la Ciutat 2011) and transported it to Barcino's city centre (Vila 1998) and can still be seen today integrated into the wall of a building at Capellans street (Figure 3.3). Water supply to Barcino was guaranteed by the use of a second aqueduct that took water from a different source located at another point of the Collserola range and was used to complement the input of water to the city (Maluquer de Motes Bernet, Jordi 1998). A third example of Roman water works in Catalonia can be seen near the town of Pineda de Mar, where the remains of a Roman aqueduct still last. This aqueduct obtained water from a dam which impeded the flow of a little stream and transported its water for 3.5 kilometres towards a *lacus* –an irrigation pond- which was used for irrigation purposes and to provide water to the many Roman villas scattered around the area (Prat i Puig 1933). A final example can be found in Sant Jaume dels Domenys (Guitart i Duran, Tura Bolós et al. 2005).

Figure 3.3. Barcelona's Roman aqueduct as it can be seen nowadays.
Source: Author's work.

These water transportation and treatment techniques lasted in most of Western Europe until the fall of the Roman Empire in the 5th century AD, and Catalonia was not an exception. Even though, some infrastructures continued being used centuries after the Roman Empire disappeared, like the Aqueducte de les Ferreres, which remained in use until well into the Middle Ages (Calvet 2007).

The centuries that followed the end of the Roman Empire were characterised by the comparative lack of new water infrastructures, with the notable exception of Al-Andalus in the Iberian Peninsula. The territory that today defines Catalonia became divided into two distinct areas, the *Caltunya Vella* or Old Catalonia, where Christian nobility ruled, and the *Catalunya Nova* or New Catalonia, which was part of Al-Andalus and under Islamic influence (Barrera González, Lisón Tolosana 1985). The divide had social, technical, historical, geographical and ecological repercussions which also included differences in the public water distribution systems.

In areas under Christian rule, population distribution was characterised by the existence of disperse farmhouses called *masies* (Figure 3.4). Masies had in many cases its origins in rural Roman villas (Capdevila Werning 2008), which evolved into almost autarkic economic units where a family of farmers who owned the house and the surrounding land produced their agricultural crops (Feduchi 1976). Sometimes, people who lived in the masia and worked the land where not the owners of the property, they were tenant farmers called *masovers* who by a legal contract were entitled to use the masia (Llamas Pombo 2006). Masies were the basic territorial entity of medieval Christian a Catalonia, to have a big influence in Catalan law, traditions and land organisation which in some aspects are still valid nowadays (Eizaguirre i Garaitagoitia 2001). Many masies were located near springs to guarantee a provision of clean water, so they easy access to drinkable water (Casado Aijón 2001). In addition to the advantage of having water near where they lived, since the population density of the areas where masies were prominent was quite low, springs were unlikelier to become polluted, providing a reliable source of water to farmers living in the masia.

On the other hand, areas under Muslim rule tended to choose a concentrated model of habitation (Bolòs i Masclans, Universitat de Lleida 1996). Living in concentrated populated places, like towns or villages, has two consequences. First, having many people in the same place puts a strain into clean water, meaning that it is more difficult to find drinkable sources of water in the vicinity of the town due to pollution (Cropper, Griffiths 1994). However, having higher population densities together with a centralised government allows creating more expensive and complex public infrastructures. In the case of New Catalonia, under Muslim rule pre-existing Roman irrigation canals were maintained, improved and new water conductions were created (Soler Álvarez 1979). Under Moor rule another water transportation technological advance was introduced, the waterwheel, which improved crop production, allowed the elevation of water to higher areas and gave a constant flow of water to canals (Bresc, Guichard et al. 2001). When Christian Catalan counts progressively conquered the Islamic taifas[21], they did not abandon the canals and they even increased the network. For example, the Pinyana Canal, the oldest functioning canal in Catalonia (Vilagrasa Ibarz 2003), which between the years 1147 and 1180 -during the rule of Ramon Berenguer IV (Lladonosa 1975)- was elongated by several dozens of kilometres from the town of Almenar to the city of Lleida (Soler Álvarez 1979). The aforementioned canal is still intensively in use today for irrigation purposes, but most importantly for the purposes of this thesis, it still transports drinking water to the citizens of Lleida, the largest city of inner Catalonia (Vicedo i Rius, Aldomà i Buixadé 2006).

It should be noted that even if less common, Old Catalonia also had its share of canals, usually linked with cities. The Rec Comtal, which supplied water to the city of Barcelona for centuries and can be traced back to the year 1040 is a prime example of the Christian canal production, this time to run a series of mills that were built alongside the water course (Bensch, University of Cambridge 1995). Together with the Rec Comtal, the Old Catalonia has other examples of canals created to provide cities and its surrounding with drinking water, irrigation and energy, like the important Sèquia de Manresa built in the 14th century (Latorre i Piedrafita 2002) or one from the river Aravó to Puigcerdà (Soler Álvarez 1979).

[21] Independent Muslim-ruled principalities

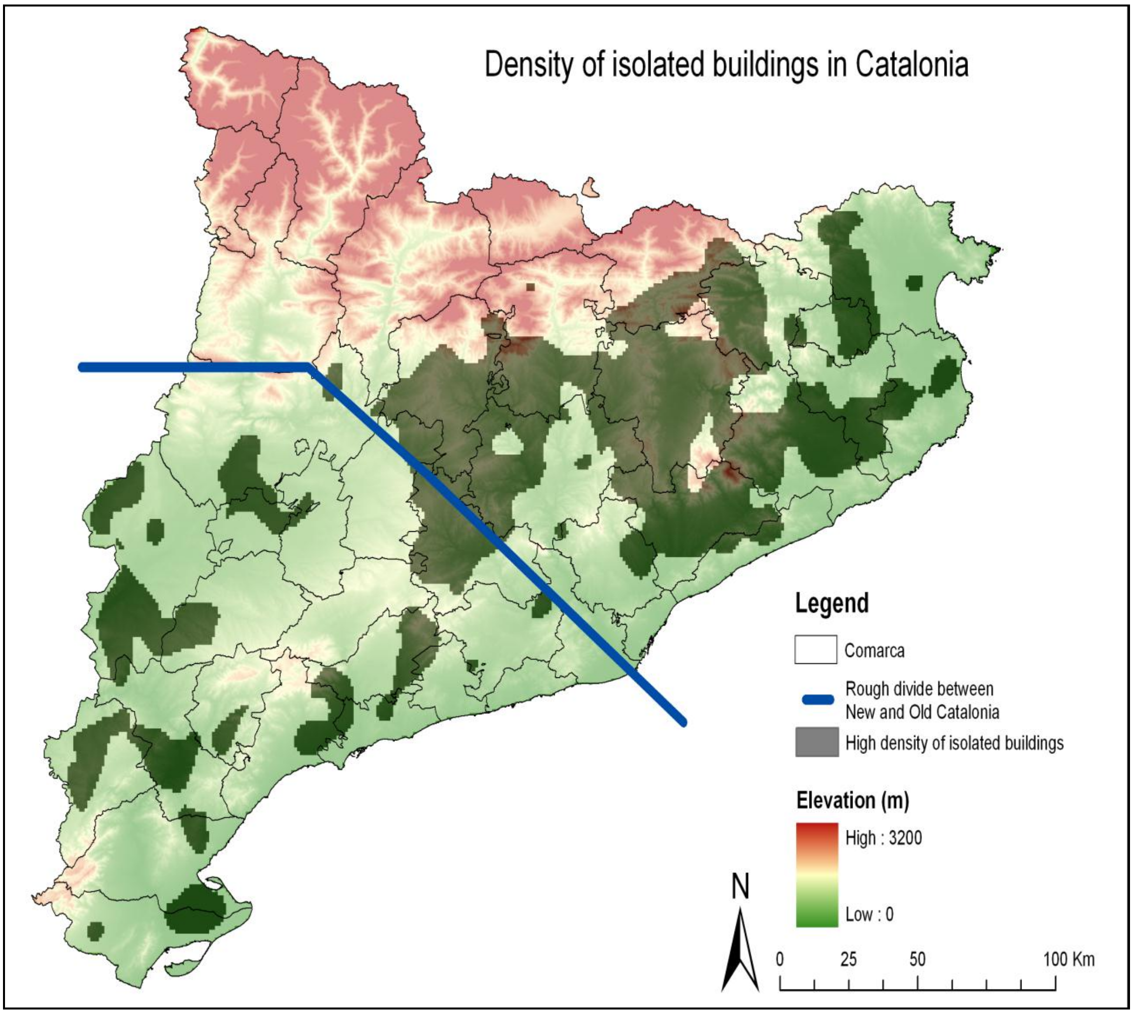


Figure 3.4. Density of Isolated Buildings in Catalonia showing the divide between Old and New Catalonia.
Source: Author's work from (Institut Cartogràfic de Catalunya, Institut d'Estudis Catalans 2009, Vinyoles, Universitat de Barcelona 2005)

The divide between Old and New Catalonia had a deep influence in the territorial and population distribution of Catalonia which nowadays it is still identifiable. As Figure 3.5 shows, the type of settlement –concentrated or disperse- still broadly followed the *status quo* established during Medieval times in the year 1900 (Palós 2005). This meant that water wise there were two different Catalonias, one where people lived concentrated and had to undertake large public works to obtain the necessary amount of water, and another one which due to a lower population density had easier access to clean springs or wells.

The explained situation changed with the advent of industrialisation, which implied that certain traditional rural areas became production centres and areas which already were cities saw their population density rapidly increase. These changes compromised the distribution of water in those areas, which had an influence in the bottled mineral water market.

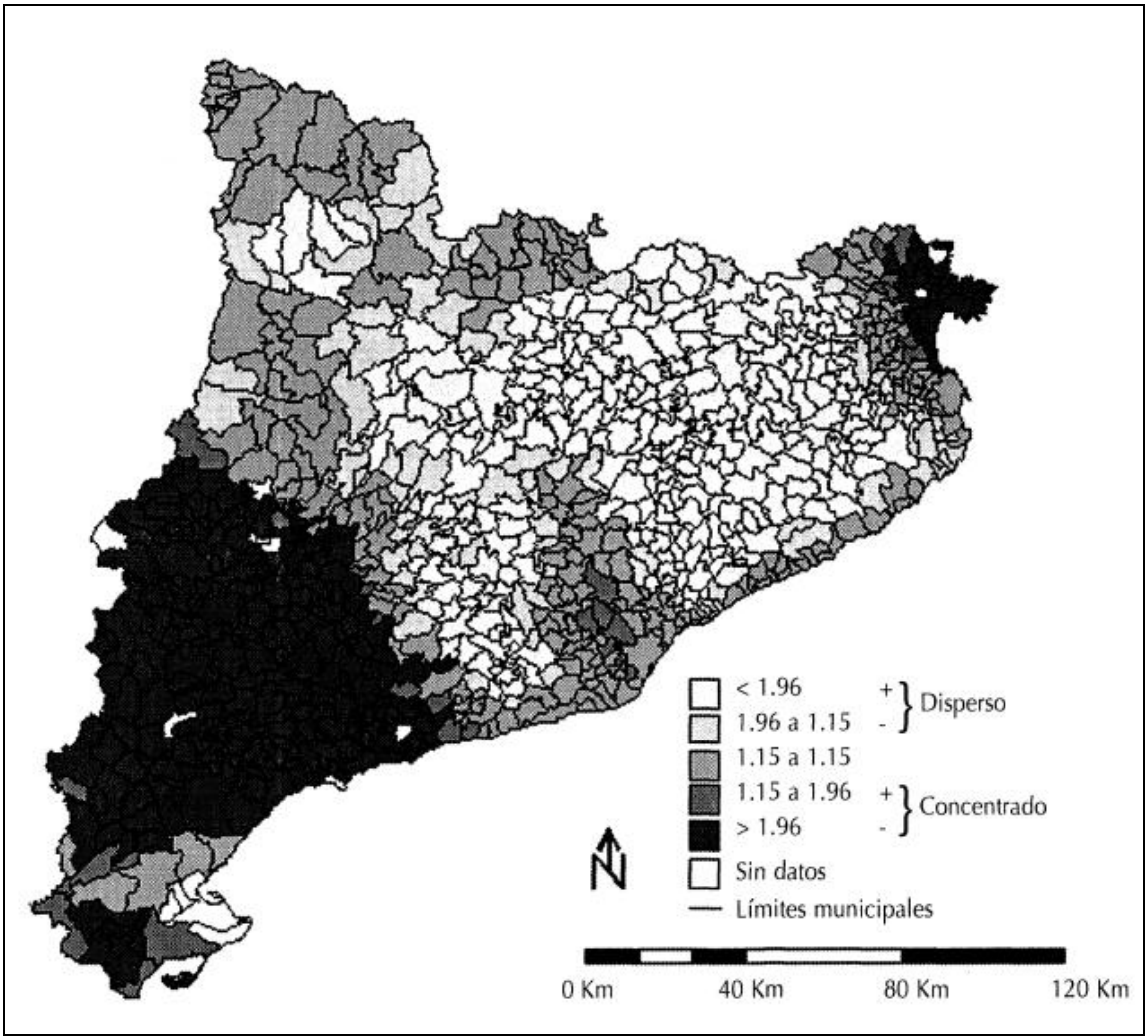


Figure 3.5. Habitat types in Catalonia in the year 1900. Darker tones indicate concentrated towns while lighter colours indicate disperse housing.
Source: (Palós 2005:493)

3.2 Catalan industrialisation and public water distribution systems.

The rapid process of industrialisation experienced in the 19th century by several Catalan towns and cities often was associated to a strain in the supply and quality of water. The increase in population, the industry water needs or the pollution of water sources increased the possibility of suffering from lack of potable water. The two factors explained in this section had an impact in the water distribution systems: the lack of sufficient water and unsatisfactory water quality.

3.2.1 Water quantity

Catalonia was one of the first areas in Europe to become industrialised and it can be considered a paradigm of the proto-industrialisation process (Ogilvie, Cerman 1996). In the 18th century capitalists avoided having to go through the guild system which existed in cities by hiring inner Catalan farmers as workers, using what is nowadays known as the putting out system (Herr 1974), which, in essence, was a way of industrialising small rural communities. However, when the Industrial Revolution arrived to Catalonia during the first third of the 19th century, the production system changed (Fontana 1988). Capitalists, instead of taking raw materials to workers, created factories that required intensive labour. This meant that people had to move to the new production centres to work in the industry, which in the Catalan case it occurred in two different places, at the industrial colonies and in the cities.

Industrial colonies were mainly located in rural Catalonia and consisted of a factory, which obtained its energy from a water course, and an associated village where workers lived. Industrial colonies where one of the most characteristic phenomena of the industrialisation process in rural Catalonia, mainly in the Ter and Llobregat river basins (Serra 2011), but also in other areas like Lleida, where instead of using rivers, colonies were located by canals (Antorn Montseny, Teixidor Felip et al. 2009). Even if colonies existed in other areas, like the renowned New Lanark in Scotland, nowhere in Europe exists a density as high as in Catalonia (Serra 2011). However, even if industrial colonies implied a change in traditional rural Catalonia and a source of wealth for the country, they were in essence new towns -hence the name colony- which had industry instead of agriculture as their primary source of revenue. Therefore, the introduction of colonies may not have had a high impact on water resources for the colony itself, but it might have had an effect in towns using water from rivers downstream. However, quantifying how much colonies affected the quality of water is difficult to know, as not much literature exists about the pollution caused by industrial colonies to water sources.

The Industrial Revolution had a different and profound impact in cities as existing cities multiplied their population many times in a short time. Sometimes it even meant the apparition of new human concentrations where only meadows existed (Lillie 1968). Catalonia, with its high level of industrialisation experienced an important migration from rural areas to cities first (Vicens Vives, Llorens et al. 1958) and from areas further away later (Oyón, Maldonado et al. 2001). All this population helped increase the population of cities and to create new conurbations, which in turn caused a strain in the public water distribution services. Cities like Sabadell, Terrassa or Manlleu experienced spectacular population increases in a relatively short time (Enrech 2005).

However, the case of Barcelona, being the largest city of the country and its capital, is paradigmatic. Barcelona’s population experienced a dramatic growth between the ancient regime’s dusk and the consolidation of the Industrial Era. During the 53 years before the start of the Second Spanish Republic (1878-1931) the population of Barcelona grew from 250,000 inhabitants to more than a million, four times more (Figure 3.6). It should be noted, however, that this level of expansion in the population of Barcelona came associated with an increase of the municipal boundaries via the integration of neighbouring municipalities in the years 1897 - Gràcia, Sant Gervasi, Sants, les Corts, Sant Martí and Sant Andreu-, 1904 –Horta- and 1921 –Sarrià- (Miralles-Guasch 1997). The population of Barcelona *strictu sensu*, the one within the city walls which were put down in the year 1854 (Fernàndez 1985), had achieved by 1857 a population of over 235,000 in a very limited amount of surface enclosed by the aforementioned city walls

(IDESCAT 2012a). Population density achieved dramatic values by mid-19th century. The growth of the city was confined to the land within Barcelona's city walls due to military reasons, so the population density increased dramatically during the Industrial Revolution, achieving 859 people per ha^2 with a peak of 1724 people/ha^2 in one of the districts of the city in the year 1859 (Fernández, Jover Zamora et al. 1997). As a reference, Paris had a density of 356 people/ha and Dickens' London had a value of 86 people/ha (Naylon 1982).

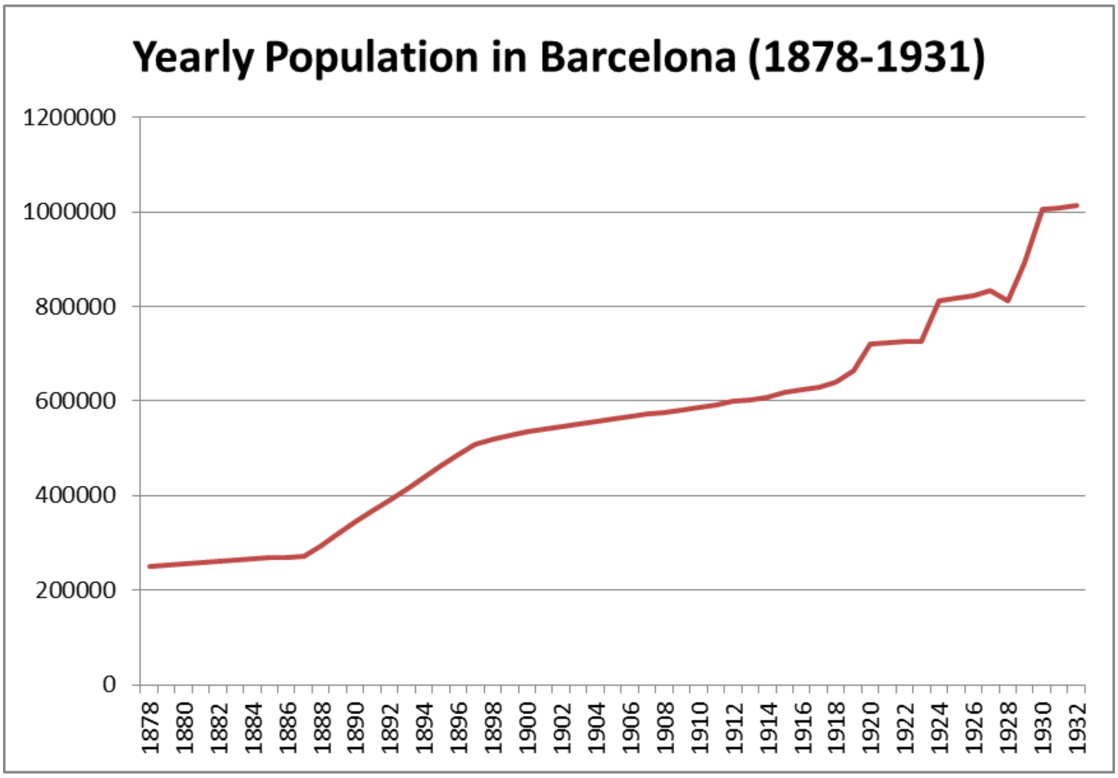


Figure 3.6. Evolution of the population of Barcelona between the years 1878-1931.
Source: Author's work with data from (Conillera i Vives, Llabrés et al. 1986)

While wealthy individuals had the right to access to private wells, most citizens had to rely on the public water system to obtain the necessary water to fulfil their daily needs (Alberch i Fugueras, Bou i Roura et al. 1998). Apart from several water mines located near Collserola (Garcia i Fuertes, Fundació Salvador Vives Casajuana 1990), the two main water sources of Barcelona until the city walls were demolished in the year 1854 were two canals, the Rec Comtal and the Riera de Sant Joan. However, they were mainly used to irrigate crop fields, move mills and other industrial uses, so water became polluted, making it unsuitable for human consumption. In fact, the popular name for the

Riera de Sant Joan canal was “Merdançar” (Riba i Arderiu, Colombo et al. 2009), which could be translated as “river of crap”, and gives an idea of how dirty the water flowed. It was therefore imperative to obtain drinking water from another source to provide the city. Until the 14th century the only source of drinking water were wells located within the city or very close nearby, but from then on the city council started obtaining water from water mines (Guàrdia 2011a). Water mines are underground galleries which obtain water from the subsurface and transport it towards the mine’s opening, being subsequently transported to the city using pipes (Oller, Suárez Fernández et al. 2008). The use of water mines became quite popular not only in Barcelona, but also in other cities across Catalonia, like Terrassa or Sant Just Desvern (Oller, Suárez Fernández et al. 2008). The place of origin of the water mines of Barcelona was mainly the mountains that surround the city, and the Collserola range. From the first water mines in Montjuïc and Can Cortés, the increasing need of more water for the growing city meant that during the following centuries more water mines were opened. Examples are the Mina del Frare Negre, the Mina del Frare Blanc, the Mina de la Diputació or the Mina de la Font del Falcó, amongst many others (Guàrdia 2011a).

However, the quantity of drinking water produced by the water mines in Collserola proved to be insufficient in the 18th century thanks to the very fast increase of the city’s population due to the starting stages of the industrialisation -Barcelona increased its population from 34,000 people to over 100,000 between 1718 and 1787. Therefore an alternate source of water had to be sought, and the city council decided to derivate a portion of the water from the Rec Comtal to Barcelona –what became known as the “Fibla del Clot”-, in first instance to irrigate the urban trees and provide water to horses, but also for human consumption if needed (Guàrdia 2011a). As the city kept on growing due to the economical impetus provided by the Industrial Revolution, the need for drinking water became more and more apparent. In the year 1826 a brand new canal of drinking water started providing water to the city with water from the Mine of Montcada, the Aqüeducte de Montcada –Montcada Aqueduct (Guàrdia 2011b). This aqueduct should not be confused with the Rec Comtal, which obtained its water from the same water mine and had a parallel route. The new water conduction was built purely as a means of transporting clean drinking water to the city, while the Rec Comtal was several centuries older and has a merely industrial and agricultural purpose. The importance of this new source of water for the city can be seen if the amount of water it delivered is compared to the amount the existing water mines provided to the city. In the year 1859, right after the city walls were demolished, traditionally mined water from Collserola produced 149 plomes[22], of which only 31 reached Barcelona because most of them remained in the town of Gràcia, while the Aqüeducte de Montcada provided 1,400 plomes (Cerdà 1859). Therefore, the construction of the Aqüeducte de Montcada allowed to dramatically increasing the amount of water available per inhabitant in the city, guaranteeing a more reliable supply of water for its inhabitants.

Alternative sources of water were sought as the city kept on growing and became more and more populated. Therefore, several companies were established to distribute water from a number of origins into Barcelona. Examples are the "Compañia de Aguas de Barcelona" which brought water from Dosrius in the Maresme comarca, the "Compañia de las Aguas Subterráneas del Río Llobregat" which obtained the water from the Llobregat river or the "Compañia de las Aguas de Montaña" which took its water from some of the hills that surround Barcelona (Martín Pascual 2005). This myriad of companies, most of them founded before the advent of the 20th century, started a process of unification which by the year 1896 had agglutinated into a sole company, the "Societat General d'Aigües de Barcelona", which nowadays is a multinational corporation that still provides water to city of Barcelona and other cities around the world (Martín Pascual 2005).

The water from the mines, some still used nowadays, was transported to the city using underground pipes. Since water mines were located on higher ground, water flowed downhill without the need of pumping it. This allowed creating a network of public water fountains which started in the 14th century linked to the first water mines and which grew as the city expanded. It is worth mentioning one of the most important documents in the history of water services in Catalonia, the "Llibre de les Fonts" or "Book of the Fountains" written by Francesc Socies in the year 1650. The manuscript, preserved in the Historical Archive of the City of Barcelona, explains with great detail Barcelona's water

[22] A "ploma" was a traditional Catalan measure of water flow which varied depending on the area. In Barcelona it was equal to 2,200 liters of water per day (Carreras i Martí 1986; 1998)

distribution system of drinking water and the characteristics of all its public fountains (Garcia i Fuertes, Fundació Salvador Vives Casajuana 1990, Cubeles i Bonet 2011). Thanks to this book we know where the sources of water were originated and where could the citizens obtain their water from. The study of this document, together with other sources of documentation written afterwards has allowed knowing which public fountains existed during different periods of time existed and where were they located. Mapping them within a GIS and overlaying them to historical cartography has shown that most of the population was within a 250 meter radius of a public pump between the 17^{th} and 19^{th} centuries (Figure 3.8). As the city grew in size and population, it filled all the available space within the city walls, but the amount of public water fountains increased at the same rate and spread throughout the city. There were however areas which were developed before a source of water was installed in the area or that had a more difficult access to the water, like the Barceloneta neighbourhood, which implied a lesser degree of accessibility to drinking water. Citizens living in those areas had to either walk for a while and carry the heavy water back home –a task usually done by children or women (Clarke 1993)- or buy the water from water carriers who filled metal containers with ten litres of water in public fountains and sold them from house to house around the city for a profit (de Ramon i Vidal 1996) (Figure 3.7).

Figure 3.7. Water carrier filling his containers from the fountain of Padró square. Source: Picture taken at the exhibit "La revolució de l'aigua a Barcelona. De la ciutat preindustrial a la metròpoli moderna, 1867-1967". Author of the original picture: Just Garcia Ventosa.

Therefore, even if not perfect and universally easily available to all citizens, the water distribution system of Barcelona tried to keep up with the constant increase of population. As a result, people had a relatively easy access to drinking water, since even if a large proportion of the households did not have a private supply; they had not excessive difficulties obtaining it. However, even if a constant flow of water arrived to the city and people had a relatively easy access to water, records show that it was in this period that citizens started buying mineral bottled water, an apparently contradictory phenomenon the reason of which will be explained in the following section.

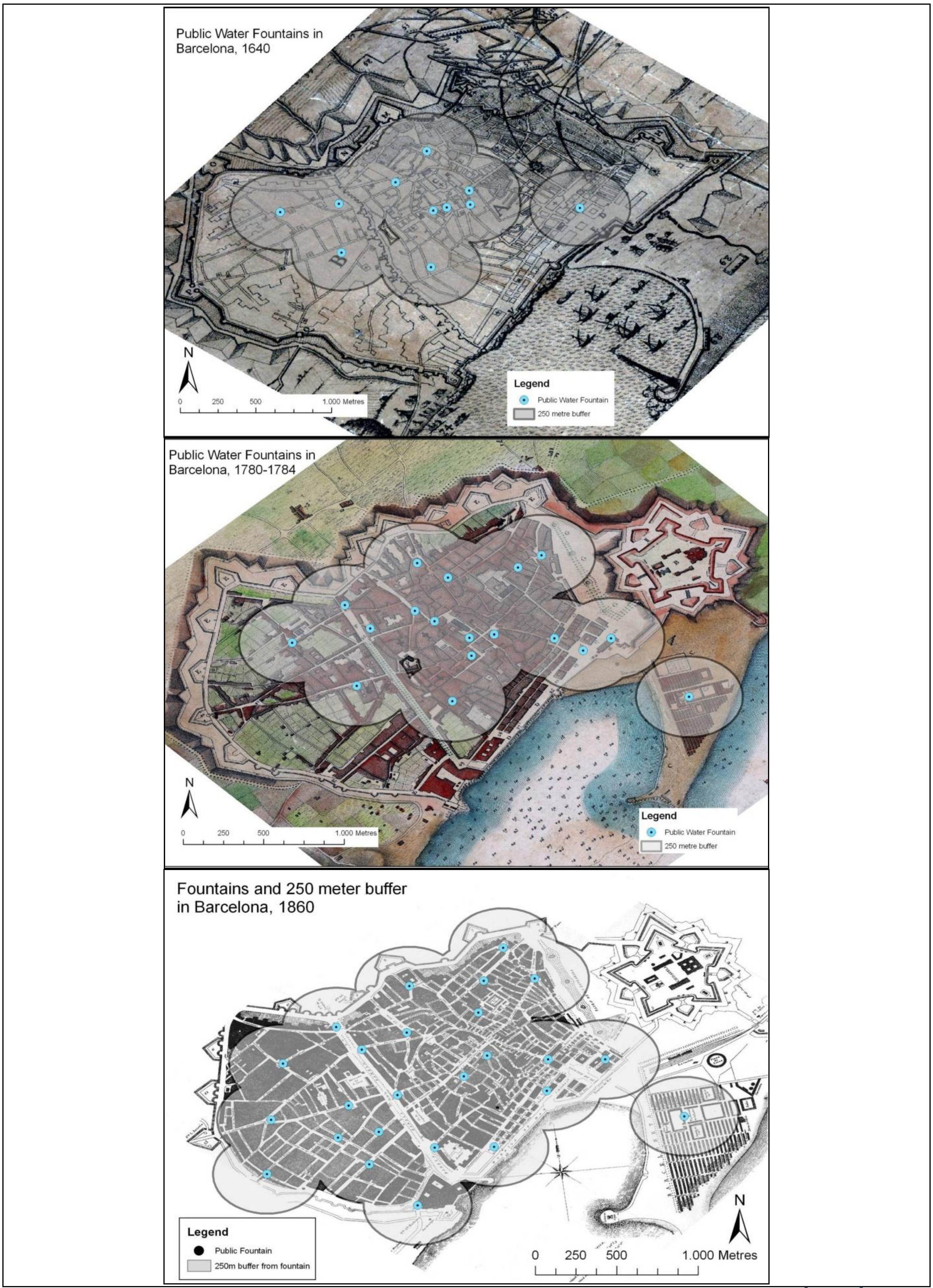


Figure 3.8. Evolution of the public water pumps in Barcelona in the 17th, 18th and mid-19th centuries with a 250m buffer around them.

Source: Author's work from (Latorre i Piedrafita 1998a, Saurí, Matas 1849). Background maps obtained from the ICC digital map library.

3.2.2 Water quality

If accessibility to drinking water was not an extremely serious problem and the influx of water had been more or less guaranteed by the second half of the 19th century, why did the mineral bottled water industry start at that point in time? The answer is lack of reliability in the water treatment and distribution systems.

The separation between clean and used waters in many European cities had not been adequately solved by the turn of the 20th century, especially in those older city areas which had not grown with a proper and sustainable set of planning regulations. While from the second half of the 19th century new developments usually included plans to create sewage systems, being Barcelona one of its pioneers thanks to Ildefons Cerdà's urbanization theories (Caldés i Torrent 2002), the problems created by foul drinking water were evident throughout Europe. As an example, a cholera epidemic in Paris in the year 1832 caused the death of 18,000 people and another cholera epidemic of Hamburg killed 9,000 in 1892 (Hayes 1992). The problem caused by contaminated water was therefore not a minor issue.

Barcelona was not immune to this serious issue and its inhabitants suffered from periodic epidemics, mainly cholera and typhoid fever. The reasons that triggered the outbreaks varied from episode to episode, but they had a common denominator, the contamination of potable water by foul water or other insalubrious substances caused by the inefficient separation of waste water from clean water conduits. The inhabitants of Barcelona mainly used latrines connected to the public sewage system, but also to cesspits (Garcia Fuertes 1984). The use of cesspits meant that the odours and emanations they produced gave the city a characteristic bad smell and a feeling of insalubrity. There are many historical records which explain complaints between neighbours about the reeking smell produced by latrines and cesspools, which caused concern about the public health of the area (Guàrdia 2011d). Many of the cesspits were quite old and had been built in a precarious way, with limited sealing capabilities, so faecal matters could suddenly escape and pollute the surrounding soil. This was an important issue if we take into account that in the year 1858, 4,360 water wells existed in the city with a depth that ranged from five to fourteen meters (Cerdà 1859), so they could become contaminated quite easily if in contact with a cesspool leakage. Even if a cesspit was well built and did not have any leaks it had to be periodically emptied out and cleaned, a dangerous job as many cleaners died intoxicated by the toxic emanations produced by the manure. When a cesspool was emptied, its contents had to be carried elsewhere –usually the nearby fields to be used as fertiliser-, and the transport was done using barrels on carts pulled by horses, which also could leak leaving an insalubrious trail wherever they went (Unknown author 1875).

The lack of proper and modern sanitation systems meant that Barcelona, like other European cities, had recurrent epidemics related with water. The case of the cholera epidemic in London in the year 1854 is well known and one of the paradigms in the fight against the spread of water borne illnesses. It is also relevant to geographers as it was the first time a map was used to perform spatial analysis, as figure 3.9 shows (Longley, Batty 1996). John Snow was the physician in charge of the area around Broad Street -nowadays known as Broadwick Street- in the Soho district of London when the 1854 cholera epidemic hit the city. His approach to discovering the source of the pollution was innovative because he used spatial analysis on a map and discovered that those living closer to a specific water pump had higher rates of infection. The epidemic was especially deadly, with a death rate of 150‰ in the area around Broad Street (Koch 2011), but when the pump was disabled, the cholera outbreak rapidly diminished and it became clear that Snow's suspicions were right. Once the pump that started the epidemic was found, investigations discovered that it was located very close to an old cesspit which had spilled its contents into the well that nourished the water pump (Johnson 2006).

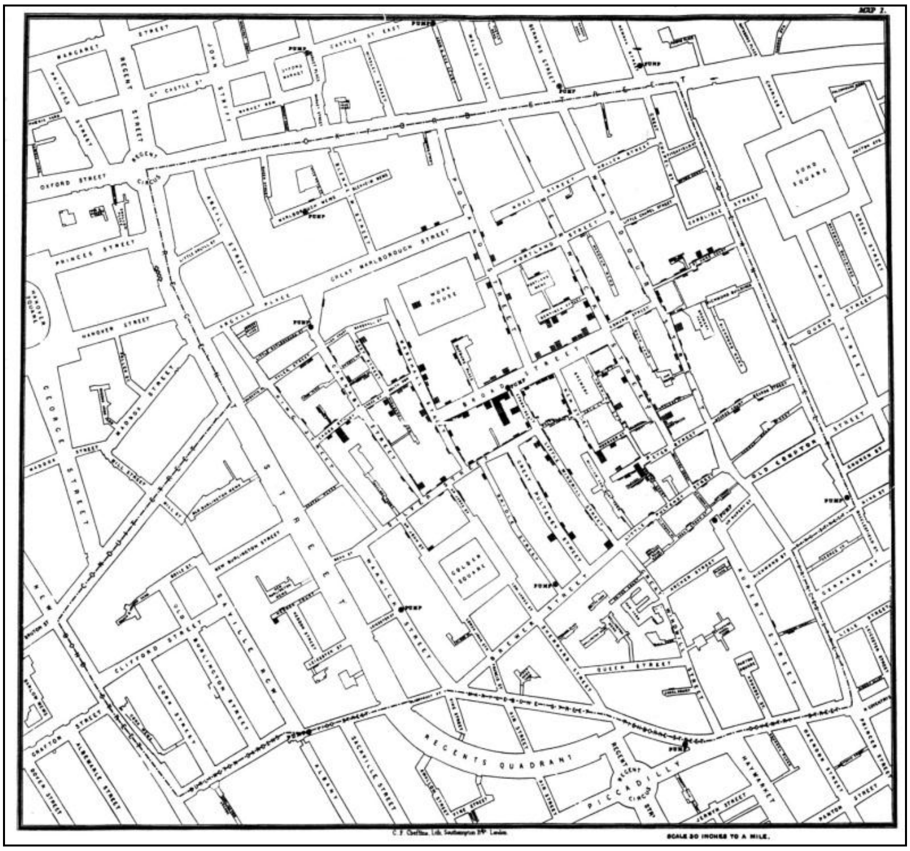


Figure 3.9. John Snow's cholera map.
Source: (Snow 1855:45)

Barcelona also had its share of cholera epidemics, with five important episodes occurring during the 19th century in the years 1834, 1854 –coetaneous the Broad Street episode in London-, 1865, 1870 and 1885 (Figure 3.10). The first cholera epidemic to reach Barcelona happened the year 1834 and was part of the second cholera pandemic that started in the Indian subcontinent, most likely in Bangladesh (Colwell 1996). The results of this first epidemic were quite dramatic, out of a total population of around 120,000 people, 30,000 became infected and 3,500 died (Cladellas Blasco, Escudé i Aixelà et al. 1995). It was however the cholera outbreak of the year 1854 which caused the largest number of deaths, with almost 6,000 deceased citizens (Busquets, Corominas 2009?). A witness of this epidemic explains that apart from causing thousands of deaths, cholera outbreaks occasioned episodes of social chaos, with people fleeing the city running away from the illness and creating cases of civil unrest. In his testimony, Conrad Roure explains that all the people who could afford it fled the city in search of more healthy countryside locations: "*The Barcelona within the city walls was becoming empty, with citizens leaving the city and others dying to cholera (…) only sanitary personnel and* *those too poor to not have a chance to leave the city and remained*" (Roure 1925; 1927). The authorities thought that cholera was transmitted through air –John Snow would prove that to be wrong-, and tried to fight it by igniting huge fires of tar to create the maximum amount of smoke. The result was an empty and polluted city with broken pavement everywhere, as the heat cracked and broke the cobblestones (Roure 1925; 1927). The situation was so desperate that the civil governor of the city, the liberal Pascual Madoz, pleaded the central Spanish government to allow the city to destroy the city walls so the city became better ventilated, a wish that was eventually granted (Vallejo, Escamilla 2007) and meant the spread of the city over a larger urbanised area, which allowed to decrease the population density and modernising the sanitation systems of the new neighbourhoods.

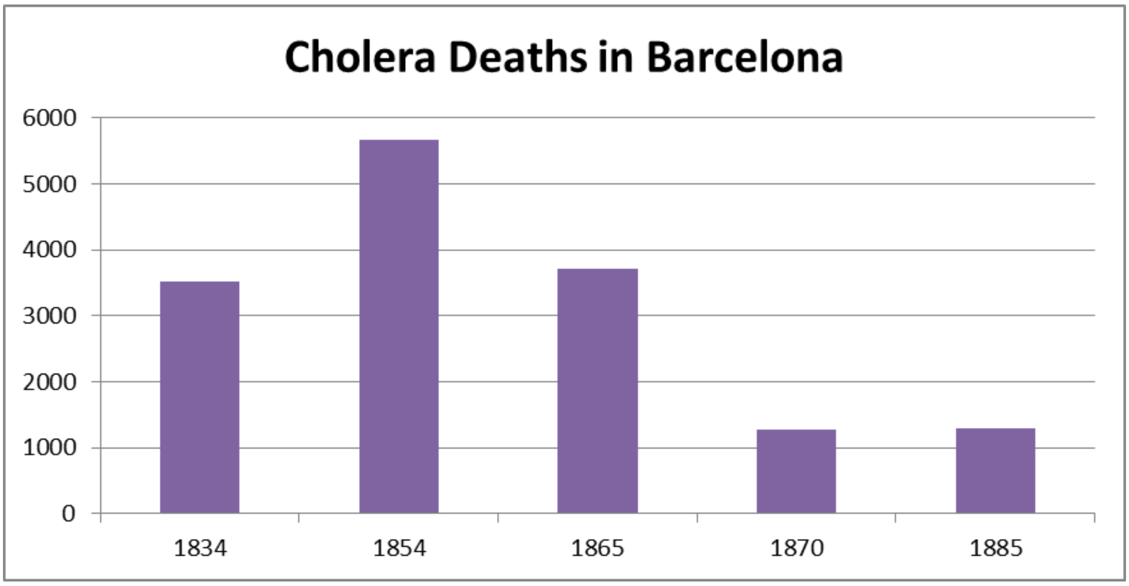


Figure 3.10. Cholera epidemics and number of deaths in Barcelona during the 19th century.
Source: Author's work from (Busquets, Corominas 2009?)

Following outbreaks did not cause death rates as high as the two first epidemics did. Thanks to the improvement in sanitation systems, medical innovations and a lower population density the number of deaths was lowered. Even so, each outbreak created a panic situation as nobody knew if the water they were drinking was safe or foul or which pumps were more likely to cause the illness. The civil authorities tried to fight the illness by using different methods, sometimes contradicting previous paradigms and confusing the public about what was best to avoid becoming infected and how to treat those who were already ill (Figure 3.11). However, the identification of the bacterium that caused the illness –the *V. Cholera*- by Robert Koch in 1883 (Brock 1999) and the creation of the first vaccine by Waldemar Haffkine some years later (Hamlin 2009) meant that, eventually, the likelihood of experiencing a cholera outbreak was dramatically reduced.

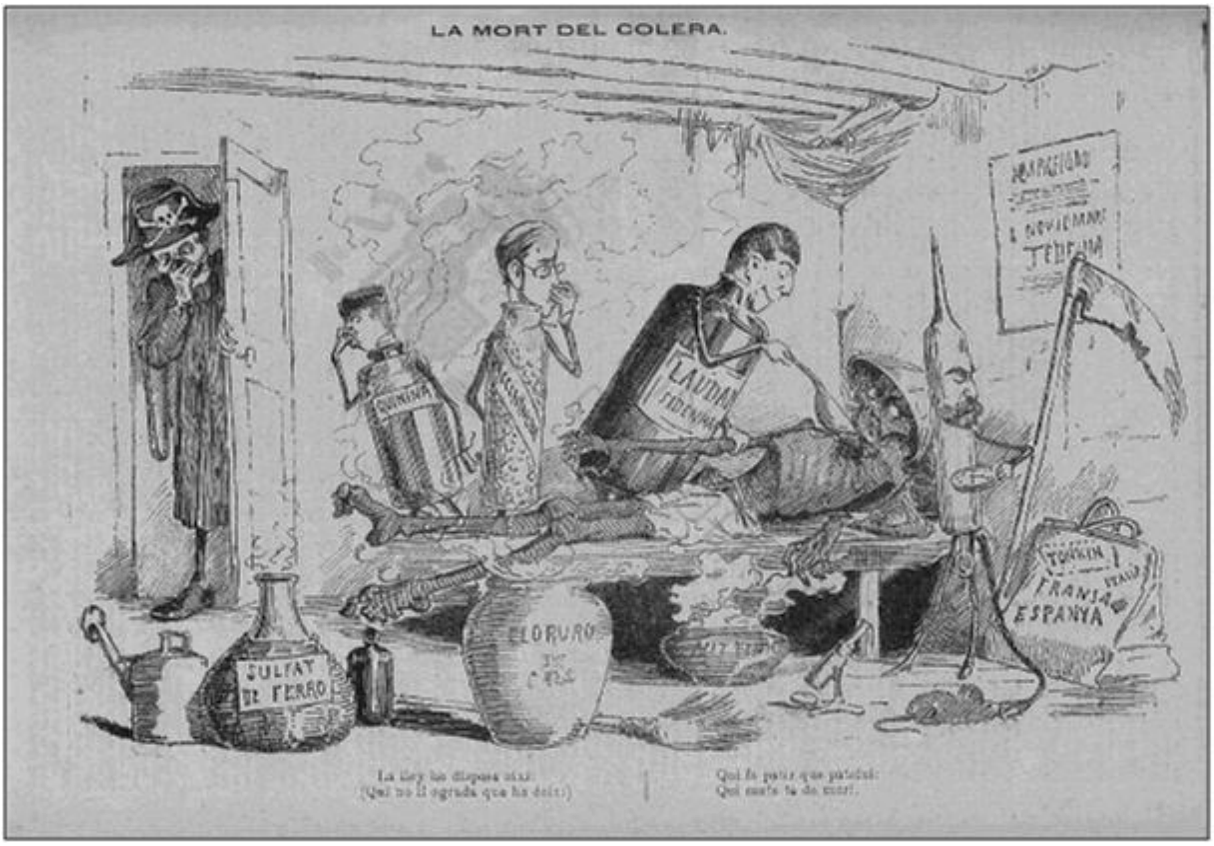


Figure 3.11. Drawing caricaturising the different ways of fighting against the 1885 cholera outbreak.
Source: (La Campana de Gràcia 1885:5)

Cholera was not the only main water related illness which punished industrialised cities. Typhoid fever, a disease also transmitted by drinking contaminated water, caused thousands of deaths well after cholera outbreaks were under control. Typhoid fever was a common and deadly illness that, as figure 3.12 shows, relentlessly inflicted population losses in Barcelona. However, in a similar way as with cholera, improvements in sanitation systems, medical advances and lower population densities meant that the percentage of infected people and casualties tended to decrease as years went by. The tendency was consistent up until autumn 1914, when an extremely virulent outbreak of typhoid fever stroke Barcelona with a mortality rate of three casualties per thousand inhabitants. This epidemic episode even had repercussions in how the public considered public water distribution systems.

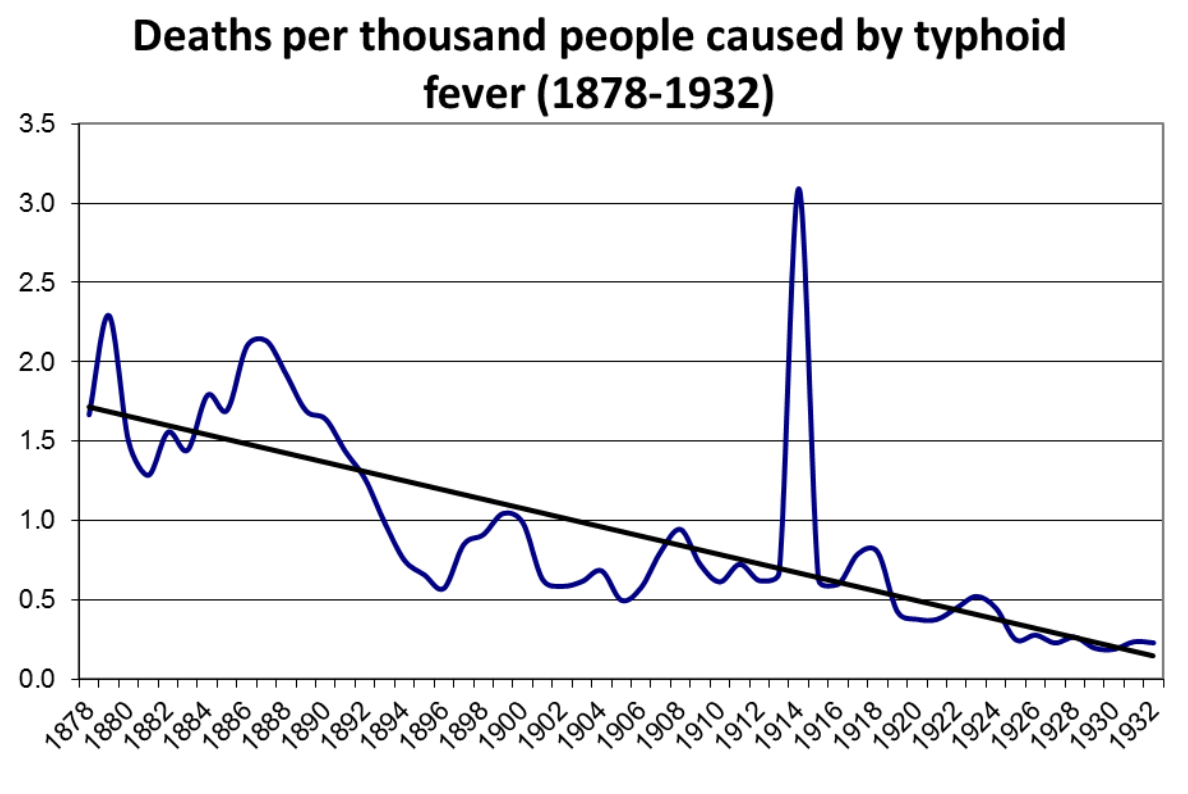


Figure 3.12. Evolution of the mortality rate caused by typhoid fever between the years 1878-1932 with a simple linear regression line.
Source: Author's work. Data obtained from (Conillera i Vives, Llabrés et al. 1986)

Typhoid fever is caused by the bacterium *Salmonella enterica* serotype *Typhi*, and records show that it has been infecting people in Europe since at least Ancient Greece times (Rhen 2007). The origin of the illness however was not clear until modern medicine discovered the bacteria that caused it, and theories pointing at miasmas and telluric causes were common amongst scientists for a long time (de Ramon i Vidal 1996). Nowadays it is known that the bacterium is transmitted by poor hygiene habits and not adequate public sanitation conditions, since it is usually required that drinks or food contaminated by infected faeces are ingested in order to contract the disease. The first vaccine proven to have a certain success rate for typhoid fever was created in the year 1896 in England (Kaufmann 2004), so by 1914 the disease was on the decline in Barcelona and many other industrialised cities. Consequently, the 1914 typhoid fever outbreak started at a time when scientists and doctors were not ignorant about what caused the disease, so the chronological lateness of the epidemic has to be explained using other arguments than ignorance.

When the first citizens became infected and people started to succumb to the illness, there was some confusion about the origin of the epidemic as the real source of infestation, the water from the Montcada aqueduct, had been recently analysed and no traces of the bacterium were found (de Ramon i Vidal 1996). As a result, the source of the contamination was sought amongst one of the other many sources of water that provided water to the city, giving the population a sense of insecurity. After some days searching for it and dozens of deaths, it became clear that the source of the epidemic was found in the public fountains that obtained their flow from the Montcada aqueduct. A map produced by Dr. Claramunt twenty years after the outbreak, which followed Snow's method proved that those public fountains were rightly blamed, as most casualties were near them (Figure 3.13). The logical way of proceeding would have meant stopping the provision of water from the Montcada aqueduct and disinfecting it using antiseptics, a process which would have implied closing the watercourse for some time. However, this procedure was not followed immediately.

During the years and months previous to the outbreak, there had been tensions between the Barcelona city council and the Sociedad General de Aguas de Barcelona about the municipalisation of the company, which led to the formation of two strongly opposed sides, those in favour and those against of the private proprietorship of the company. When it was suggested that the flow of water from the Montcada aqueduct had to be stopped to disinfect it, voices against it arose from those not supporting the municipalisation of the Sociedad General de Aguas de Barcelona because they thought it was a way of promoting a change of ownership. Discussions continued, but it took almost a month to start the treatment of the water by injecting a colorant -permanganate- into the water to warn citizens that it was not suitable for consumption and therefore stop the spread of the epidemic (Guàrdia 2011c). During the first two weeks of the epidemic, in the middle of crossed political and economic arguments, a bunch of ineffective prophylactic measures were broadcasted by the city council to the citizens to minimise the propagation of the disease, but the illness continued, a fact greatly criticised by the press of the time (Figure 3.14). This meant that when effective measures were advertised to the population, the public was reluctant to adhere to them. The slowness and inefficiency of the process meant that almost 2,000 people died from typhoid fever between the months of October, November and December of the year 1914 in Barcelona (de Ramon i Vidal 1996). The cause of the outbreak was discovered during the works to disinfect the Montcada aqueduct water system, a dead fox in an advanced state of putrefaction inside one of the water conductions was the root of the epidemic (de Ramon i Vidal 1996).

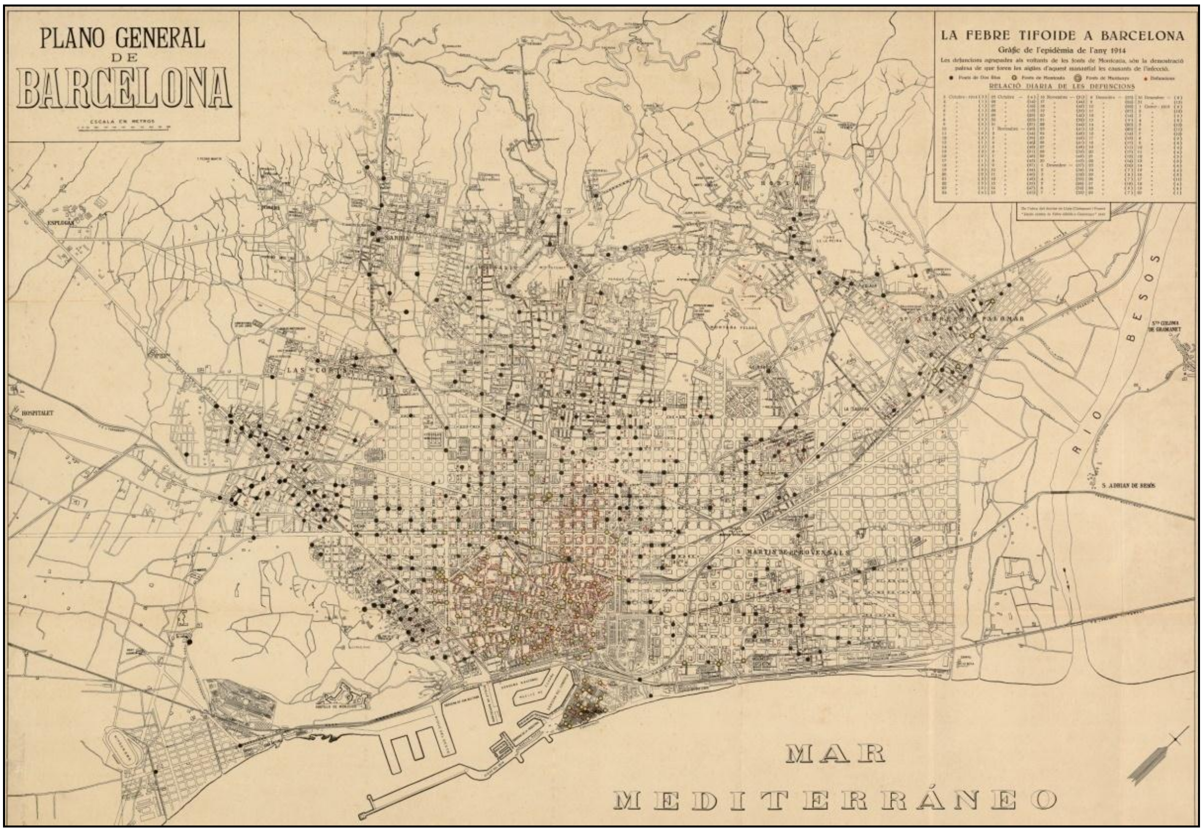


Figure 3.13. Map showing the location of the victims of the 1914 typhoid fever which proved that near the fountains supplied with water from the Montcada aqueduct more infections occurred.
Source: (Claramunt i Furest 1933)

As a result of all the potential illnesses transmitted by water -mainly cholera, typhoid fever and dysentery-, drinking water from the mains or the public fountains became a potentially dangerous choice. Authorities tried to improve the sanitary qualities of water by using the best water treatment techniques available at each time, but as it has just been shown, they resulted quite often ineffective. This unsuccessfulness was not limited to

Catalan cities, but also to other cities across the world, as water treatment techniques were quite rudimentary until the discovery and broad utilisation of chlorine as a disinfectant agent (Kohn 2008).

Figure 3.14. Satirical illustration criticizing the incompetency of the authorities during the typhoid fever outbreak. The text reads "The typhoid fever outbreak is a phoney alarm", while funeral carriages head towards a graveyard.
Source: (L'Esquella de la Torratxa 1914:1)

The first method used to guarantee a supply of safe water to the population, as it has been explained, was to obtain water from a clean spring guaranteed a reliable source of water.

However, as cities grew, the distance to clean springs increased, increasing at the same time the length of the canals and aqueducts needed to transport suitable water to population centres. As it has been shown with the typhoid fever episode in 1914, lengthy of water conductions meant an increased chance of contamination and made it more difficult to monitor their full length. Together with this method, separating clean and used water via a proper sewage system was an efficient way of greatly improving the drinking water quality. In the case of Barcelona the incapacity to transport foul water out of the city by the sewage system had been proved by the second half of the 19th century (Arandes Renu 1980). It was not until the year 1891 that the sanitation systems of Barcelona experienced an important qualitative step with the approval of the sanitation plan designed by Garcia Faria[23], the establishment of new municipal ordinances and the foundation of the Municipal Institute of Hygiene (Capel Sáez, Tatjer 1991). These three improvements, together with previous initiatives like Cerdà's urban plan in 1859 or Garcia Faria's sanitation plan in 1886 (Silva, Ausejo et al. 2007), meant that the separation between clean and foul waters could begin in a systematic way, guaranteeing a minimum degree of healthiness.

However, obtaining water from a clean source and keeping it separated from waste water is not enough to ensure that running water is fully safe, as the 1914 typhoid fever epidemic proved, it is necessary to treat water before it reaches consumers. One of the first techniques used to treat water was the use of alum and other substances as a coagulant. There is some discussion as if ancient civilisations like the Egyptians, Indians, Chinese, Greeks or Romans already used alum to clean turbid water or not (Jahn 1999), but it seems clear that since ancient times the coagulation of water has been used to plummet particles in suspension to the bottom of water tanks (Pearse 2003). This technique was usually linked to a second way of cleaning water from floating substances, leaving the water for some time to settle via a process of decantation. The water which was used to provide the population was obtained from a height, not from the bottom of the tank, which meant that the sediment remained while cleaner water was delivered to the mains system (Malacrino 2010).

[23] The then town of Gràcia approved a sanitation plan in 1887, which was confirmed in 1889 by the central government based in Madrid (Nadal 2012).

Flocculation and decantation techniques allowed cleaning the water to an extent, but microorganisms were still able to make their way onto their future hosts, the consumers. An innovation discovered in Venice at some point between the Middle Ages and the Renaissance allowed to dramatically reduce the number of pathogens present in drinking water, slow sand filtering (Chapelle 2005). Slow sand filtering is a technique still used nowadays in many regions of the world, including Europe and especially the UK (Ratnayaka, Brandt et al. 2009). Slow sand filtering consists of making the untreated water cross a certain quantity of sand that slowly filters the water from impurities and prevents the proliferation of microorganisms before being supplied to consumers (Matsuo 2001). In contemporary times, slow sand filtering was first used in the Scottish town of Paisley to provide safe drinking water to the population in the year 1804 and in the year 1827 the engineer Robert Thom was granted a patent for a slow sand filter system (Parsons, Jefferson 2006). The use of slow sand filtering spread across Europe and it proved it effectiveness in many occasions. For example, in the year 1892 both German cities of Hamburg and Altona obtained their water from the river Elba, but while Altona used a slow sand filtering system, Hamburg did not. That year, the water from the river became contaminated and a cholera outbreak occurred in Hamburg causing 8600 deaths, while in Altona nobody died from it (Ratnayaka, Brandt et al. 2009).

Another mechanical technique to treat drinking water -linked to slow sand filtering- was fast sand filtering. It followed the same principle as slow sand filtering, but it reduced the need to clean the sand often and therefore it improved the level health safety while reducing maintenance costs (Berk 2009). It soon became popular and during the 1890s cities used this system together with coagulation and decantation methods, achieving good results in water treatment and a decrease in water borne illnesses (Logsdon 2008).

However, even if by the turn of the 20th century water treatment techniques had dramatically improved, they mainly relied in the use of mechanical treatments, not chemicals. One of the first attempts to use chemicals to sterilise water was carried out by Dr. Snow during the Broad Street water pump episode in 1854. In that occasion he used chlorine to disinfect the water, pioneering water disinfection (Hempel 2007). However, the use of chlorine as a water cleaning agent did not become habitual until the first years of the 20th century. The first time it was broadly used to disinfect the water it was during the 1892 Hamburg cholera outbreak (Hendricks 2011). Following that, other cities across Europe started using chlorine as a means of keeping their water safe –for example Middlekerke (1902) and Ostend (1903) in Belgium and Lincoln (1905) in the UK (Black & Veatch 2010). In the USA, the first use of chlorine as a water disinfectant was in Jersey City in the year 1908 (American Water Works Association 2006). The results were so satisfactory, that soon most cities embraced the new method of disinfection, consequently dropping the deaths caused by typhoid fever and cholera (Figure 3.15).

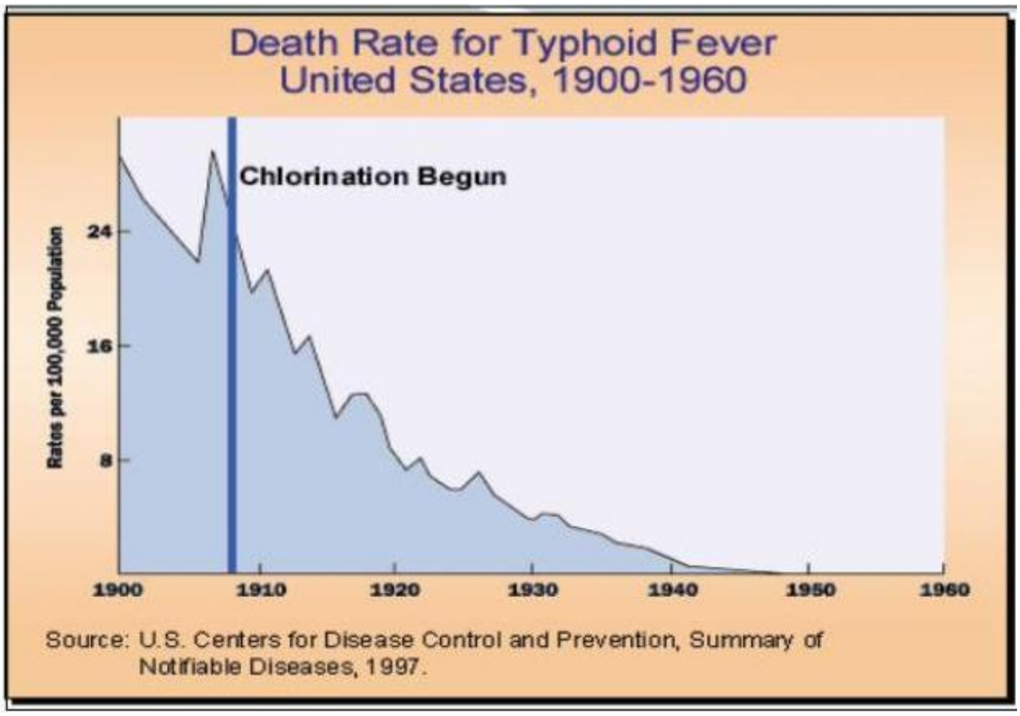


Figure 3.15. Evolution of deaths caused by typhoid fever in the USA before and after the start of chlorination.
Source: (Centers for Disease Control and Prevention 2010)

Therefore, even if the years between the start of the Industrial Revolution and the first third of the 20th century saw a continuous improvement in water treatment techniques, during most of the period those techniques were not always efficient enough to keep the population safe. The number of epidemics and casualties caused by waterborne diseases remained important up until the start of water chlorination. While in the United States the key date of 1908 meant the beginning of water chlorination and the progressive defeat of waterborne illnesses, in Catalonia it took a bit longer to improve the water quality using chlorine. The diffusion of the use of chlorine in the country was quite progressive as each town and even each neighbourhood had different water origins, qualities and needs. It is therefore difficult to establish a specific date of when chlorine became broadly used in Catalonia as it was a gradual process which span through many decades. The first reference of its systematic use can be found in the year 1915, when the *Sociedad General de Aguas de Barcelona* upgraded their water treatment capabilities to improve a polluted source of water from the Vallès area by using Sodium hypochlorite (Martín Pascual 2007). The dissemination of the use of chlorine as a water treatment system was however quite slow since some influential doctors doubted of the effectiveness of this treatment method. The discussion amongst experts about the capacity of chlorine to clean water in an efficient way seemed to push back the generalisation of its use as a disinfectant agent (Martín Pascual 2007). By 1923 the aforementioned water company decided to invest in chlorine based water treatments and built a water sterilisation plant in Cerdanyola del Vallès which used liquid chlorine (Figure 3.16). The machinery used in this water treatment plant was purchased to the company Wallace-Tiernan from New York, which was experienced in supplying water sterilisation systems to American towns and cities (Societat General d'Aigües de Barcelona 1925).

The fact that Barcelona, the capital of Catalonia and the headquarters of one of the main water supply companies of the country, did not have permanent chlorination facilities until the year 1923 shows how slowly chlorination techniques were adopted in Catalonia. While a town per town study would be needed to achieve a detailed description of how the use of chlorine spread across the country, it is quite significant that the city of Barcelona, so advanced in other aspects, waited around 20 years form its first use in Europe to adopt chlorination as a means of treating water. It is therefore not surprising that other Catalan cities took even longer to adopt the new technique. An indicator of whether a city had adopted chlorination is if typhoid fever was endemic or not. As an example, in the year 1923 Manresa, Terrassa, Sabadell and Sant Feliu de Guixols -which were four important, industrialised and modern cities- were considered to have endemic typhoid fever due to their consistent and high death ratios caused by typhoid fever (Faura i Sans, Viñals et al. 1923), which shows that chlorination was not a regular practice even in urban environments. Meanwhile, contemporary European cities with proper sanitation systems had much lower values and typhoid fever was not considered endemic but epidemic (Faura i Sans, Viñals et al. 1923).

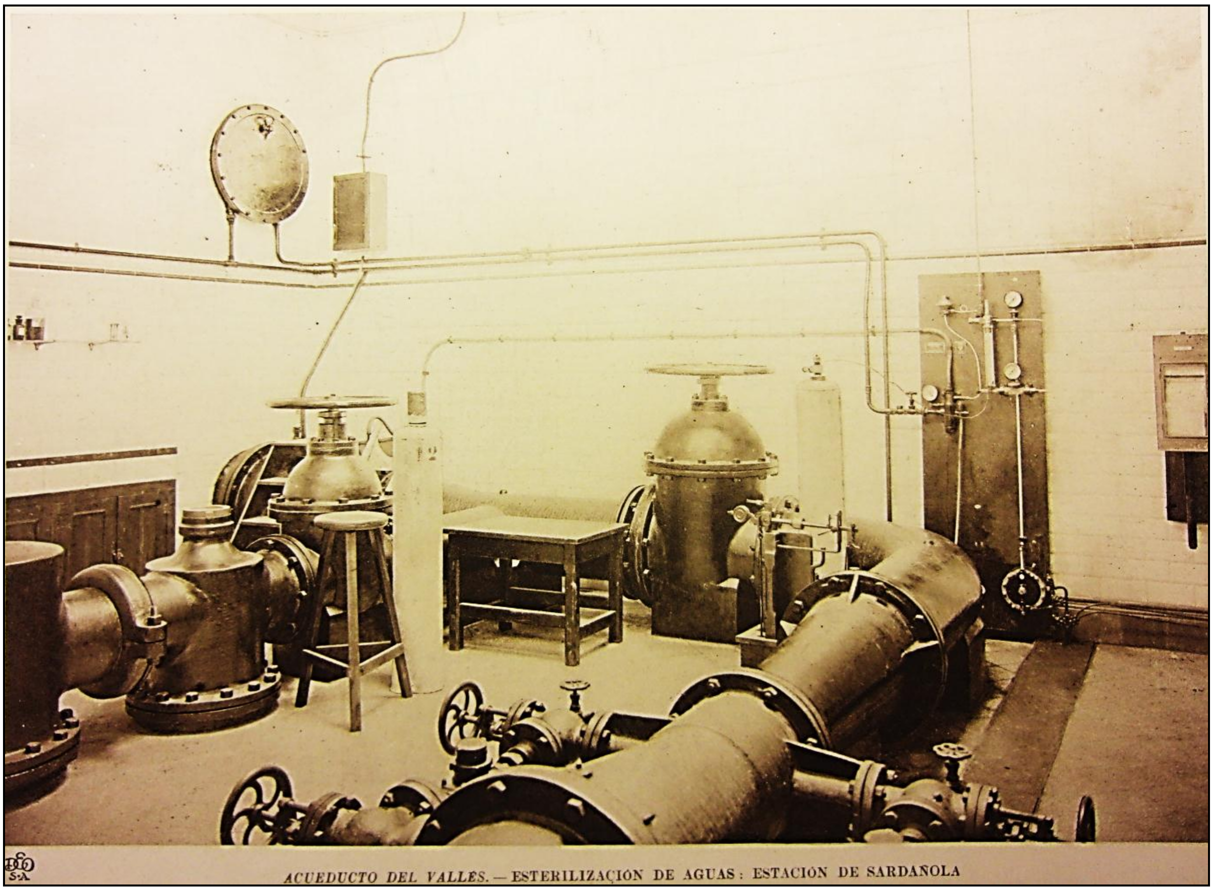


Figure 3.16. Water sterilisation facilities built by the Sociedad General de Aguas de Barcelona in 1923 in Cerdanyola.
(Societat General d'Aigües de Barcelona 1925)

3.3 Bottled water and public water distribution networks

3.3.1 Mineral water as a health product, the medicinal stage

From what it has been explained up to this point, it is clear that between the start of the Industrial Revolution and the advent of the Second Spanish Republic water consumption from the mains in Catalonia was unreliable and at times dangerous. Even with the improvements developed and applied during those years, it was not until the spread of chlorination that water became more dependable. Therefore, many people who lived in especially unreliable areas sought alternative ways of keeping hydrated. The traditional way, as explained in chapter 1, was drinking beverages with included alcohol as a way of keeping pathogens under control or obtaining water from clean springs usually located far away.

Another way of consuming safe liquids was to boil water before consuming it, something that authorities usually recommended during epidemic episodes (La Vanguardia 2012f). Boiling water was a very common solution, so to facilitate the process water boilers started being sold as a remedy to avoid getting water related diseases (Figure 3.17). The problem was that drinking hot water after having boiled it was unpleasant to many people. In fact, boiled water can have certain effects in the digestive system, a fact well known by some dieticians who use it as a means to lose weight (Sitaram Sabnis, Kúhn-Sabnis 2005), a side effect controversial amongst the medical community (Asthana, Nirmal 2010). In any case, drinking water hotter than 22 degrees may cause unpleasantness because it may affect the inner musculature and impede the proper digestion of nutrients (Alfonso 2002). These side effects did not go unnoticed to entrepreneurs who, taking advantage of the governmental advices, sold additives which turned boiled water into “mineral water” by mineralising it (Figure 3.17) (La Vanguardia 2012h). These additives, however, did not kill bacteria and were not suitable if used with non-boiled water.

Figure 3.17. Advertisement of a water boiler (top) and of "Salutinas" and "Lithinés dels Dr Gustin" (bottom) additives, which allegedly helped fighting epidemics by improving the properties of boiled water from the mains.
Source: (La Vanguardia 2012h, La Vanguardia 2012b)

Another side business which arose to fight the burden of waterborne diseases was the production of sterilised drinking waters. Those waters, not to be confused with mineral water, used standard mains water and after going through several processes they became sterilised and were sold bottled. Sterilised waters were usually sold carbonated and were advertised as scientifically clean (La Vanguardia 2012k). The sterilisation process rendered them effectively disease free, while keeping all properties which made water healthy, something that according to their advertisements did not occur when standard water was boiled (La Vanguardia 2012k). Only labs run by pharmacists could manufacture them, which gave a certain guarantee to consumers that the water would be properly decontaminated (Marty 2009) Two examples of sterilised bottled water found in Barcelona were "Agua Lustral" and "Amicrobina Miralles" (Figure 3.18).

Figure 3.18. Advertisement of "Amicromibina Miralles", a brand of sterilised drinking water.
Source: (La Vanguardia 2012k)

The last way of avoiding the dangers of consuming contaminated drinking water during those years was to leave the affected town and move towards a safe area. This solution, which nowadays may seem a bit far-fetched, was quite common during epidemic outbreaks. Many wealthy individuals would leave their cities and move to their summer houses to avoid falling ill, while poorer individuals could stay with relatives from the countryside. To illustrate this point the words of a Spanish politician who greatly influenced the use of water in Spain - Joaquin Costa- during a cholera outbreak are quite descriptive (Benet, Martí 1976)[24]:

> *"The aspect of this city [Barcelona] is more and more horrendous as days go by. Emigration of pacific people is increasing as days go by; houses and shops are locked everywhere…"*

However not everybody was able to leave the city and flee from the outbreak. Many less fortunate people had nowhere to go or no option but to remain in the city. Their only option to avoid drinking polluted water was to adopt one of the strategies already explained, like drinking boiled water.

Some wealthy people who went away from the city spent their time in bathhouses "taking the waters". As it will be thoroughly explained in chapter 4, they attended spas not only to avoid drinking foul water, but also to heal from illnesses or just to socialise. Treatments were quite lengthy and some customers had to depart before their cure had finished. If they wanted to continue the cure from their hometowns, some spas offered ways to continue the treatment remotely. One of the ways to continuing consuming clean water from spas was to ship bottles to the cities and then distributing them to customers. According to spa catalogues from the time, this kind of treatment was not as good as attending the spa –perhaps because it meant less profit for the bathhouse-, but nevertheless spas assured that it gave good results (Murillo 1910, Unknown author 1925).

Since the water bottled and sold from the spas was generally safer than water from the mains and had a better flavour than boiled water, it soon became a good alternative to the previously explained ways of avoiding foul water. They were usually sold in what became known as water depots -*depósito de aguas*- and pharmacies, which gave them an aura of healthiness. Therefore, bottled water started being sold as a health product, an

[24] Pg. 424

extension of treatments found in bathhouses. However, mineral water distributors soon became aware that their customers were not only buying their water as a treatment for illnesses, like rheumatism, skin rashes or tuberculosis, but also as a way of having access to clean uncontaminated water. Proof of this can be found in a series of articles from 1890 regarding what to do if people suspected that their water was contaminated by cholera (Robert 1890):

> *"If it the slightest suspicion of [cholera] pollution in the drinking water of a household, a neighbourhood or even a city exits (...), it is advisable to drink boiled and aerated water. However, since it is not quite digestive, it can be substituted by lightly mineralised waters from an area where nothing suspicious happens"*

As a reaction to this new use for mineral water in the cities, bathhouses changed their marketing strategy and started advertising their waters as an effective treatment against waterborne illnesses, especially typhoid fever. The fact that most mineral water producers obtained their water from wells and springs located in sparsely populated areas meant that their produce was unlikely to become contaminated by human activities. Therefore, drinking their water truly was a good choice to avoid becoming contaminated and falling ill. Consequently the new business consisted in selling mineral water to hosts returning to cities or to people who could not attend the spa at all. Right after each epidemic mineral bottled water companies held advertising campaigns advising consumers to drink their water as it would keep them safe during the outbreak. Eventually, the words typhoid fever and cholera became common in many mineral water advertisements (Figure 3.19).

Figure 3.19. Three advertisements of bottled mineral water enhancing their role as a way of preventing typhoid fever (the third advertisement regards a Spanish brand, not located in Catalonia).
Source: (La Vanguardia 2012c, La Vanguardia 2012g)

Of the 44 brands of bottled mineral founded between the years 1844 and 1930 in Catalonia, the majority (54.5%) had their origin in towns where a spa tradition existed. This can be due to the fact that spas already had the infrastructure, the brand name, the tradition and an existing potential clientele, so the creation of a side industry selling their water outside the spa's facilities was a natural move. Bathhouses did not even have to create a brand to sell their new product, as many of them were well known and renowned across the country. Therefore, the main investment they had to do in order to start the mineral water bottling process was the construction of a bottling plant and the creation of a distribution system.

However, after seeing that people were starting to buy bottled mineral water, many entrepreneurs not linked to the spa business saw an opportunity to make money and started *ad hoc* bottling plants with no relationship to existing bathhouses. These new companies appeared some 50 years after the first spas had started selling their water outside their premises, which indicates that it was not until the turn of the century that the bottled mineral water business became profitable enough as to have room for independent producers.

The first found reference to the sale of bottled water unlinked to a spa was the water of Rubinat-Llorach in 1878, which was an instant success. However, its famous and powerful laxative properties excluded it from being an alternative daily drinking water. Therefore the first brand of bottled mineral water which could be consumed as an alternative to water from the public distribution system and that was not obtained from a spa was “Font del Ferro”, located in the town of Montcada. It should be noted that the waters from the Font del Ferro source, even if they were not linked to a spa where well known for their therapeutic properties across Barcelona. Advertisements of the water tell us that the marketing strategy consisted in comparing itself with some of the most famous European spas like Vichy, el Voló or Spa. They also stated that the Font del Ferro water was as beneficial for the health as water obtained from one of those spas (La Vanguardia 2012d). At the fountain there was a hotel which obtained its running water from the spring, and since the 1850s a daily omnibus covered the transport from Barcelona to the source and back every day, so people could conveniently take its waters (Diario de Barcelona 1850). It is not casual that, even if not linked to a bathhouse, the first mineral water sold bottled that did not come from a spa was already well known for its healing properties. And it is not casual either that the first found reference of the existence of this brand is 1885 (La Vanguardia 2012d), the year when the last big cholera epidemic occurred in Barcelona (Busquets, Corominas 2009?). As a result, it be argued that the during the starting stages of the production and distribution of bottled water, only those sources linked to health related sources were capable of selling their water bottled. An anecdotic note regarding Font del Ferro, it is that the town where the source was located is the same where the origin to the main aqueduct which provided drinking water to Barcelona started.

A second factor which influenced the apparition of new brands of bottled water were recurring epidemic episodes. Figure 3.20 shows a timeline which displays the first found reference of bottled water brands –split between if they were related to a spa or not- and typhoid fever and cholera epidemics. As it can be observed, between the beginning of the mineral bottling industry and the turn of the century almost all the brands –excluding the aforementioned exceptions- were originated in towns with a spa tradition, while the bulk of brands not related with bathhouses appeared between the years 1900-1930. The figure also allows observing that some brands –linked with spas or not-, were created during or right after an epidemic occurred. However it is difficult to tell from observing the graph if a relationship existed between epidemic episodes and creation of brands, since both events are quite common throughout the series and the lack of data hinder a full interpretation. Even though, a proxy of the existence of this relationship can be obtained from advertisements of the time paid by bottling brands. They explicitly advertised the use of bottled water as a safeguard to waterborne illnesses.

It is therefore apparent that from the turn of the century onwards, the number of mineral water bottlers not related to spa towns blossomed, with almost one new brand per year (Table 3.1). This proliferation can be explained by two reasons. The first one is that it had been proven that people drinking bottled mineral water were less prone to become infected from waterborne diseases, which meant that each time there was an epidemic the demand for mineral water increased. However, during the starting stages consumers had a tendency to consume water from spa towns, which were regarded –as it was advertised- as ‘healthy’. As time went by other brands of water not related to spas were able to open a niche in the market and start selling their water, even if they were not related to traditional springs.

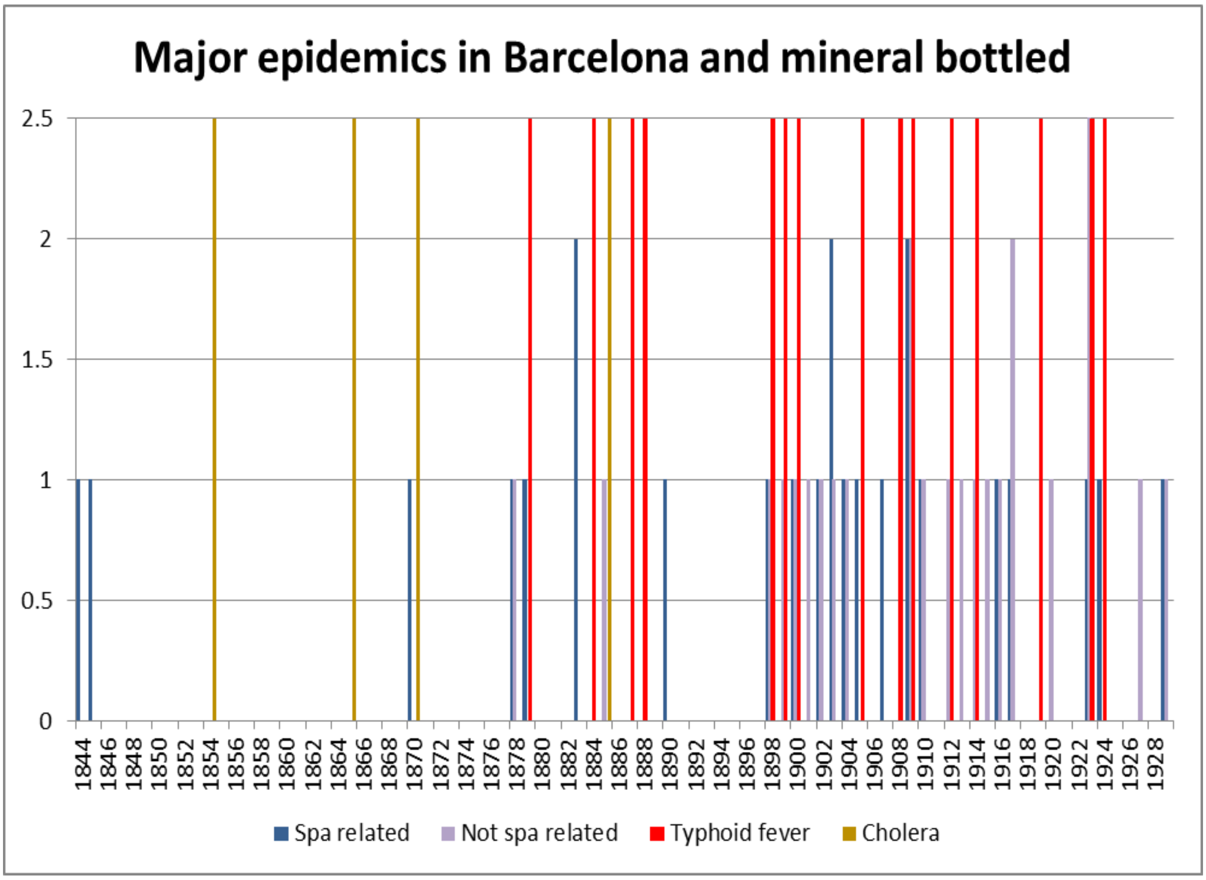


Figure 3.20. Timeline comparing the creation of bottled water brands in Catalonia and the occurrence of epidemics in Barcelona.

Notes: Data for typhoid fever is limited to the period 1878-1930. While new bottled water brands follow the scale depending on the number of brands created yearly, the epidemics columns are not related with the scale.

Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Conillera i Vives, Llabrés et al. 1986, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Magrinyà, Marzá et al. 2009).

It was around the same time when the second factor that increased the business of all types of bottled water, but most especially of those not related to bathhouses, happened. Until the turn of the century bottled mineral water was usually sold using the term "minero-medicinal water", an expression which focused in the mineral origin of the water and its healing properties, the latter proven by their origin in renowned spas. In this context waters originated in a newly exploited springs had more difficulties finding a consumer base, as they were of a mineral origin, but their curative properties, even if real, were not easy to prove. This paradigm changed when people started drinking bottled water not as a remedy to heal illnesses or as an alternative to boiled water during epidemics, but as an alternative to wine, beer or mains water. At this point bottled mineral water started being named "table water", a term which focused in the use of mineral water as the drink to have while having a meal at the table. The origin of the term seems to be linked to bathhouses, where drinking water during meals –instead of the omnipresent wine- was regarded as a form of treatment (Puerta 1884). Initially the term was only used by foreign companies, like the German Apollinaris (La Vanguardia 2010a) or the French Vals-Beatrix, (La Vanguardia 2010c) but after the change of century Catalan companies started using it as a new selling argument.

Table 3.1. Name, location and first found reference of mineral water bottling plants not related to spa towns (1850-1930)

Brand	Town	Comarca[25]	First found date
Rubinat-Llorach	*Rubinat*	*Segarra*	*1878*
Font del Ferro	Montcada i Reixac	Vallès Occidental	1885
San Román, Salat y Serre	Rubinat	Segarra	1898
Aguas de Madremaña	Madremanya	Gironès	1899
Timó	Sant Pere dels Arquells	Segarra	1900
Jalpí	Tordera	Maresme	1901
Vila-Roja	Vila-Roja	Gironès	1902
Agua Fargas	Barcelona	Barcelonès	1903
Miralles	Sant Daniel	Gironès	1904
Agua Radial	Barcelona	Barcelonès	1909
Rocafort	St. Martí de Riucorb	Urgell	1909
Santa Rita	Barcelona	Barcelonès	1910
Prats de Rey	Prats de Rey	Anoia	1912
Agua Val-Par	Barcelona	Barcelonès	1913
Agua Sarva	Barcelona	Barcelonès	1914
Agua San Martín	Torrelles del Llobregat	Baix Llobregat	1915
Fuente Tenebrosa	Barcelona	Barcelonès	1916
La Mina	Barcelona	Barcelonès	1917
Agua St. Climent	Sant Climent Sescebes	Alt Empordà	1917
Mont-Alt	Barcelona	Barcelonès	1920
Agua Stirling	Barcelona	Barcelonès	1923
Aigua Salenys	Bell Lloc, Sta Cristina d'Aro	Baix Empordà	1923
Agua de Palou	Granollers	Vallès Oriental	1923
Agua Better	Sant Fost de Campsentelles	Vallès Oriental	1927
La Roureda/ Agua Suprema de Mesa 'M'	Sant Pere de Vilamajor	Vallès Oriental	1929

Note: Rubinat water could not be used as an alternative to mains water as it was highly laxative.

Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002)

[25] A comarca is a geographical organisation unit similar to the English or American counties.

3.3.2 Mineral water as a commodity, the commercial stage

One of the first mineral water brands to use the expression table water was "Titus", a brand created as a by-product of the Caldes d'Estrac spa. They paid an advertisement in 1903 which was published in the La Vanguardia newspaper (Figure 3.21) and it is one of the first references where the term table water is found regarding Catalan water. The advertisement stated that, amongst other illnesses, Titus water could prevent and treat typhoid fever which was caused by the "*awful quality of most of the drinking waters supplied in Barcelona*". It continued by arguing that Titus water was controlled and analysed, which guaranteed that even if a lot of it was drunk, the effect of the water in the body would not be harmful but beneficial. This last statement meant that it could be used in a daily basis to fulfil the daily water requirements, as people from more advanced European cities like Paris or Brussels did (La Vanguardia 2011f).

The change of use of bottled water from something which was consumed during illnesses to a product which could be used in a daily basis was of paramount importance for the sector. It meant that instead of being mainly consumed by ill people and during epidemics it could be potentially consumed by anybody, all year round and every year. The potential increase in sales was worthy for the few existing companies at the time, but they had to fight against new brands, counterfeit water and certain limitations, as a "bottled water rush" spread across Catalonia.

After bottled mineral water became a mainstream commodity around the year 1900, many entrepreneurs saw in it a chance to make easy money. If during the period 1869-1899 only 11 brands of bottled water were created, during the period following thirty years as many as 39 new brands entered the market, meaning that more than 78% of the brands created between 1869 and 1930 were established during the second half of the period (Table 3.2). The dramatic increase in new bottling companies, with a new brand appearing every year on average, shows that the change of marketing strategy from a medicinal product to a commodity revolutionised the sector.

FIEBRES DE MALTA DE BARCELONA
Tifus y Paludismo
Se curan y previenen usando en bebida el
AGUA DEL
Manantial Titus (Termas de Caldetas)

La gravedad de tan terribles azotes proviene en primer término de una pésima calidad en la mayoría de las aguas puestas al consumo en Barcelona, y que no reunen la filtración suficiente ni las debidas condiciones de potabilidad. En la bebida deben usarse al estilo de París y otras capitales, aguas embotelladas bajo el amparo de un concienzudo análisis; Aguas Minero Medicinales que por sus especiales condiciones se reconozcan para usarlas á diario y no perjudiquen aun tomándolas en gran cantidad. Deben rechazarse por completo esos millares de botellas que se expenden á 5 y 10 céntimos sin más garantía que una tosca etiqueta (sin análisis) y que no se llenan directamente en los manantiales; pues ellas representan más que un fin humanitario una mal entendida especulación que puede ser de funestísimos resultados para el consumidor. Pocos son los depósitos de Aguas Minerales y Farmacias que se presten á tal negocio; y en su mayoría prefieren reducir sus ingresos á vender esas botellas clandestinas.

Una buena agua evita y cura numerosas enfermedades; pero también precisa que una á sus buenas cualidades, una condición especial é indispensable: La Economía.

Entre todas el agua del Manantial Titus reune estos requisitos; pues además de ser esencialmente curativa de las enfermedades del estómago, bronquios é intestinos; es además una deliciosa Agua de mesa, evitando su uso las malas digestiones, el restreñimiento y la infección.

Es la más económica de todas y la que ofrece mejores resultados

El agua del MANANTIAL TITUS es la más favorecida del consumo y este aumenta cada día

Figure 3.21. Water "Titus" advertisement which appeared in the "La Vanguardia" newspaper in the year 1903.
Source: (La Vanguardia 2009b)

Some bathhouses which had not yet bottled and sold their water started doing so during those years, but the change in the paradigm meant that since bottled water was not exclusively sold as a medicinal product anymore, sources without a healing tradition found a niche in the market. Therefore, some entrepreneurs started bottling water from sources which were not broadly known or not renowned for their healing properties. If during the starting stages of the bottled mineral water business in Catalonia almost 70% of the brands had their origin in a spa town, between 1900 and 1930 more brands were created in non-spa towns (Table 3.2). This fact is quite relevant since it shows that bottled water, which started as a sanitary product sold in pharmacies, progressively became an object of mass consumption which was seen as an alternative to water from public sources which could be bought at water deposits. It was not used as a healing method anymore, but as prophylactic measure to keep water borne illnesses away which with time became a commodity. Doctors embraced this new use for mineral water and in 1914 Dr. Josep Maria Mascaró i Castañer, who was in charge of giving the start of year speech of the Hygene Acadamy of Catalonia stated (Mascaró Castañer 1914): "*Mains water should be substituted by mineral water when there is the slightest suspicion that the quality of the water is foul or if a doctor indicates so"*.

Table 3.2. Number of mineral bottled water companies created in Catalonia and their origin and continuity (1869-1930)

		1869-1899	%	1900-1930	%
New Companies		11	22	39	78
Of which	From spa town	9	69.2	15	41.6
	From scratch	4	30.8	21	58.3
	Still existing	3	27.3	5	13.9
	Disappeared	8	72.3	31	86.1

Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002)

The change of use did not mean that people stopped going to spas or buying mineral-medicinal water, instead it broadened the potential consumer base for bottled water. Waters which had been being sold previously as a treatment for certain illnesses continued their business as usual, but a new parallel market emerged. Some existing brands linked to spas which had water which could be consumed in a daily basis were able to reconvert their marketing strategy and sell their water as table water as well. Other brands which had highly mineralised water or which had a laxative effect were not able to do so, a fact which was picked up by the competition. For example, the aforementioned Titus water published an advertisement which said:

> "*…it is also a danger that certain waters may become dangerous if they are used as table water. Some waters which are excellent if consumed moderately, become*

> *dangerous if they are drank in great quantities. For example, no more than three glasses per day should be consumed of the waters from Caldes de Malavella and Vichy -with break periods. These indications can be seen in all of their labels. In higher dosages they can be quite dangerous to certain people. Remember that the glasses used in the bathhouses of Vichy -both the Catalan and French ones- are mathematically graduated, proving that those companies do not want to sell a lot, they just want to heal. The waters from Vichy and those similar to them are therefore not table water, because their salts are so intense…*" (La Vanguardia 2011f)

The unsuitability of certain waters as table water was not as simple as the advertisement explains. For example, "Agua Xala" -previously known as Vichy Caldense and nowadays known as Imperial-, was founded by the industrialist Pau Estapé in July 1902 as a bottling plant not related to any of the spas which existed in the town (Bohigas, Buscató i Somoza 2007). However, the new brand aimed to obtain the benefits of being sold as table water, therefore being consumed as everyday water, and it advertised itself under that category (La Vanguardia 2009i), but it used the aura of healthiness spa towns gave by –unsuccessfully- naming the brand Vichy Caldense and displaying a picture of the town's Roman baths on the label (Bohigas, Buscató i Somoza 2007). So even if some brands from spa towns were not as suitable as others, at the end most of them tried to obtain a portion of the ever-growing table water business, even if some doubts about their suitability as table waters existed.

The change in how people used bottled water can be easily seen in advertisements throughout the period. Older advertisements only focused in how the water could heal existing conditions following the spa tradition which was common during those years, but after the turn of the century, and most importantly after the creation of the term table water, they also focused in bottled water as way of not drinking water from public fountains. This tendency originated from the evidence that waterborne diseases were transmitted throughout the public water distribution system. As Figure 3.22 shows, an advertisement of Rubinat water from the year 1881 only focused in how the water could treat, amongst others, digestive, menstrual and hepatic disorders, while an advertisement from thirty years later only focused in how bottled water could prevent certain illnesses.

AGUA MINERAL NATURAL PURGANTE
DE RUBINAT.

Unica agua española hasta el dia declarada de utilidad pública en Francia, y autorizada su venta por el gobierno de aquella nacion: premiada en la última Exposicion Universal de París, y eficazmente recomendada por las Academias de Medicina de Barcelona y París. Su uso se recomienda en los empachos gástricos, infartos viscerales, hiperemias cerebrales, ataques apopléticos, constipacion de vientre, desarreglos biliosos, herpes, scrófulas y desórdenes menstruales.

Se vende en todas las farmacias, principales droguerias y en el depósito de Aguas minerales de Ramon Freixa, calle del Pino, 12.

PREVENTIVA DEL CÓLERA
AGUA THERMION
de Caldas de Montbuy
Evita infecciones y Enfermedades Epidémicas
LA MAS PURA AGUA DE MESA

El agua **Thermion** la recomiendan todos los médicos en los casos que sea preciso usar un agua de pureza microbiana efectiva.

El agua **Thermion** es la más indicada para usar en bebida, en las épocas del año en que abundan ciertas enfermedades infecciosas. Es la **única** que **debe** usarse para prevenir alguna enfermedad de carácter **epidémico.** A este propósito, decía un médico eminente, al hablar del agua **Thermion:** «Si fuera posible que la mayoría de las gentes usasen en bebida, aguas de pureza bacteriológica indubitable, no registraríamos ciertas enfermedades infecciosas ó **epidémicas,** y entiendo que en este sentido el agua **Thermion** de Caldas de Montbuy, por su pureza especial, es de las únicas indicadas á este objeto.»

Todo veraneante que acuda á una localidad que no disponga de buena agua potable, debe proveerse de agua **Thermion** de Caldas de Montbuy, si quiere evitar de una manera segura ciertas infecciones.

El agua **Thermion** posee, además, la ventaja de no ocasionar irritaciones ni congestiones intestinales, como ocurre con otras aguas minerales que contienen anhídrido carbónico y hierro en exceso.

Los **artríticos, reumáticos y gotosos,** no deben usar otra agua en bebida que el agua **Thermion** de Caldas de Montbuy.

UNICA indicada para evitar la **Apoplejía.**

UNICA EN SU CLASE

El agua **Thermion** se expende en todas las farmacias, depósitos de aguas minerales, droguerías, etc. Exíjase en los Hoteles y Restaurants.

Los Agentes generales del agua **Thermion,** Sres. Maciá y Espinós, Mallorca, 295 (entre Lauria y Bruch). Teléfono 3.688, Barcelona, facilitarán gustosos cuantos datos se deseen adquirir acerca de dichas aguas, para expenderlas en todas las poblaciones de España.

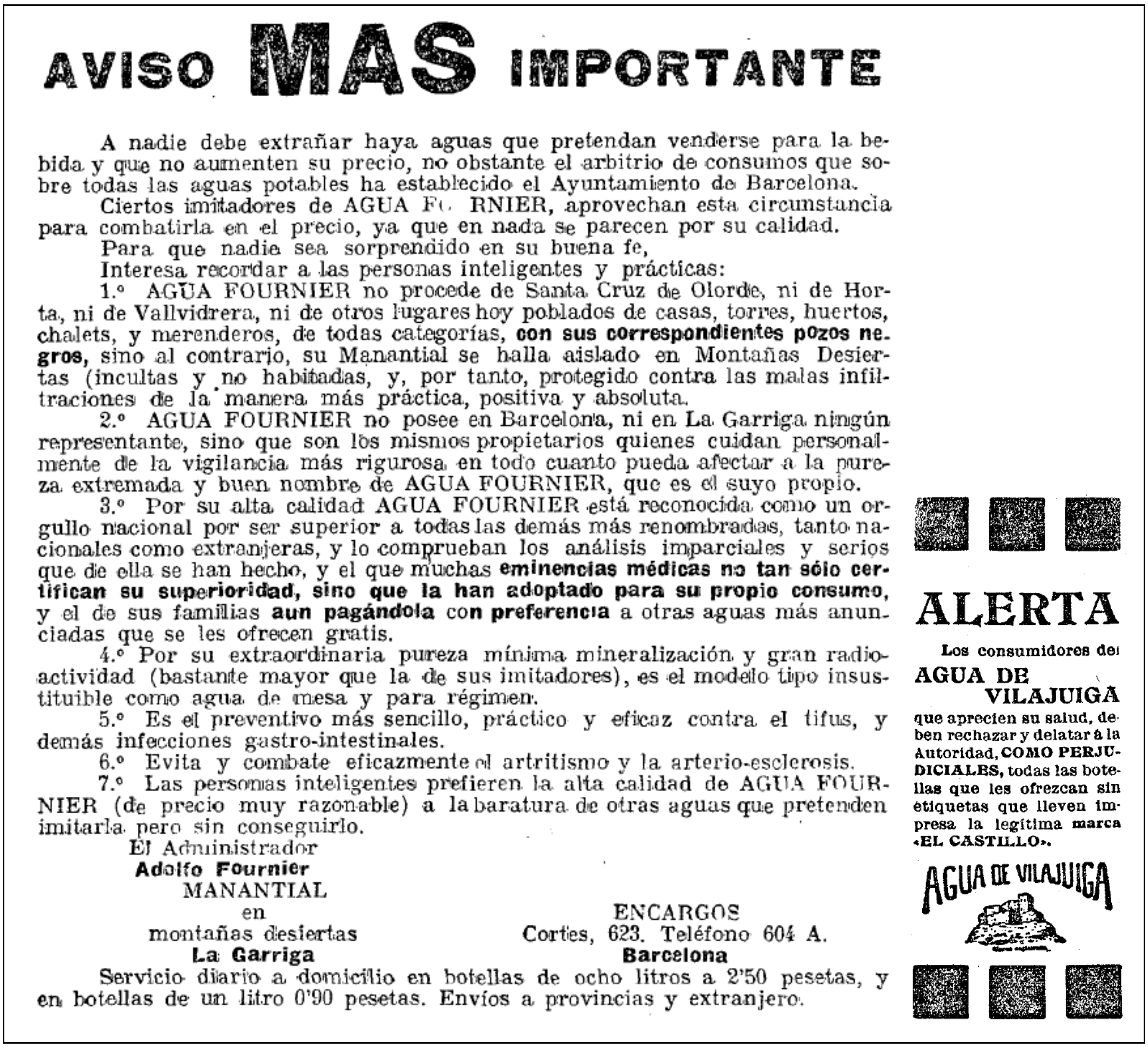
Figure 3.22. Evolution of the focus of bottled water advertisements from treatment (top) to prevention (bottom).
Source: (La Vanguardia 2009f, La Vanguardia 2009e)

The progressive increase in the use of bottled water did not go unnoticed to the scientific community of the time. Dr. Coroleu i Borrás wrote an article in the year 1912 warning the population about the change of water consumption habits in Catalonia. He explained that bottled water was not uniquely consumed by ill people anymore as many started drinking it because of its pleasant flavour and not for their chemical composition, so he distinguished the aforementioned two types of bottled mineral water, mineral-medicinal and table water (Coroleu 1912). The first type was considered a medicament, therefore a treatment, while the second one was used as a way of avoiding pathogens when drinking water. Therefore, while during the starting stages of mineral water bottling those brands which were highly mineralised were the ones which had better acceptance by consumers, during the following decades those waters with less minerals were the ones that achieved more success. At the time, the cut between a highly mineralised water and table water was 500 mg/l, so brands which were below that figure made sure their consumers were aware of it (La Vanguardia 2010b).

As table's water success grew, bottled water consumption arose, which meant that traditional brands could not cope with the high demand and new companies flourished to make an economic profit from it. This situation led to the exploitation of sources which had little analytical control or which plagiarised the name of more successful brands to confuse consumers and increase their revenue. Eventually, very high levels of demand caused the apparition of counterfeit bottled water. Phoney mineral waters usually consisted of water from an unreliable source which was tampered with additives, chemical processes or mixed with legitimate mineral water to enhance its flavour (Coroleu 1912). Bogus mineral water became quite a problem for companies selling legitimate mineral water. As they did not follow the legal and medical controls, they could sell their produce much cheaper, dumping the price of bottled water. In the year 1913 the Civil Governor of the Barcelona province, after receiving many complaints from legitimate mineral water bottlers regarding the breach of sanitary laws by many illegal bottling companies, published a memo about it in the province's gazette. He stated that even if the term "table water" was used on the label water from a natural origin had to be verified by a chemist. Any water that had not received all the sanitary and legal checks was therefore classed as fraudulent and could be decommissioned and destroyed by the authorities (Boletin Oficial de la Provincia de Barcelona 1913).

To fight this unfair competition, legitimate mineral water brands advised against them in many ways, for example by designing unique labels or campaigning on the press. Two examples of this strategy by the brands Fournier and Vilajuïga can be seen in figure 3.23. Water Fournier advised their costumers by posting and ad on the press that certain forgers had starting selling counterfeit water with their name in Barcelona. The precedence of those waters was not La Garriga, the original place where Fournier water was bottled, but Santa Creu d'Olorda, Horta or Vallvidrera –all of them located in Barcelona- which, compared to the legitimate source, were more likely to have polluted waters. They also advised that fake water was being sold by scammers who, disguised as sellers of Fournier water, were tricking buyers and that their water had extraordinary qualities that no forged water could equal. Therefore, they advised their costumers to be vigilant and evade consuming those cheaper and bogus waters to avoid having adverse effects on their health. On the other hand, Vilajuïga water owners opted to add a trademark in the shape of a castle to their labels which guaranteed their costumers they were buying legitimate bottled water. They also encouraged costumers to report to the police in case of seeing those selling counterfeit waters.

Physicians were also worried that the proliferation of bogus mineral waters was a public health hazard because they had not been analysed, so their edibility had not been proven. In his inaugural speech at the Hygene Acadamy of Catalonia, Dr. Mascaró also expressed his concerns about all the unhealthiness and fakery which surrounded table water: *"The medical profession has to react against practices which bypass our opinions and which do not fear in toying with the people's health. (...) Each water claims to heal all illnesses (...) as it is bottled and sold from house to house all of them with the same label"* (Mascaró Castañer 1914). The potential unsuitability of bogus water was an issue for the general population, but also for mineral water bottlers, as if a fake bottle used their name and contaminated several people, the brand's reputation could suffer from it. But counterfeit water was not the only competition mineral bottled water had, other beverages fought for a share of the drinks business.



AVISO MAS IMPORTANTE

A nadie debe extrañar haya aguas que pretendan venderse para la bebida y que no aumenten su precio, no obstante el arbitrio de consumos que sobre todas las aguas potables ha establecido el Ayuntamiento de Barcelona.

Ciertos imitadores de AGUA F(. RNIER, aprovechan esta circumstancia para combatirla en el precio, ya que en nada se parecen por su calidad.

Para que nadie sea sorprendido en su buena fe,

Interesa recordar a las personas inteligentes y prácticas:

1.° AGUA FOURNIER no procede de Santa Cruz de Olorde, ni de Horta, ni de Vallvidrera, ni de otros lugares hoy poblados de casas, torres, huertos, chalets, y merenderos, de todas categorías, **con sus correspondientes pozos negros,** sino al contrario, su Manantial se halla aislado en Montañas Desiertas (incultas y no habitadas, y, por tanto, protegido contra las malas infiltraciones de la manera más práctica, positiva y absoluta.

2.° AGUA FOURNIER no posee en Barcelona, ni en La Garriga ningún representante, sino que son los mismos propietarios quienes cuidan personalmente de la vigilancia más rigurosa en todo cuanto pueda afectar a la pureza extremada y buen nombre de AGUA FOURNIER, que es el suyo propio.

3.° Por su alta calidad AGUA FOURNIER está reconocida como un orgullo nacional por ser superior a todas las demás más renombradas, tanto nacionales como extranjeras, y lo comprueban los análisis imparciales y serios que de ella se han hecho, y el que muchas **eminencias médicas no tan sólo certifican su superioridad, sino que la han adoptado para su propio consumo,** y el de sus familias **aun pagándola con preferencia** a otras aguas más anunciadas que se les ofrecen gratis.

4.° Por su extraordinaria pureza mínima mineralización y gran radioactividad (bastante mayor que la de sus imitadores), es el modelo tipo insustituible como agua de mesa y para régimen.

5.° Es el preventivo más sencillo, práctico y eficaz contra el tifus, y demás infecciones gastro-intestinales.

6.° Evita y combate eficazmente el artritismo y la arterio-esclerosis.

7.° Las personas inteligentes prefieren la alta calidad de AGUA FOURNIER (de precio muy razonable) a la baratura de otras aguas que pretenden imitarla pero sin conseguirlo.

El Administrador
Adolfo Fournier

MANANTIAL
en
montañas desiertas
La Garriga

ENCARGOS
Cortes, 623. Teléfono 604 A.
Barcelona

Servicio diario a domicilio en botellas de ocho litros a 2'50 pesetas, y en botellas de un litro 0'90 pesetas. Envíos a provincias y extranjero.

ALERTA

Los consumidores del AGUA DE VILAJUIGA que aprecien su salud, deben rechazar y delatar á la Autoridad, COMO PERJUDICIALES, todas las botellas que les ofrezcan sin etiquetas que lleven impresa la legítima marca «EL CASTILLO».

AGUA DE VILAJUIGA

Figure 3.23. Advertisements paid by Fournier and Vilajuïga water to advice of the existence of scam mineral water.

Source: (La Vanguardia 2009j); (La Vanguardia 2011b)

3.4 Mineral water is expensive, what else is there?

Even if by buying table water from the black market instead of buying it from recognised mineral waters people could be scammed, some bottled water drinkers obtained their water from those sellers because it was a cheaper way of obtaining water, even if it could be of a dodgy origin. As an example, the price of a bottle of counterfeit water in the year 1903 -around the time when bottled water became a commodity instead of a treatment-, was between 0.05 or 0.1 pesetas (pts) (La Vanguardia 2009b), while a bottle of a recognised brand like Titus was 0.5pts (La Vanguardia 2011f). To put those prices into perspective, a worker of a textile factory –a very common job in Catalan cities at the time- earned around 15.75pts per week in 1903 (Llonch Casanovas 2004). Therefore, if only the parents of a family of four[26] had a salary and they only consumed bottled water to avoid contamination the weekly need of bottled water -five to eight litres per day[27]-, would mean that between 56% and 89% of the family's income would have been spent in bottled water. On the other hand, if the same family bought unlabelled water they could cover their water needs by using only between 5.5% and 18% of their salary. It is therefore not strange that a parallel market appeared when bottled became a commodity, as only well-off people could consume top bottled water brands which offered a higher quality at higher prices. Fournier water was clear about this elitism in an advertisement which stated "We do not offer bargains, but we warrantee high quality. This is why our water is the favourite of those people who CAN SPEND AND KNOW HOW TO SPEND their money CORRECTLY" (Figure 3.24) (La Vanguardia 2009c)


NO OFRECEMOS BARATURAS PERO GARANTIZAMOS ALTA CALIDAD
Por esto esta agua es la preferida de las personas que PUEDEN GASTAR Y SABEN GASTAR BIEN su dinero

Figure 3.24. Original extract from a Fournier water advertisement (1923).
Source: (La Vanguardia 2009c)

[26] The average family size for the period 1900-1930 in Spain was four people (Campo Urbano, Rodríguez-Brioso Pérez, María del Mar 2002)
[27] The range of values depends on the age of the children and assumes that the family only used water to fulfil their daily hydration needs. The maximum water intake has been established in 2 litres per person per day, but the actual water needs vary greatly depending on temperature and physical activity. However, a figure between 1.8 and 2 litres per adult is considered to be a good approximate (Valtin, (With the Technical Assistance of Sheila A. Gorman) 2002).

To accommodate their product to the demands of less wealthy people, mineral water brands soon started selling their water using larger containers to reduce the price. The most common offered size, together with the one and ½ litre bottles, was the eight litres flask. For example, in 1923, Fournier water sold one litre bottles at 0.90pts per unit, while eight litre bottles cost 2.5pts (La Vanguardia 2011b). This means that by changing the container's size, the price per litre was reduced to 0.31pts/l, almost three times less. If we use the same family as an example[28] it meant that by buying the larger bottle they could save between 28% and 45% of their income by buying the larger bottle.

However, families with more children or families where only one parent was employed could not afford to even buy the larger sized containers, so if they wanted to prevent falling ill during a waterborne epidemic event they had to be provided with alternatives to mains water. One alternative was to buy those cheaper bogus mineral water bottles from uncontrolled sources which have just been mentioned, but even if they were substantially cheaper than their more expensive counterparts, other affordable alternatives for those less fortunate existed.

[28] The average salary for a textile factory worker in the year 1923 was around 36.5pts per week (Llonch Casanovas 2004)

3.4.1 Lithium water

The market readily responded to the demand for cheap and safe liquids and a wide array of alternatives to mineral bottled water appeared in the market. What those alternatives have in common is that most of the time they claimed to be as good as mineral bottled water (Figure 3.25), which means that mineral water –whether from a spa town or not- was the benchmark to which other options compared to. One of the most popular and economical alternatives to mineral bottled water was lithium water or “agua de litines” in Spanish. This product, which still can be bought nowadays (Edosa 2012) -even if its consumption has dropped dramatically since the beginning of the 20th century-, was an economical way of improving the taste of water after having boiled it by turning it fizzy and adding several minerals to it (La Vanguardia 2012b). The product itself was a powder sold in little sachets which could enhance the flavour of a litre of water per dose. It is important to stress that even if the advertisements of the time stated that the use of lithium water defended the organism from pathogens, lithium water was a good prophylactic only if mixed with boiled water and it could therefore be defined as a flavour enhancer. However, the need to boil water together with its low price made lithium water a popular way of improving the flavour of mains water after having boiled it. Another common use of lithium powder to mix non boiled water non-boiled water with wine, allowing its alcohol to kill germs present in water while enhancing the flavour of the blend (La Vanguardia 2012b). There were many brands of lithium water like *Lithinés del Dr Gustin, Salutinas or Litinoides Serra*, just to mention some popular trademarks, but they all shared the desire to become an alternative to mineral and table water. For example an advertisement from 1915 by *Lithinés del Dr Gustin* stated “It is only necessary to dissolve a sachet of *Lithinés del Dr Gustin* in one litre of water to obtain a delicious mineral water” (La Vanguardia 2012b) and a poster of *Salutinas* from 1922 contained the phrase “With *Salutinas* you will transform your mains water into an exquisite sparkling mineral water (…)” (La Vanguardia 2010d). Even if they claimed to turn standard water into mineral water, it was clear that the difference in price meant that they two very different products. For example, in 1923, a litre of Fournier water was 0.9pts, while one litre of water prepared using lithium water from the brand *Salutinas* was only 0.1pts (La Vanguardia 2010d).

Figure 3.25. Lithium water advertisement which stresses how it is equal to mineral water and the best table water (1914).

Source: (La Vanguardia 2009h)

3.4.2 Soda water

Similar to lithium waters, in the sense that there was not need to buy bottles with liquid, an alternative to mineral water was to buy capsules which, when mixed with mains water inside a soda syphon, created soda water. Like other similar products, soda water also claimed that consumers could create something as good as the best table water available (Figure 3.26). However, it is unclear if this product actually made the water safer to drink or if it was just false advertisement. Producers claimed that it made water safer to drink, but if advertisements of the time are to be believed, haemorrhoids, boldness or hernias would be nothing but a bad memory.

Soda or Seltzer water is created when standard water and carbon dioxide under pressure are mixed and the water becomes effervescent (Smith 2007). The process *per se* should not have any influence on potential pathogens and minerals present in the water, rendering the transformation of mains water into soda water unsuitable to prevent the spread of waterborne epidemics. The only health benefit which may occur due to this process is that digestion may be aided by the gas present in the water, but not much more (Pouderoux, Friedman et al. 1997). It was therefore necessary to boil the water before using the product in order to guarantee an adequate level of alimentary security. What the capsules achieved, however, was to transform still water into sparkling water, giving less wealthy families the chance to enjoy sparkling water without the need to buy more expensive sparkling mineral water. For example, if the family used in previous examples wanted to consume only soda water, the cost would represent spending at least 40% less than if they bought naturally sparkling mineral water (Table 3.3). Nevertheless, that saving would be achieved if uniquely running costs are taken into account. Soda water required an initial investment to purchase the syphon and capsules which could be recharged as many times as desired. This meant that soda water, while being an alternative to the more expensive mineral waters, was not available to the masses. It was mainly used by middle, upper classes and bars, which would drink who would often mix it with alcoholic drinks like whiskey (Smith 2007). When mixed with alcoholic beverages, it would kill some of the potential pathogens present in water without having to boil it. Even if more expensive than other alternatives because of the initial investment required, once the siphon was owned the running costs were not much higher than for example those of lithium water. It is worth noting that following the zeitgeist capsules containing the gas could be bought with added radioactivity to provide a "constant supply of radioactive water" (Oak Ridge Associated Universities 2009c).

Figure 3.26. Sparklets soda water advertisement (1914) describing it as table water.
Source: (La Vanguardia 2009a)

3.4.3 Sterilised water

Another type of product which competed with the mineral water market was sterilised water, a product sold in bottles and produced in pharmaceutical labs. The idea behind them was to take advantage of the most modern sterilisation techniques of the time and turn tap water into something aseptic that posed no risk to the human health. The process used to achieve this goal claimed to kill all pathogens while keeping the naturally present salts and gases from the water unaltered. Therefore, sterilised water should not be confused with distilled water, where the process is the opposite and minerals are removed (Downes, Ito 2001). Techniques used to achieve this antiseptic water varied depending on the brand, but mainly used filters, chemical processes, boilers and UV light (La Vanguardia 2012k). These waters claimed being the best table water (Figure 3.27) because they bottled their product in an anaerobic atmosphere. To stress their higher level of sterilisation they argued that analyses undertaken at mineral water sources might have rendered the water as pathogen-free, but during the bottling and transportation processes the water could become contaminated. On the contrary, sterilised water suppliers guaranteed that all the processes involved in the bottling of the water were done in an aseptic environment, which meant that their product was better than mineral water (La Vanguardia 2012k). The downside of all this efforts was that sterilised water, which started being tap water, was quite expensive. Even if mineral water sold using one litre bottles was more expensive than sterilised water, mineral water sold in eight litre bottles was half the price (Table 3.3). Therefore sterilised water could not reach the hoi polloi and ended up being a minor product due to the higher popularity and longer historical background of mineral water.

—Bebed siempre AMICROBINA MIRALLES, que es la mejor agua de mesa, potable y esterilizada. Gran botella á 0'25 ptas. líquido. Paseo de San Juan, 45.

Figure 3.27. Sterilised water "Amicromina Miralles" advertisement (1914).
Source: (La Vanguardia 2010b)

Some people who wanted to drink sterilised water could buy the steriliser instead of buying just the bottles of liquid. The market supplied several instruments which claimed to sterilise water and to make safe to drink, like filters or full blown domestic sterilisers (Figure 3.28). Even if choosing this option was cheaper in the long run, the initial investment could be too high for many people, so their importance as a business was not as relevant as other products of the time. However, they can be seen as the predecessors of the myriad of products like jars and filters which can be bought nowadays and claim to improve the tap's water quality and flavour.

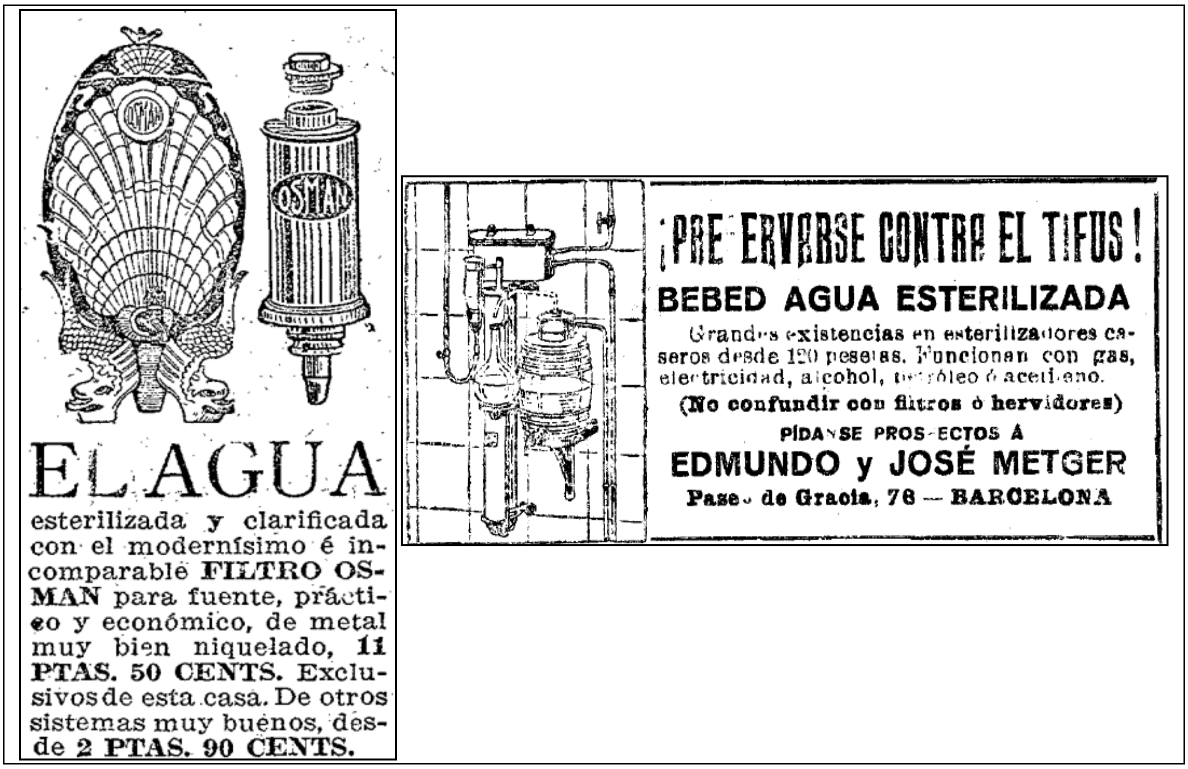


Figure 3.28. Different ways of obtaining sterilised water at home (1911 and 1915).
Source: (ABC 2012a, La Vanguardia 2012e)

Finally, a third option existed which claimed to sterilize tap water by killing all bacteria present in it; tablets that when mixed with water could clean up to one litre of liquid (Arrizabalaga, Martínez Vidal et al. 1999). The name of one of these products, "Clorisal" is quite transparent about how they achieved this; they used chlorine as a water disinfectant. Unlike other products which just stated that they could convert tap water into safe water to drink, Clorisal guaranteed good results. The antiseptic properties of these tablets were proven in the year 1916 when the owners of the brand asked Dr. Turró, a preeminent physician who worked at the Bacteriological Laboratory of Barcelona[29] and had an important role during the typhoid fever epidemic of the year 1914 (Alcoberro i Pericay 2007), to analyse contaminated water before and after using the product. According to the report produced by Dr. Ramon Turró, Clorisal was able to eradicate all bacteria from water after just ten minutes, an outstanding result even by today standards (ABC 2010). It is remarkable the chronological coincidence of three factors, the typhoid fever epidemic, the analysis of Clorisal by Dr. Ramon Turró and the starting stages of chlorination in Barcelona. All three events occurred in less than one and a half years, and while it cannot be certainly said that they were related without an in depth study, it is a quite noteworthy coincidence. Nonetheless, the sterilisation of water using chlorine tablets was a serious alternative to the use of bottled mineral water, as they were two ways of drinking clean water. However, the use of the tables was never as successful as the use of mineral water because tablets arrived too late in history. The first found reference to the use of tablets is from the year 1916 (ABC 2011), right at the time when bottled mineral water was at its prime and therefore finding a niche for a new product was a difficult endeavour. In addition to that, the product appeared contemporarily to the use of chlorine as a way of treating mains water, so even if it was effective, the competition by the public sector went against it. If the product had been introduced some years earlier, it is possible that it would achieved a greater success, as it was a cheap and effective way of cleaning water without the need to boil it, something which was highly advertised by the company (Figure 3.29).

Figure 3.29 Clorisal advertisement which stresses that it could treat "crude water" (1916).
Source: (ABC 2012b)

[29] Laboratori Bacteriològic Municipal de Barcelona

3.4.4 Other drinks

As it has been already explained in chapter 1, alcoholic drinks had been consumed for centuries, amongst other reasons, to guarantee a means of drinking clean liquids. Whether mixed with water or alone, alcoholic beverages became an important part of European culture, and businesses associated to them were very important. Catalonia, being a Mediterranean country, largely relied on wine as the alcoholic drink of choice. This generated a huge wine industry which employed a significant proportion of the working force (Pan-Montojo, Espanya 1994). There were obviously other alcoholic drinks available, like distilled drinks, of which Catalonia became a major producer (Figueras, Castelló Bou 2010), but due to their high alcoholic content they were not ideal as an everyday drink when it came to bing hydrated. Beer, the other popular European fermented drink, had been produced in Catalonia for centuries (Jordà Garcia, Capel Sáez et al. 2010), but it was not until the second half of the 19th century that industrial production of beer started in Catalonia mainly thanks to European immigrants – especially from the Alsace (Calvo 1993). Production and consumption, however, were quite limited and even by the first quarter of the 20th century beer was an exotic drink mainly consumed by foreigners living in Catalan cities (Calvo 1993) as it was quite an expensive drink (Jordà Garcia, Capel Sáez et al. 2010).

As figure 3.30 shows, in the year 1917 wine was the most consumed alcoholic drink in Barcelona, followed at a great distance by liqueurs and even further away by cider and beer. This pre-eminence of the wine industry shows that wine was the drink people normally consumed as it was a tasty way of avoiding water. Wine was so imbricated as the liquid to have while having a meal that even spas offered it during meals to their clients instead of the establishments' water[30] (Murillo 1910). In fact, wine was so ubiquitous that it was the only drink considered as a first necessity good in the Barcelona statistical yearbook in 1921 (Barcelona 1902; 1921). *Winecentrism* was so preponderant that a myriad of farmers, producers and sellers existed; making cheap wine readily available and sold by the litre in many places (Serres Buenaventura 1999). The price of table wine sold by the litre was lower than the price of a litre of mineral bottled water

[30] Unless the customer had an illness which recommended otherwise

(Table 3.3), allowing its purchase to almost all types of families from different economic backgrounds. More expensive bottled wine was also available, but its price was several times higher than that of a lower quality (Table 3.3), meaning that only wealthy households could afford it on a daily basis.

Figure 3.30. Consumption of beer, liquor, cider (including txacolí) and wine in 1917 in Barcelona (thousands of kilos).
Source: (Calvo 1993:229)

Having a drink like wine so readily available was a problem for mineral water producers, as most people chose wine over water due to it having taste, being inebriating and being safe to drink[31]. Wine is inherently safe to drink because, unlike sometimes water, when wine goes bad its flavour changes, and due to its alcoholic content pathogens have difficulties growing in it. Wine can become corked, oxidized, maderised or refermented (Boulton 1999, Unwin 1991), but those processes are easily noticed by the taste buds, making it possible to avoid drinking unsuitable wine. During waterborne epidemics, wine companies saw an opportunity to increase their sales by discrediting not only tap water, but all kinds of water. Figure 3.31 shows an advertisement published in 1914 during the

[31] Even religious reasons can be found for this choice. Jesus converted water into wine, which can be interpreted as wine being better than water. Something which in a country as religious as the Catalonia of the time could have had an influence in devotees (Jeffrey 1992).

typhoid fever epidemic where a wine seller undermines the consumption of water due to its inherent danger. Entitled “Against water”, the seller argues that the medical authorities advised the population to absolutely not drink water, without specifying that only tap water was under scrutiny. The advertisement also stresses the fact that the alcohol present in wine was a safeguard as it assured the healthiness of the drink.

However, the level of alcohol present in wine, which made it safe to drink, was a two-edged sword. As with any alcoholic drink, consuming too much wine could lead to health and social problems, something that did not occur if water was drunk.

-CONTRA EL AGUA

Si las autoridades médicas y micrógrafos eminentes recomiendan abstenerse en absoluto de beber agua,

¿con qué apagaremos la sed?

Solamente el vino puede satisfacer tal necesidad, siempre que sea garantida su pureza y prudencial su grado alcohólico. Son indicados, por reunir estas condiciones los vinos de Gelida, marca Albert, que siendo de cosecha propia, se elaboran con la pulcritud y el esmero que el altruismo impone.

Depósito en Barcelona: paseo de San Juan, 18, y Ali-Bey, 33. Teléfono 3.777.

Figure 3.31. Wine advertisement against water (1914).
Source: (La Vanguardia 2010b)

Another product which was a competition for mineral water producers were soda drinks. The process of elaboration of those drinks required cooling the water, cooking sugar syrup, preparing acidic solutions, adding flavourings, dosing the syrup, carbonating the water, filling the bottles with a mix of syrup and water and finally closing and labelling the bottle (Jordà Garcia, Capel Sáez et al. 2010). While being safe to drink due to their high content in sugar, which prevented the propagation of pathogens, they did not have the drawbacks of wine as they did not have alcoholic content. Also, since the production of soda pops was an industrial activity, factories could be placed virtually near any source of water. This meant a big advantage versus mineral water, as soda pop factories could be placed very close to consumption centres. As figure 3.32 shows, the distribution of soda pop factories in Catalonia during the first quarter of the 20th century was scattered across the country, with a special concentration in Barcelona. The flexibility when installing a soft drink factory meant that they had an advantage when compared to mineral water producers, who could not change the location of their businesses freely, which increased transportation costs.

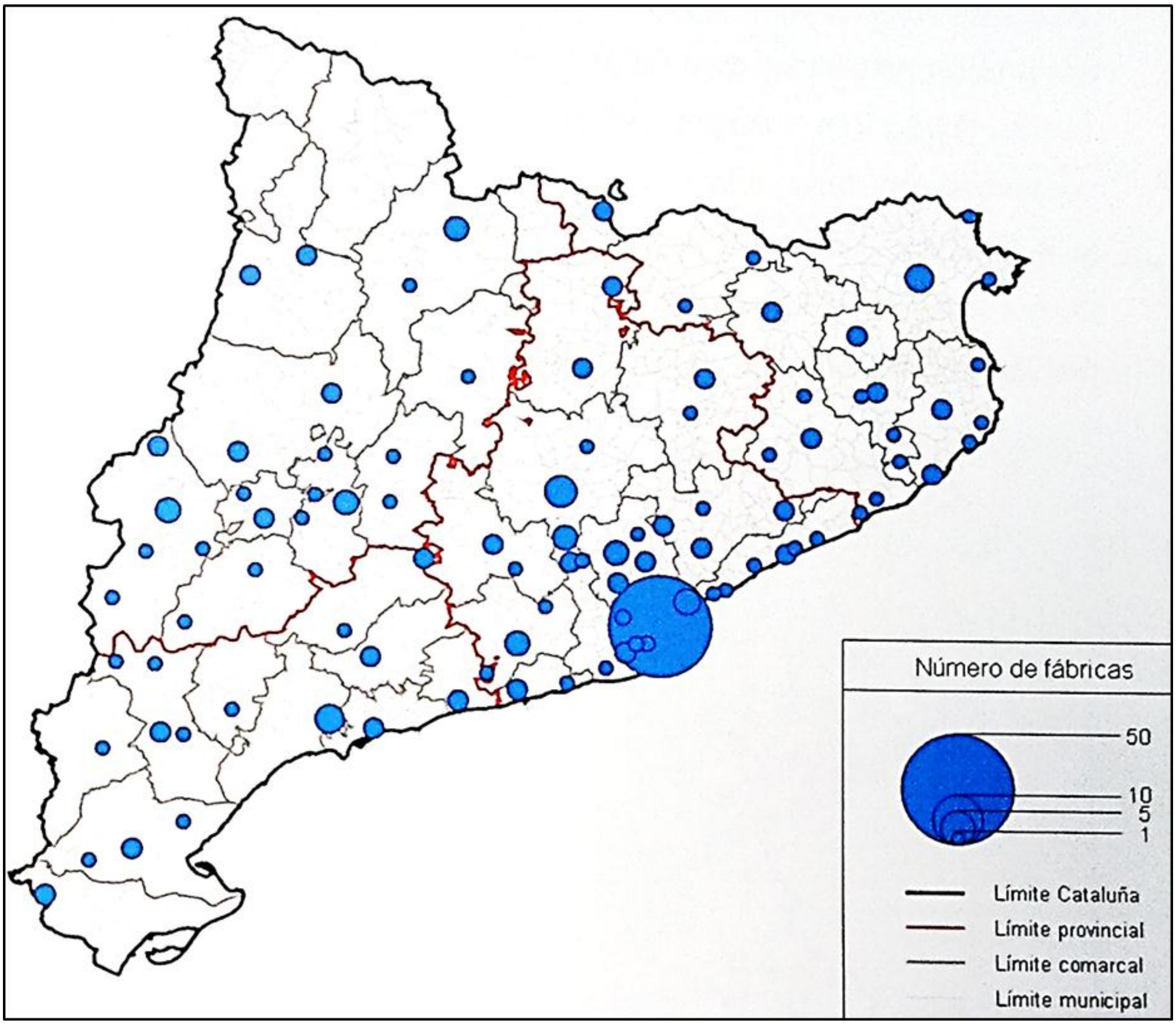


Figure 3.32. Distribution of soda pop factories in Catalonia (1924).
Source: (Jordà Garcia, Capel Sáez et al. 2010:145)

The flexibility soda drink factories had when choosing their location meant that in the year 1924 there were 200 soft drink producers located in 97 different towns, while there were only 48 mineral water bottlers located in 34 settlements. This allowed them to reduce the cost of transport when compared to bottled water, which consequently resulted in cheaper sale prices than the equivalent size mineral water container (Table 3.3).

Table 3.3. Prices of alternatives to tap water in Barcelona in the year 1923

		Price litre	Δ 1L bottle water (%)	Weekly price per family[i] (pts)	% of family's weekly salary[j]
Mineral water[a]	**1 Litre bottle**	0.9	0	38	52
	8 litres bottle	0.31	-66	13	18
	Counterfeit water[b]	0.12	-87	5	7
	Lithium water[c]	0.13	-86	5	7
	Soda water[d]	0.19	-79	8	11
	Sterilised water[e]	0.73	-19	31	42
	Sterilising tablets[f]	0.14	-84	6	8
Wine	**Wine**	1.75	94	74	101
	Table wine	0.65	-28	27	37
	Beer	1.6	78	67	92
	Soda pop[g]	0.5	-44	21	29
	Coca-Cola[h]	1.38	54	58	80

Notes: All prices refer to the year 1923 and do not include the price of the cask in case one was needed. a) Based on Fournier and Vilajuïga bottled water prices b) Since it is difficult to know the specific price of illegal water but it is known that they were between 5 and 10 times cheaper than legal water, the following formula has been used (Value of 1 litre of mineral water/7.5) c) Price obtained by using an average between several lithium water providers d) An initial investment of 17.5pts was needed to purchase the syphon and 2.75pts to buy 12 capsules which could be recharged e) Price adjusted to 1923 from the price of a litre of Miralles sterilised water in 1905 f) Price adjusted to 1923 from the price of a litre of Clorisal sterilising tablets in 1916 g) Based on a litre of "D'Onis" soda h) It is an anachronism as Coca-Cola was introduced in Catalonia in the year 1928, but prices have been adjusted. Price referred to 8 fl oz bottle i) Assuming a family of four with two children that only consumes water and averages a consumption of 1.5 litres per person j) Assuming that the two adults of the family were employed as workers in a textile factory.

Sources: Product prices: (La Vanguardia 2011e, La Vanguardia 2010d, La Vanguardia 2011b, La Vanguardia 2009b, La Vanguardia 2012k, ABC 2010, La Vanguardia 2009d, La Vanguardia 2009g, La Vanguardia, Jordà Garcia, Capel Sáez et al. 2010) Salaries: (Llonch Casanovas 2004)

3.5 Chapter conclusions

Obtaining uncontaminated water for human consumption has been a continuous challenge since humans chose to settle. The fight to separate clean from foul water has led to the creation of important engineering works, but also to episodes of illness caused by the inability to provide adequate water to citizens. Receiving a suitable quantity of clean water has been a challenge only achieved in recent times in developed countries, but less than a hundred years ago it was still a big topic on the agenda and public water was an unsolved issue. Catalonia was not an exception, as several cholera and typhoid fever epidemic spread across the country, but most especially in Barcelona. The fight against waterborne epidemics was unsuccessful until the introduction of chlorine in the water sanitation systems, something which slowly started around the year 1915 but did not become widespread until many years later.

Due to the potential danger mains water represented, citizens grew aware of the dangerousness drinking water from the mains meant, so they sought safer ways of keeping hydrated. Amongst other solutions like wine or beer, mineral water became an alternative to water obtained from the city fountains. Bottled mineral water had existed for several decades before it was regarded as a substitute to mains water, but when people saw it as a commodity the marked boosted and the first golden age of the product started. However, since a lot of money could be made by selling alternatives to mains water, bottled mineral water had to compete with several alternatives which also wanted to obtain a share of the market.

Alternatives to mains water suffered a big drawback with the popularisation of chlorination and other technological advances as a means of treating water. Clean, cheap and readily available water became accessible to the population, so there was no need to purchase a product as mineral water. Even though, it took several decades for chlorinated water to reach most of the population, so in the interim, some mineral water brands managed to continue with their business. However, the number of companies and sales dropped as a consequence of increase in reliability of public water distribution systems. Other products which had competed with mineral water also lost their momentum and became progressively marginal. All things considered, one of the factors which triggered a rise in the consumption of bottled mineral water –an unreliable public water distribution system- also was one of the causes of its downturn.

4. A social predisposition towards drinking bottled water

Introduction

A proper water container and the need for clean water do not explain by themselves the apparition of bottled mineral water in Catalonia. Those are necessary but not unique factors, so other reasons must be sought in order to explain the blossoming of a new industry. Apart from technical reasons, bottled water needed to have a social predisposition towards it to be successful. Even if Say's law states that "*l'offre crée sa propre demande"* (Waquet, Montoussé 2006), it seems clear that selling bottled water without a sizeable demand would have meant that it was not a profitable business. Historical records tell us quite the opposite, bottling water became a popular and flourishing industry during the second half of the 19th century and the first third of the 20th century. This chapter searches the historical roots of the relationship Catalan people had with mineral water, the influence of spas and hygienist theories in the perception Catalans had about drinking mineral water, and how both elements combined to create a social predisposition towards drinking bottled water.

4.1 Mythical waters

Drinking mineral water from springs and sources is as old as mankind. Even animals have been known to recognise springs which had healing effects. Many popular legends and stories about how mineral water sources were discovered include animals as the ones who already knew the curative properties of the water. A common example, which can be found linked to many springs, is the one where a livestock farmer discovered a spring when he observed how his sick cattle healed after drinking from a puddle on the ground, which had been originated from the raising of underground water. Even more mythological legends include animals as the ones which, not only discovered, but created the spring by using their might (Hall 2003). The mentioned healing properties of certain springs, many times defined as miraculous, added to the mysterious emergence of water from the rocks, have been historically surrounded by an aura of mysticism. With time, mysticism mixed with local religious beliefs and became an integral part of the cultural baggage of many ancient societies. An example of how local legends, mysticism and religion merged as a single narration can be found in the Greek cosmogony. In Greek mythology, Naiads[32] were the daughters of Zeus or Oceanus[33] and were the deities of springs and fountains. These goddesses had healing powers, because when the sick drank from their springs they improved their condition, but bathing in their springs was considered sacrilegious, so baths were rarely built in the area of influence of the Naiad (Littleton, Marshall Cavendish Corporation 2005). Some of those Naiads -and their corresponding springs- were born when Pegasus' hoof struck on the land and water started to flow. In honour to that equestrian origin their names included the *hippo* (horse) particle like Aganippe, Hippocrene or Hippe (Guthrie 1971).

Devotion towards gods living in clean water sources has existed unstopped for centuries and has been shaped into many traditions, some of which have remained until nowadays. One of the most famous examples in occidental culture has been to throw valuable items, like coins or precious materials, to wells and fountains while wishing something so the

[32] Naiads were divided into different categories depending on where they lived. For instance Naiads living in springs were called Pegaeae and Naiads living in fountains were called Crinaeae (Chopra 2005)
[33] According to Homer, they were the "daughters of Zeus", but elsewhere they were known as the daughters of Oceanus or as the daughters of the local river (Grimal, Maxwell-Hyslop 1996).

wish comes true. All across Europe and America whishing wells and fountains can be found, with hundreds of coins lying at the bottom. This tradition was also followed by Ancient Greeks or Romans, but examples of the same ritual can be found amongst the Celtic and Germanic tribes. For example, the Irish deity Caolainn lived in a well located in County Roscommon in western Ireland. Tradition said that if passersby threw a coin into her well she would grant them a wish (McCoy 1995). Perhaps the most spectacular example of the tradition of throwing coins into springs and wells was found at "Sorgenti di Vicarello"[34], a sulphuric spring owned by the Jesuit Order on the border of the lake of Bracciano. In 1852 they hired a gang of masons and asked them to clear the mouth of the spring to improve its condition. After starting their work, only a few decimetres under the surface, the masons found a stratum of coins from the fourth century AD. After digging a bit deeper they found a layer of coins and objects from the early decades of the Empire, below that layer they found coins belonging to the last centuries of the Roman Republic and even deeper down the spring there were some of the oldest Roman coins, *aes signatum* and *aes gravem* (Lanciani 1868). This means that during all the different periods of the ancient city of Rome the tradition of throwing coins and valuable items to springs existed, but the findings at the Sorgenti di Vicarello were not limited to the time after the foundation of Rome. Indeed, deeper excavations allowed the discovery of shapeless fragments of copper, previous to the apparition of coins in the area now known as the Lazio. But perhaps the most surprising finding was, that below all this strata of coins and valuable materials, a layer of arrowheads, paalstabs, and knifes of polished stone were found. They had been offered to the spring's deities by the Stone Age inhabitants of the area (Lanciani 1868). Wishing wells show how the mystical effect mineral water springs had, became an integral part of many societies which has survived for centuries, to the point that nowadays the bottom of wells or public fountains still glitter with coins.

Another illustrative example of how important springs were for the Graeco-Roman world can be found by reading the letters of Pliny the Younger (61 AD – ca. 112 AD). He wrote a letter to his friend Romanus which explains how springs were linked with divinatory, healing, religious and mystical matters (Muntz 2011):

[34] Known as "Aquae Apollinares" in Roman times (Lanciani 1967)

> *"Have you ever seen the source of the river Clitumnus*[35]*? (...) At the foot of a little hill (...) a spring gushes out, which, breaking up into different and unequal streams, forms itself, after several windings, into a large, broad basin of water, so transparently clear that you may count the shining pebbles, and the little pieces of money thrown into it, as they lie at the bottom. (...) Near it stands an ancient and venerable temple, in which is placed the river-god Clitumnus clothed in the usual robe of state; and indeed the prophetic oracles here delivered sufficiently testify the immediate presence of that divinity. Several little chapels are scattered round, dedicated to particular gods, distinguished each by his own peculiar name and form of worship, and some of them, too, presiding over different fountains. For, besides the principal spring, which is, as it were, the parent of all the rest, there are several other lesser streams, which, taking their rise from various sources, lose themselves in the river; over which a bridge is built that separates the sacred part from that which lies open to common use. Vessels are allowed to come above this bridge, but no person is permitted to swim except below it. The Hispellates, to whom Augustus gave this place, furnish a public bath (...) You may also amuse yourself with numberless inscriptions upon the pillars and walls, by different persons, celebrating the virtues of the fountain, and the divinity that presides over it."* (Muntz 2011)

In this epistle Pliny the Younger mentions how at the source of the river one could observe many coins laying there as an ordinary situation, which confirms that during his time it was common to throw coins at springs. He adds that the pilgrims or visitors that went to the source to obtain the god's favour wrote on walls and pillars praises to the water deities. He also mentions that the river had a river-god named as the river, Clitumnus, who could predict the future and had a temple dedicated to him. Together with Clitumnus, who was the main god of the main spring, other minor spring gods, each with its own name and ritual associated, had chapels and ruled over different sources. Finally, as it has previously been explained, bathing at the source was prohibited because of its sacred nature, but a bathing house had been built a bit further down the river to give service to the many visitors.

[35] Nowadays know as the river Clitunno. It is located in Umbria, Italy.

The sacralisation of springs and wells did not finish when Graeco-Roman and other local cosmogonies across Europe were abandoned, it continued with Christianity. When Christianity became the official religion of the Roman Empire in the year 380 (Williams, Friell et al. 1994) many pagan traditions were readapted to comply with the new official creed. There are numerous examples of pagan rituals being integrated into Christianity; for example the Roman pagan Saturnalia festival, which celebrated the beginning of the New Year, the start of winter and the winter solstice (Lang 2005) is thought of being the origin of the Christmas festivities (Thompson 1855). This integration of pagan traditions within Christianity also applied to the veneration of water sources. Again, a good example can be found at the source of the river Clitumnus. As Pliny the Younger explained, there was a temple dedicated to the adoration of the pagan god Clitimnus, where many pilgrims asked for healing and other requests. With the adoption of Christianity the mythical aura that surrounded the place did not change, what changed was the recipient of the prayers. Indeed, the god Clitimnus was replaced by the adoration of Jesus, in his role as Saviour, known in Italian as *San Salvatore* (Emerick 1998). The Roman pagan temple was used by early Christians to build their paleochristian church, so a place which once worshiped a pagan god of water, became approved by the Church, but this is not a unique case. All across the Roman Empire pagan places near springs became sacralised as Christian worship sites and shrines or churches were built, many times readapting older pagan edifications. The only change was that instead of adoring the local god or Naiad, they venerated a local Saint or Marian apparition.

Catalonia, as an area included in the former Roman province named Hispania Tarraconensis first (Balari y Jovany 2009), and a mostly Christian area since then[36], has many examples of sacred springs. Many springs are called “Font Santa” which means Saint or Sacred Spring, and many more sources have a place name dedicated to a saint or to the Virgin Mary. Figure 4.1 shows a map of all the Catalan Catholic sacred buildings that are less than 1.5 kilometres away from a spring. The data used to elaborate the map has been obtained from the last edition of the Catalan gazetteer, which lists all place

[36] This is a deliberate simplification. The religious history Catalonia is far more complicated, but it escapes the scope of this text to explain it. In any case, the Christian influence in Catalonia since Roman times is patent. For more information , amongst others, a good starting point is (Valls i Taberner, Soldevila 2002).

names that appear in the 1:50,000 scale maps. This level of detail omits many springs and sacred places, mainly in urban or densely populated areas, because the density of place names is too high and many labels have to be discarded. The consequence to this fact is that the distribution of the elements of the map is not scientifically relevant because what it is really showing is the toponymic density of Catalonia. For example the area around the city of Barcelona and the comarca east of Barcelona, the Maresme, have many springs which are linked to churches or shrines but are not displayed in the map because they are highly populated areas. But even if it is not complete, it is a good sized sample which is useful to show that many sources have a sacred building linked to them, which gives the springs a sacramental meaning. The 1:50,000 Catalan gazetteer lists 1,795 sacred buildings and 1,627 springs in Catalonia (Institut Cartogràfic de Catalunya, Institut d'Estudis Catalans 2009). 27.41% (446) of the springs are located less than 1.5 kilometres away from a sacred building.

It is relevant that many springs share their name with their religious neighbour and vice versa, which shows the intense relationship that exists between mineral water and religion, or in other words, the holiness of clean water. The abundance of sacred springs follows a tradition which can be traced back to the Stone Age, a tradition that has been continuously followed until nowadays through the Graeco-Roman myths and the Christian cult.

The importance of clean, healthy and available water led to the sacralisation of many springs, sources and wells and to the construction of many shrines, churches and monasteries linked to them. Therefore, it is not unusual to find a well inside a sanctuary or by a shrine (Figure 4.2). Nowadays it is not strange to find pilgrims going to a sacred well or fountain to drink or bathe in their holy water. Many examples can be found across the world, perhaps the most spectacular one being the case of Lourdes, in southern France, with over six million visitors each year (Boniface, Cooper 2009). In Catalonia, the popularity of going to a distant natural water spring, many times linked to a sacred building, and obtaining water to drink later at home has become quite popular. This has led to conflicts between the water takers and locals, who have given them the derogatory nickname of "*garrafaires*", which could be literally translated as "demijohners" (Herrero i Baró, Centre d'Estudis de Sant Pere de Vilamajor et al. 2003). In any case, it is clear that the mythical importance of mineral water, born with the first human settlers of Catalonia, has been maintained through centuries and adapted by subsequent creeds and beliefs until nowadays. Without this mythological background, the appearance of bottled mineral water in Catalonia would have been different and maybe it would have not happened when and how it did.

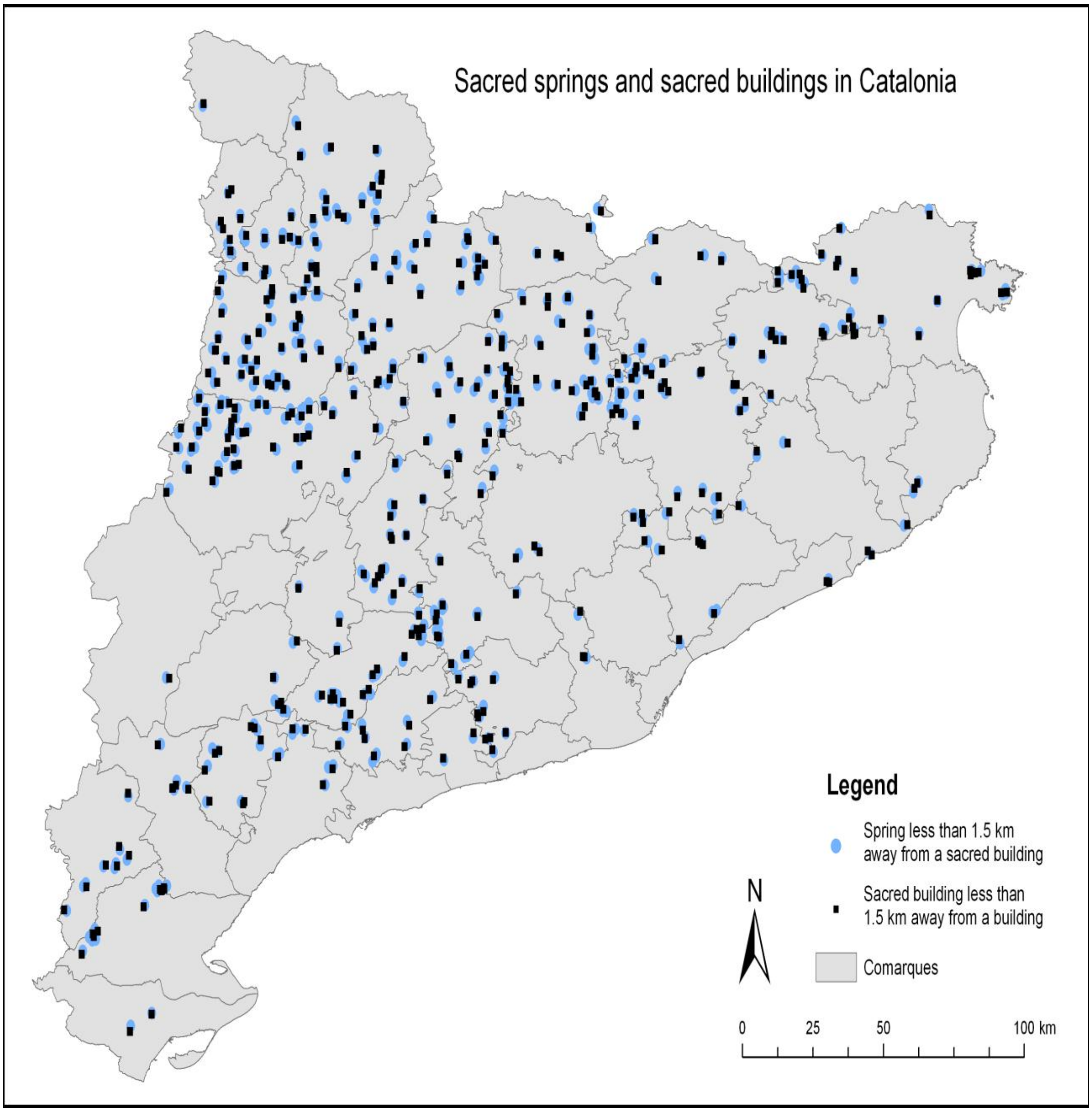


Figure 4.1. Sacred springs and buildings in Catalonia located less than 1.5 kilometres apart one from the other (place names at 1:50,000 scale).
Source: Author's work. Data obtained from the 1:50,000 Catalan Gazetteer (Institut Cartogràfic de Catalunya, Institut d'Estudis Catalans 2009)

Figure 4.2. Water well inside the "La Gleva" sanctuary at Les Masies de Voltregà (top) and water source by the "La Damunt" hermitage at Folgueroles (bottom).
Source: Author's work.

4.2 Rational waters

Some of the most therapeutic springs had bigger shrines linked to them, which sometimes evolved into spa towns[37]. Again, it was during the Roman influence in Catalonia when the first and most spectacular cases can be found. Romans constructed many bathhouses where hot or mineral water spring gushed, and with time some of them evolved into spa towns where the sick could rest and recover. Some Catalan towns still preserve Roman baths or place names which are derived from the Latin word “calidas”, which means hot and was used to name many spa towns (Institut d'Estudis Catalans 2002). In fact, many towns with the word Caldes still have working spas, some of them of Roman origin. According to the 1:50.000 Catalan gazetteer, Catalonia has sixty-two place names derived from the word “calidas”, like Caldetes, Caldes de Montbui (Figure 4.3) or Escaldes (Institut Cartogràfic de Catalunya, Institut d'Estudis Catalans 2009), which shows the influence of the Roman spa culture in ancient Catalonia. Another example of continuity between roman baths and contemporary spas is the town of Les, located near the French border in the Pyrenees. The etymology of the name of the town comes from the local Roman water deity Lex, which was linked to the hot waters found in the town. These waters where used by different bathhouses from Roman times until the 1960s[38] (Grup Enciclopèdia Catalana 1986).

With the fall of the Roman Empire and the rise of Christian morals, bathhouses and spa towns suffered a progressive decline (Mitjà i Sarvisé, Associació Balneària et al. 1999). In the Early Middle Ages, Catalonia was divided in two areas, one controlled by the Christian nobles, and another ruled by Muslim sovereigns (Font i Rius 1985). Muslim sovereigns promoted bathing and helped maintain and build public baths, like the ones in Palma de Mallorca (Font i Rius 1985) or Xàtiva (Ferrer i Mallol 1995), while there was much discussion amongst the Christian nobles about if taking the waters was rightful or otherwise. While some nobles or army leaders found that bathing in spas was appropriate for the healing of their soldiers, others loathed it. A good example of dichotomy can be

[37] The history of spas, spa towns and bathhouses in Catalonia has been studied in depth by many scholars, so in this text only a brief account will be explained

[38] The bathhouses were not continuously open during all the period. The last working spa opened in 1834 and closed in the 1960s (Mitjà i Sarvisé, Associació Balneària et al. 1999).

found in the rulers of the different Christian Kingdoms of the medieval Iberian Peninsula. In the 11th century, king Alfonso VI of León, accused his troops of being effeminate because they took many baths, so he ordered the demolition of all bathhouses of his kingdom. On the other hand, king Alfonso I of Aragón promoted the reconstruction of some of the traditional baths of his kingdom, like the ones located in the towns of Alhama de Aragón[39] and Jaraba (Rosa, María Carmen de la, Mosso, María de los Ángeles 2004). Judaism, even if minority in Catalonia during the Middle Ages, also had an important relationship with bathhouses, and examples can still be found in Barcelona or Besalú, for example (Barral i Altet 2005).

Figure 4.3. Roman Baths of Caldes de Montbui.
Source: Author’s work.

Even if spas and bathhouses existed in Catalonia through the Middle Ages, with more or less fortune depending on the monarch or the bishop of the time, during the Early Modern period the use of baths as therapeutic treatment fell in disgrace because doctors

[39] Alhama is a place name derived from the Arabic language which means bath. It is the equivalent to the Latin word “calidas”.

thought that illnesses could be transmitted though water (Rosa, María Carmen de la, Mosso, María de los Ángeles 2004). This belief affected negatively many spas, but tradition continued and by the 18th century spa towns started receiving many pilgrims who wanted to take the waters to heal from many illnesses. Scientists of the time dismissed the negative ideas of their predecessors and, in order to improve the healing properties of thermal water, started the study of many known sources. For example, in the year 1697, the professor in medicine Alfonso León wrote the first Spanish book which explained the location and characteristics of the mineral water sources in Spain (Limón Montero, García Fernández 1697). The work of Alfonso León was swiftly followed by many other authors who analysed and promoted the waters of many areas of the Iberian Peninsula, claiming that they were short of miraculous. Many doctors reacted adversely to these claims, while others defended treating their patients using water cures, which evolved into a scientific discussion between both postures that lasted through most of the century. Amongst the studies produced during this time, the works of Vicente Pérez (Pérez, Martín 1752), as a supporter of hydrotherapy, and the works of Francisco Fernández, as a detractor (Fernández Navarrete, Prieto et al. 1719), can be mentioned. Well into the 18th century the works of some prominent doctors and professors, like Gómez de Bedoya (Gómez de Bedoya y Paredes,Pedro, Aguayo 1764) or Ayuda (Ayuda, Ibarra 1794), defending the positive properties of mineral water to heal specific illnesses, like syphilis, helped to popularise mineral water and abandon most pessimistic thoughts about hydrotherapy.

In addition to medical studies, improvements in water analysis techniques, like the ones described by Robert Boyle or Friedrich Hoffman, meant that the specific components of each mineral water source could be progressively better known (Coley 1990). With these new techniques many sources were analysed and the results were published in documents usually called “memória”, “noticia” or “tratado”[40]. In Catalonia, Dr. Jaume Menós i de Llena published many analysis of the mineral water sources found in the country. Amongst other springs, he wrote about the chemical properties of the water of l’Espluga del Francolí (Menós i de Llena, Abadal i Girifau et al. 1787), Sant Hilari Sacalm (Menós i de Llena, Cid et al. 1791) or Gavà (Menós i de Llena, Abadal i Girifau et al. 1790).

[40] Spanish for memoire, notice and treaty

Analysing water and publishing the results meant that doctors all around the country could read and, accordingly to the properties of each source, send their patients to take the waters to a specific bathhouse.

By the turn of the 19th century, spa cures had become a popular and recognised treatment to all kinds of illnesses, from tuberculosis to stomach aches. The government of the time, under the rule of King Fernando VII, decided that spas had to be regularised and in 1816 a decree was passed creating a new profession, the "Cuerpo de Médicos Directores"[41] (Maraver Eyzaguirre 2006). Amongst other duties[42], these doctors had the responsibility of ruling the bathhouse following a scientific model, and the obligation of controlling the quality and composition of the water by performing regular analysis to guarantee the quality and properties of the water (Rosa, María Carmen de la, Mosso, María de los Ángeles 2004). They also had to keep a statistical account of the patients, their prior illness and the ratio of recoveries. After the first edict was decreed, others followed detailing even more the requirements and duties of the doctors in the years 1817, 1828, but their main role remained the same (San Pedro Martínez 1993). Spa doctors helped to officialise and improve the therapeutic properties of bathhouses, which meant that many people wanted to attend them to take profit of their healing properties. Unfortunately for the owners of bathhouses, their business was usually far away from populated areas, so the trip to the spa could not be afforded by everyone and was quite susceptible to disruptions during downturns or military conflicts. In 1896, Dr. Taboada complained that between the years 1892 and 1896 the number of patients had decreased (Figure 4.4) because of several bad harvests and the influence of wars[43], which meant that the average number of patients per spa decreased from 592 to only 476 (Taboada, Carretero y Muriel 1898).

[41] Roughly translated, a Director Doctor, the chief doctor of a bathhouse.
[42] Other ruties included the drawing of a medical topography of the location of the bathhouse (Urteaga González 1980)
[43] Between 1895 and 1898 Spain was in war in Cuba (Baraja Montaña 1997) and between 1896 and 1898 in the Philippines (Mabini, Manila 1963)

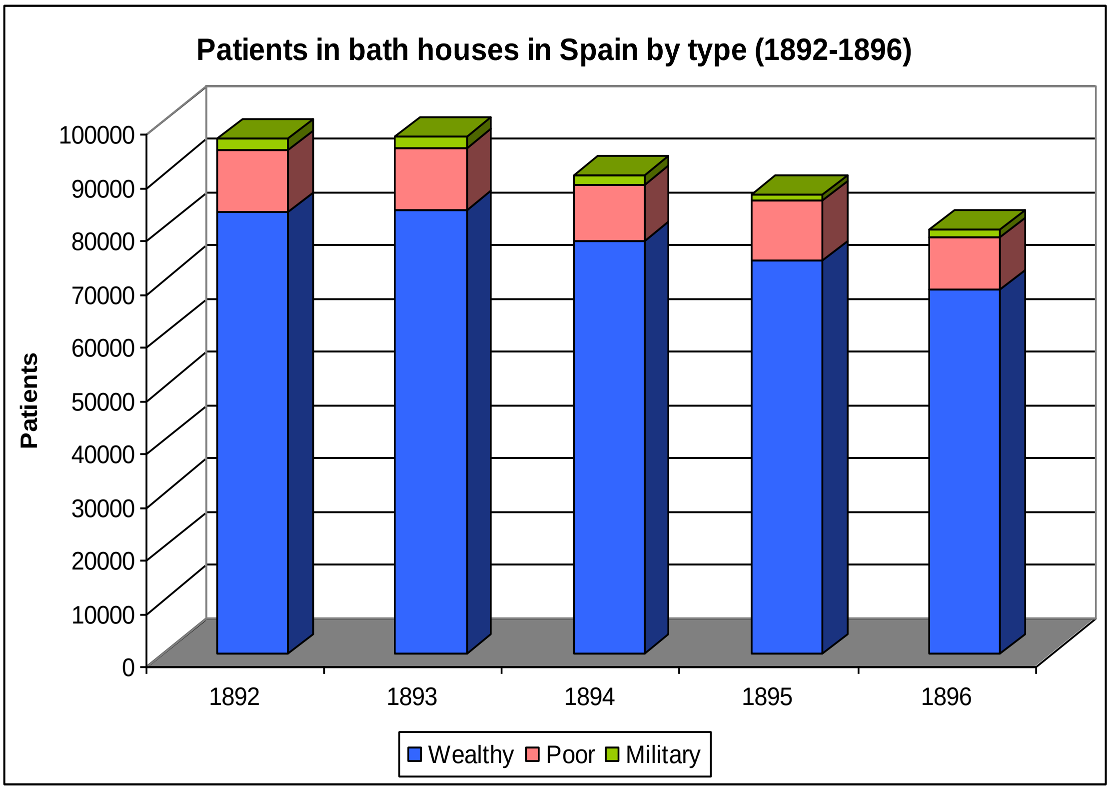


Figure 4.4. Patients in bathhouses in Spain between the years 1892 and 1896.
Source: Author's work from (Taboada, Carretero y Muriel 1898:110).

The division Dr. Taboada makes in his stats between different types of patients may be surprising because he establishes three different categories, wealthy, poor and military patients. The difference between all three categories is that wealthy people had to pay for the treatments, while poor people and soldiers had free access to the healing treatments (San Pedro Martínez 1993). As figure 4.4 shows, the immense majority of bathhouse users (86%) were classified as wealthy, while poor people (12%) and soldiers (2%) represented a minority of the clients. One may ask why if spas were free for the underprivileged did they represent such a low percentage of the total number of visitors. The answer is that bathhouses were usually far away from large population centres, so travelling to the spa to take the waters was reserved to wealthy people, even if free for the deprived. As figure 4.5 shows, in the year 1896 spas which were close to the Barcelona area or close to a railway had a large number of visitors. On the on the other hand, bathhouses in the Pyrenees or very far away from Barcelona or a railway had few visitors. Another factor that almost forbade taking the waters by underprivileged people was that treatments usually were quite elongated. Indeed, to feel positive effects, the recommended time was to take the waters during four weeks (Escomel 1913), but for more serious or chronic diseases even longer periods of time were prescribed, recommending a repetition the following bathing season (Silega 2010). The distance to large population centres, added to the costs associated to the treatment meant that only wealthy people could fully experience a proper spa treatment, marginalising the numbers of deprived people who could access the cure, even if it was free for them.

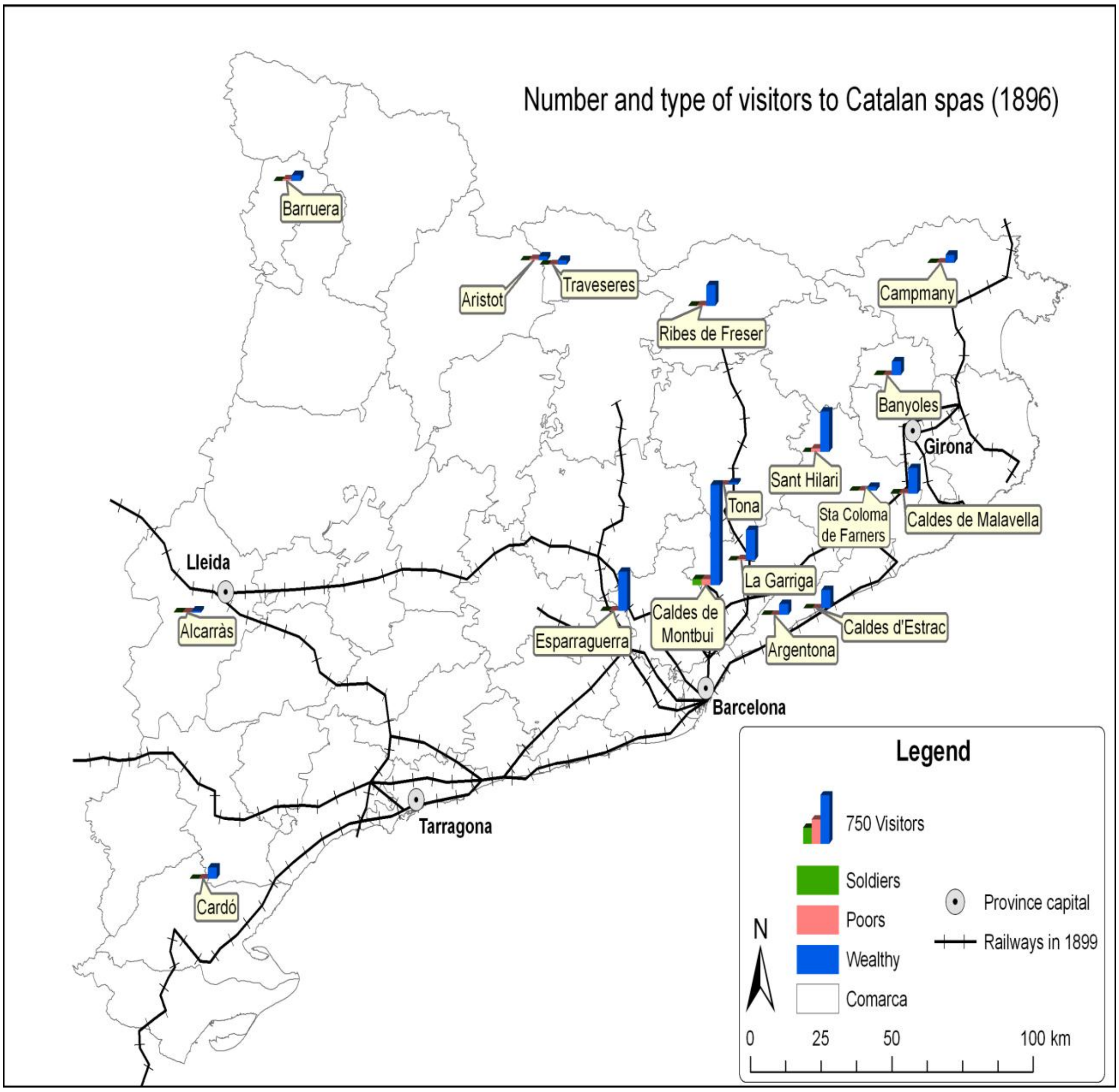


Figure 4.5. Number and type of visitors to Catalan spas in the year 1896.
Source: Author's work. Visitors data obtainded from (Taboada, Carretero y Muriel 1898) and railways data obtained from (Font i Garolera 1993).

The practice of taking the waters found an important ally with the theories of hygienism, which boosted the arguments in favour of spas. Hygiesnism was a medical movement which began during the last quarter of the 17th century, when many doctors became concerned about the high number of fatalities caused by many epidemic episodes across Europe. Scourges increased with the start of the Industrial Revolution, becoming almost pandemic. Because of the dreadful conditions factory workers and less fortunate classes suffered, which could be described as "abominable" (Pike 1966), the ratio of deaths increased dramatically. Some enlightened scientists and doctors, following the tradition of Illustrated Rationalism, considered the cause of this high ratio of casualties not only as a medical problem, but also as a social phenomenon (Fraile, Bonastra 2001). As the Industrial Revolution consolidated and spread across Europe, more authors became followers of hygienism and by the first half of the 19th century, hygienism had become a discipline which influenced not only medicine, but also other studies like sociology, urbanism or economy. In Catalonia, and especially in Barcelona, hygienism became quite popular amongst the bourgeois because the living conditions in the city were almost unbearable. It was in this dramatic context that many Catalan doctors and scientists embraced hygienism during the first half of the 19th century and influenced many disciplines, like public works, urbanism or medicine. People like Pere Felip Monlau, who promoted the demolition of Barcelona's city walls (Bohigas, Museu d'Història de la Ciutat 2004) or Ildefons Cerdà, who designed Barcelona's public expansion following hygienist precepts (Magrinyà, Marzá et al. 2009), were influential hygienists who tried to improve the living conditions of the working class by following the hygienist principles.

The principles of hygienism stressed the importance of improving the social conditions people lived in as a way of preventing pandemics in Industrial Revolution societies. For this reason they denounced that people should live in well illuminated, ventilated and clean houses, or that they should keep animals and faecal matter away from houses. In addition to these precepts, hygienists stressed the importance of clean water in preventing the spread of pathogens (Prats 1996). The influence hygienists had amongst higher classes of Catalan society benefited spas and bathhouses, which saw the affluence of wealthy people increase. Towns with preeminent mineral water experienced growth, with spas, hotels and villas being built to accommodate visitors. Since those tourists were mainly wealthy and they were influenced by the paradigms of hygienism, they demanded spas and urban expansion areas which followed hygienist recommendations. Some of the most important modernist Catalan architects designed spas and new boulevards where guests could stroll as part of their treatment in the bathhouse. Catalonia, as other European areas, offers examples of spa towns with wide boulevards –or "passeig" or rambla, as they became known locally following the inspiration of Barcelona's La Rambla-, some of which have lasted until nowadays. Remarkable examples are the Puda spa in Esparraguera, designed by the architect Elíes Rogent[44] (Rogent, Catalunya et al. 1988), the bathhouse of the Roqueta spa in Tona, wich was designed by the preeminent modernist architect Lluís Domènech i Montaner[45] (Pladevall i Font 1989) or the Vichy Catalán spa (Figure 4.6), designed by the architect Gaietà Buigas i Monravà[46] (Jardí 1973).

Figure 4.6. Vichy Catalán bathhouse designed by Gaietà Buigas following a Neo-Moorish style.
Source: Author's work.

Because of their important guests, spa towns became a place where networking, businesses and deals were made, as the chronicles of the time explain. For example, the Blancafort spa in La Garriga hosted relevant people like the writers Jacint Verdaguer, Eugeni d'Ors and Santiago Rusiñol, politicians like Francesc Cambó, Prat de Riba and

[44] He also authored the historical building of the University of Barcelona and restored the monasteries of Montserrat, Ripoll and Sant Cugat
[45] Unfortunately, this building was demolished in the year 1974. Other works by Domènech i Montaner include the Hospital of the Holy Cross and Saint Paul and the Palau de la Música, both in Barcelona (Domènech i Montaner, Garcia-Ventosa et al. 2000)
[46] He is also known for being the designer of the Columbus monument located at the end of Barcelona's La Rambla (Subirachs 1994)

Francesc Macià, the journalist Antoni Brusi or the bishop Torras i Bages (Mitjà i Sarvisé, Associació Balneària et al. 1999). Many times, the attendance of a Royal or an important politician to a spa attracted a retinue of politicians, nobility or businessmen during the treatment, which could be several weeks. A good example is when the president of the Republic of Spain, Manuel Azaña, spent the month of August of the year 1934 at the spa of Sant Hilari Sacalm receiving treatment. The chronicles of the La Vanguardia newspaper of the time enumerate who visited the president during his treatment, and, amongst others, included members of parliament, government representatives, judges, chiefs of police, mayors and important businessmen (La Vanguardia 1934). All these personalities required accommodation to match their social and economic status and this is why luxurious hotels and villas were built. Towns like Caldes de Montbui, Caldes de Malavella, la Garriga or Tona (Figue 4.7) still have outstanding villas which were owned by wealthy spa clients and today act as reminders of the wealth many spa clients had.

Figure 4.7. Array of wealthy villas designed by Francesc Guàrdia i Vidal (Pladevall i Font 1989) **in Tona, located by the Roqueta spa.**
Source: Author’s work

4.3 A social predisposition

Staying in a spa town for the length of the treatment was both time consuming and expensive, so many clients had to leave the cure and go back to their daily duties and towns. In addition to interrupting the treatment, many times patients went back to drinking water obtained from public distribution systems, which sometimes became polluted and could aggravate existing conditions or cause new ones. The addition of the explained factors, -i.e. a traditional sacralisation of mineral water, the atavic use of thermal water, the popularisation of spas, the cost of going to spas, the importance of hygienism in Catalonia and the healing properties of drinking clean water instead of foul water- meant that water from spas and mineral sources became increasingly sought after. All this factors became even more important because of the consolidation of the Industrial Revolution. According to de la Rosa and Mosso, “in the 19th century the use of mineral water became generalised as a therapeutic resource due to the sociological and psychological change the Industrial Revolution meant”[47]. As it has been explained, the first ones to enjoy the benefits of going to the spa were the wealthy classes, but soon more popular classes started demanding the same benefits, and since going to the spa was too expensive for them, spas started bottling and selling their water in cities.

Before bottles of mineral water arrived to consumers outside the spas, citizens could enjoy the services of urban bathhouses to continue their treatments or increase their personal hygiene. Inspired by classical Roman and Greek urban bathhouses, the hygienist movement promoted the creation of societies which sponsored the establishment of bathing facilities across Europe. Examples can be found in Liverpool, London[48], Rouen or Nantes (Monlau, Real Academia de Medicina y Cirugía de Barcelona 1856), and Catalonia was not an exception. For instance in 1849 up to eight urban bathhouses could be found in Barcelona (Saurí, Matas 1849) and in 1860 two bathing establishments could be found in the industrial city of Manresa which offered their services at economical prices (Cornet i Mas 1860). In coastal settlements, which included Barcelona,

[47] Translated from (Rosa, María Carmen de la, Mosso, María de los Ángeles 2004)

[48] In London it was the *Society for Establishing Baths and Wash-Houses for the Labouring Classes* that promoted bathhouses for the working classes (Monlau, Real Academia de Medicina y Cirugía de Barcelona 1856)

thalassotherapeutic treatments became popular because of the easy access to seawater and the healing properties attributed to it. Some of these bathhouses, both coastal and inland, even provided services so very sick people could profit from the hydrotherapy. To do so, bathhouse owners had bathtubs ready to take to the customer's home where the ill could receive a therapeutic wash (Saurí, Matas 1849).

Even with all these bathing facilities available to the public in cities, people living far away from spa towns demanded to continue the treatment they started with the same water they were using at the spa. In addition to spa clients, people from a humble background who were not able to travel outside the city desired to consume the same water for their treatment as their wealthy fellow citizens. It was then when spa owners decided to sell their water in sealed bottles outside their bathhouse. They had been bottling water from their mineral sources for a while, but they only did so to serve the water in their restaurants and to take the water to the clients who were hosted in the spa town's hotels or to sell as souvenirs, so spas did not have the appropriate infrastructure to export water far away (Figure 4.8).

One of the first references of bottled water being sold far away from spas in Catalonia was the Sociedad de las Aguas de la Puda, a commercial society which in the year 1845 reopened a bathhouse which had been ruined by a flash flood two years before (Mitjà i Sarvisé, Associació Balneària et al. 1999). The source was located in the town of Monistrol de Montserrat, less than forty kilometres away from the city of Barcelona, and the year the company recovered from the flood it started selling sealed bottles of mineral water to the surrounding towns of the province, but especially to Barcelona city (Saurí, Matas 1849). Figure 4.9 shows the first found reference[49] of each brand of mineral water being industrially bottled, by type of location, in a ten year basis. During the first twenty-five years after the Sociedad de las Aguas de la Puda started bottling their water, only two other companies –Malavella in 1845 and San Narciso in 1870, both located the spa

[49] Even if every effort has been made to guarantee data precision, some of the dates may be subject to review in the future if further evidence is found. In most cases a precise starting date of water being bottled has been found, but in some cases the lack of documentation has meant that only an approximation has been found. Sometimes the estimate has been decided by the first advertisement found in the press or in the first bibliographical reference found, but it cannot be stated for sure that the bottling did not start a few years earlier.

town of Caldes de Malavella- decided to bottle their water and sell it away of their towns. It is significant that the first three bottling companies in Catalonia were linked to well-known traditional spa towns. It shows that, during the first stage of mineral water bottling, it was the demand of spa water from the cities that provoked the beginning of a new industry. It was not until thirty-four years after the first bottling plant was established in Catalonia that the first independent bottler -that is not linked to a bathhouse-, appeared at the town of Rubinat.

Figure 4.8. Facilities of the Ullastres bathhouse in Tona.
Source: (Pladevall i Font 1989:379)

In fact, Rubinat's water can be considered an exception. The source was discovered during the last third of the 19th century by Dr. Llorach, who after observing that sheep suffered diarrhoea after drinking from the source analysed it and discovered its laxative properties. After the discovery Gustau Bofill, the owner of a very similar source close by, followed a traditional approach and projected a bathhouse to obtain revenue from the water, but never succeeded in doing so. Instead, Dr. Llorach chose to "take the spa to the costumers", i.e. to bottle and transport the water to where people lived instead of taking the people to the water (Puig, Mora et al. 2008). Such an innovative approach was very successful and soon "Rubinat-Llorach" water, as it was commercially known, was being sold in many chemists across Catalonia. In fact, it was such a thriving business that soon bottles were sold across Europe, South America and the United States, forcing the company to open an international office in Paris (Puig, Mora et al. 2008).

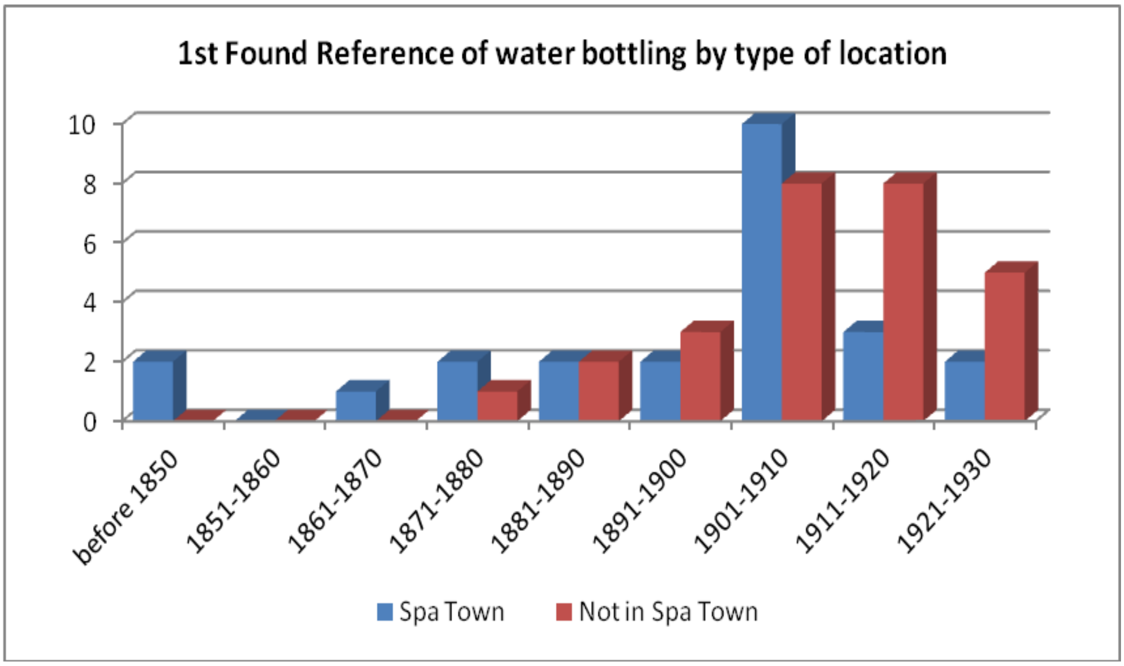


Figure 4.9. First found reference of water being industrially bottled (1840-1930). Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002)

After Rubinat-Llorach water proved that a successful business could be made from starting a mineral water bottling company from scratch, without the therapeutic pedigree a backing spa house gave, other entrepreneurs decided to open their own companies. As figure 4.9 shows, after the pioneer work of Dr. Llorach, 26 new brands not liked to bathhouses flourished across Catalonia before 1931, but traditional spas were not left behind. In front of the 27 mineral water brands not linked to a bathhouse, as many as 24 spas offered their water bottled, which means, that between 1844 and 1930 51 confirmed mineral water bottlers existed at some point in Catalonia, not an inconsiderable amount for a relatively small and dry area as Catalonia is. It can be said that the mineral bottling industry in Catalonia was born by the need of spa clients to continue their treatment outside the institution, so bathhouses covered that demand swiftly. After spas started their new and complementary business, some entrepreneurs with no links to the bathing industry emerged and offered the same product without a spa to back their product and their demand broadened, including people who could not afford going to a spa. During the golden years of bottled mineral water, between 1900 and 1930, both business models coexisted and almost the same number of companies of both kinds were created -fifteen spa based bottlers and 21 brands not linked to spas.

That a small country like Catalonia was capable of creating 51 bottling companies between the second half of the 19th century and the first third of the 20th century is quite remarkable. Such a success can be explained by the vernacular tradition which existed since before Roman times in Catalonia which venerated the healing properties of certain waters and that with the adoption of Christian faith by the majority of citizens became even reinforced. Tradition found an important boost when the improvements in chemistry and medicine allowed the analysis of water and hydrotherapy became popular across Europe. In the Catalan case, the influent hygienist theories increased even more the popularity of bathhouses as places where one could be healed. Going to a spa town was both time consuming and expensive, so wealthy classes were mainly treated there, which led to an increasing demand by people living in cities and far away from spa towns who wanted to drink that water without having to travel to the spa. Soon, spas started bottling their water and shipping it to cities, but seeing a good chance to make profit entrepreneurs started bottling and selling water from sources not linked to spa towns. But not all the necessary conditions for the flourishing of the mineral water bottling industry had been fulfilled; a last obstacle had to be yet overcome, transporting such a heavy item to consumers.

5. Location of mineral water bottlers in Catalonia, physical conditionings

5.0 Introduction to chapters 5 and 6

The present chapter and the following one should be considered as a single entity which has been split into two parts due to conceptual, formal and practical reasons. They explain and analyse why mineral bottling plants have been located in certain springs and not others, and to do so, two different points of view which follow the classical division in geography have been used. Chapter 5 explains the physical factors and chapter 6 the human factors that led to the establishment of bottlers in certain sources and not others. The chronological scope of chapter 5 is varied and changes many times throughout the text, but this chronological inconsistency is justified by two facts. Many physical factors are measured in a timescale different to the human one, so both scales have had to be used. On the other hand, due to the persistent nature of many physical phenomena changes analysed in chapter 5 have taken a long time to influence the bottled water industry. Consequently, chapter 5 in some cases goes beyond the thesis time constraint of 1930, but when it does it is justified. Chapter 6, in contrast, explains the human conditionings to the location of bottling plants, which change far faster than the physical ones so the thesis' time constraints are limited more tightly to the 1930 limit. Obviously, a strict divide between physical and human factors is impossible since all of them mix and overlap at one point or another, so the division between both chapters should not be seen as absolute but permeable

Unlike many other food and drink industries, mineral water is a geographical commodity. While soda, bread or meat producers can locate their processing factories almost anywhere while trying to maximize their profits, mineral water bottlers have to locate their bottling plants on or by the source, so they are quite limited to where they can base their economic activities. Sources are unique and they are located at the point where water naturally emerges from the innards of the earth or where a well is dug. In most cases, fountains or wells which provide mineral water are located in singular geological areas like faults, artesian wells or karstic areas[50], but, as figure 5.1 shows, in Catalonia

[50] It is not the aim of this work to explain how a spring is formed, for more information about it many geology manuals are a good starting point. A comprehensible explanation can be found here: (Chapelle 2005)

springs emerge almost everywhere. The Basic Spanish Gazeteer[51] (Instituto Geográfico Nacional 2010) lists 2,327 springs in Catalonia, with higher concentrations in the mountainous areas and scarce in the flatlands. It is an expected distribution, since in order to have a natural spring a minimum slope is necessary[52]. Some flat areas with generous underground resources, like the Plana de Vic, are not represented in figure 5.1 because even if water can be easily found beneath the surface, it usually does not naturally flow and wells have to be excavated. Catalonia has many more springs not listed in the Gazeteer, but it is a good example of the profusion of springs Catalonia has.

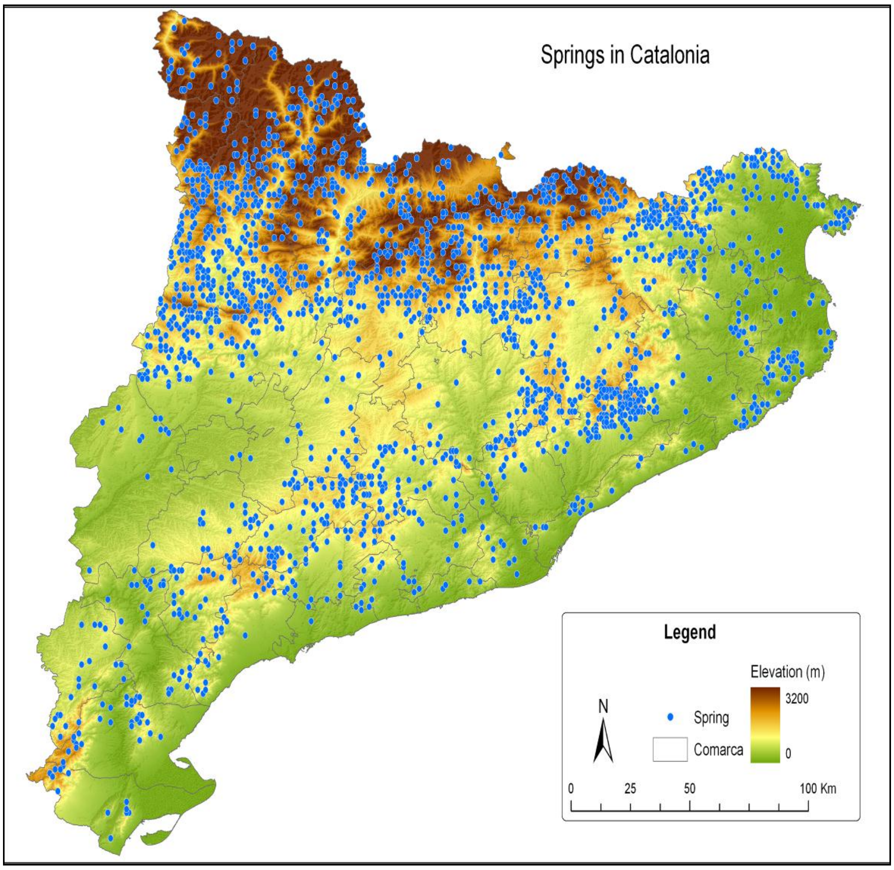


Figure 5.1. Distribution of springs in Catalonia (scale 1:25,000).
Source: Author's work from (Instituto Geográfico Nacional 2010)

If Catalonia has such a high density of springs, one may ask why some sources were used and bottled industrially and others were not. The question can be answered by analysing several qualities a spring should have to be industrially profitable, if a spring complied with several physical and human conditions, its water could be bottled and sold.

[51] 1:25,000 scale
[52] Except for artesian wells

5.1 The spring's flow

The first requisite for a spring to exist is to have an adequate input of water so the aquifer can recharge and the source does not stop flowing. In nature, the necessary input comes thanks to the water cycle, so when the sun heats the water lying in oceans, rivers and forests, clouds are formed and it rains or it snows. After falling from the clouds precipitation is partly absorbed by the soil, and it starts an underground journey which ends up recharging aquifers. When aquifers reach a certain level and the geology of the area allows it, water naturally emerges from the ground and a spring is born (Torres, Capdevila i Peña 1998). Humans can force this natural process by digging wells which, when they reach the water table, get filled with water.

The problem when recharging aquifers is that rainfall is the main input, so if there is lack of rainfall aquifers struggle to keep their water table high, and springs located at a higher level dry out. Catalonia, even if relatively small, has a wide variety of climates, and therefore it has different pluvial regimes. At a general level, Catalan climate could be divided into two main areas, one of Mediterranean influence which includes around 95% of the Catalan land, and another of Atlantic influence which is much smaller (Sacasas i Lluís 2007). Due to its geographical location and its difficult orography, Catalonia has many flavours of the Mediterranian climate, both referring to temperature and rainfall. Some authors have divided Catalonia into fourteen types of Mediterranean climate (Carreras i Verdaguer 1992), which can indicate the high variability of temperature and rainfall one can find in the country. Precipitation wise, Catalonia can be divided into two main areas, an eminently dry one, located in the southern and western area, and a humid one, stretching across the northern and eastern parts of the country. As figure 5.2 shows, areas with higher precipitation concentrate higher density of springs, with a significant lack of them in drier places (Carreras i Verdaguer 1992).

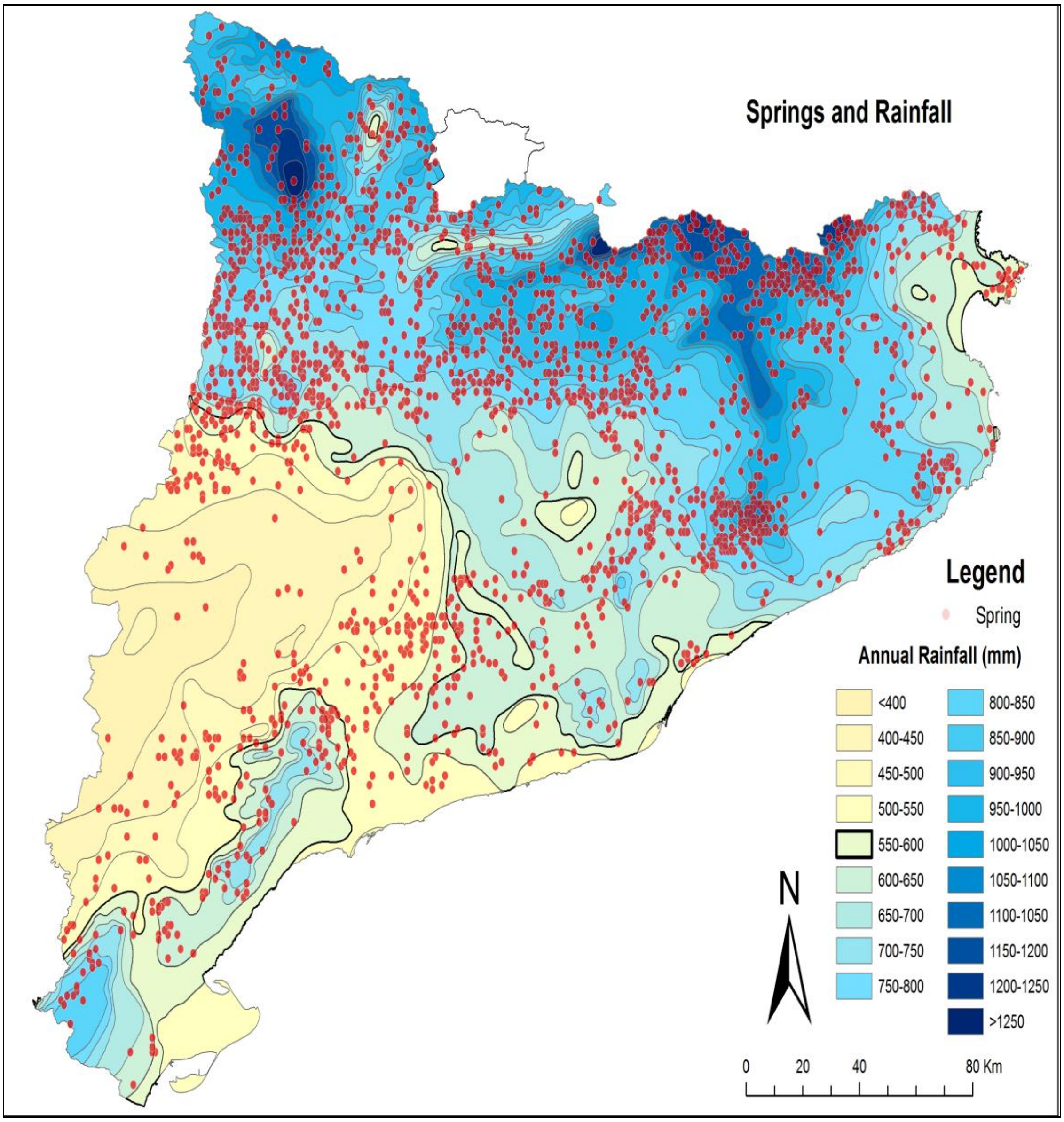


Figure 5.2. Rainfall and distribution of springs in Catalonia.
Source: Author's work from (Institut Cartogràfic de Catalunya 2009, Instituto Geográfico Nacional 2010)

However, quantity of precipitation it is not the only meteorological variable that affects the flow of springs, it is also important when the precipitation occurs. Unlike more regular climates, Mediterranean climate is highly irregular. The traditional Catalan saying "a Catalunya no hi sap ploure"[53] caricaturises this irregularity. Indeed, precipitation usually takes place in the form of violent storms, which can cause flash floods and be the equivalent of various months' worth of rain (Albentosa Sánchez 1990).

[53] Rain does not know how to fall in Catalonia

When one of these storm episodes happens not all the water can be absorbed by the soil, it flows down the slopes and ends up becoming part of a stream or river and it finally goes to the sea, so the aquifer recharge is smaller. In addition to this, Catalonia has a relatively sunny and warm climate, which added to the profusion of vegetation in many areas[54], means that evapotranspiration can achieve high levels, reducing the amount of water filtered into the ground. All these difficulties in the recharge of aquifers have an effect in the regularity of many sources, which are increased by the seasonal irregularity Mediterranean climate has, with months without almost any rain and others with plenty of it (García Alvarado, Sotelo Navalpotro 1999). In addition to the intra-year irregularity, differences in the quantity of rainfall between years are significant as well (Societat Catalana d'Ordenació del Territori 2005). Figure 5.3 shows the yearly variations in rainfall from the mean of the period 1997-2003 using data from three different stations located in three different flavours of Mediterranean climate. Torres de Segre is located in one of the driest places of Catalonia, the Observatory Fabra is on a hill in Barcelona near the Mediterrean Sea and Molló is located in the Eastern Pyrenees at over 1000 meters above sea level. Even if seven years is climatically a short sample, it serves to show the high inter-year variability most of Catalonia has, since in all three stations most years have values 20% over and under the mean, with peaks of 40% and 70% from the mean.

The high Catalan pluviometric variability means that not all springs flow all year long or every year, only some of them can be considered permanent. When choosing to bottle water form a specific source, investors had to be sure that they would have a constant flow of water to keep their industry running, so not all sources were suitable. Only springs located in places which guaranteed a constant flow, even during seasonal or yearly droughts, could be industrially exploited. There are many examples of sources which had ideal mineralogical properties and were sought after by customers, but lacked the necessary flow to sustain production. When water from a source was therapeutic and demanded by consumers, but the volume of water was small or not consistent enough, the owners of the source would usually open a bathhouse –which required less water to run- and not sell the water to drink outside of the premises. As an example, the source called "Font Santa" in Sant Pere de Torelló had a water flow of 0,08 l/s in the first years

[54] Nowadays 63.7% of the surface of Catalonia is covered by forest and 26.7% of the land is used for agriculture (Institut d'Estadística de Catalunya 2008)

of the 20th century (Mitjà i Sarvisé, Associació Balneària et al. 1999), which shaply limited its industrial use, so only a bathhouse was built. On the other hand, the source "Fontaga" in Ribes de Freser had a flow of 6,25 l/s (Mitjà i Sarvisé, Associació Balneària et al. 1999), over 78 times more than Font Santa, which allowed the construction of a bathhouse and the production and exportation of bottled water. In daily values, it meant that while Font Santa spring could fill 6,912 one litre bottles per day if all the water was used for this purpose, while Fontaga could fill 540,000 bottles.

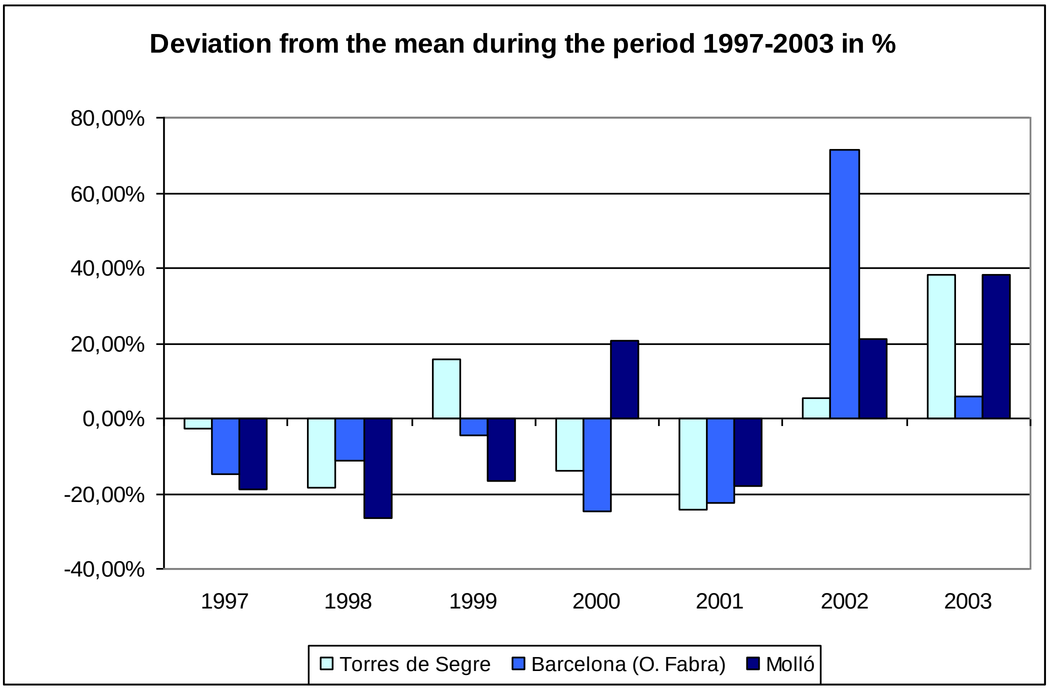


Figure 5.3. Rainfall variability in Catalonia.
Source: Author's work from (Servei Meteorològic de Catalunya 2011)

To sum up, only springs with a constant and sufficient flow could be bottled and still be profitable. Even though, some regions with very high quantities of rainfall did not have many mineral water bottlers, while areas with less precipitation had a high concentration of bottlers. The reason that explains why this apparent contradiction occurs is that the quantity of rainfall is not the only factor for the existence of an adequate source; more aspects have to be taken into account if water is to be bottled, like geological or environmental factors.

5.2 Geology

A factor of paramount importance when deciding to bottle water from a certain source is the geology of the area surrounding it. Mineral water is called mineral for a reason, so the types of rocks that water crosses from its infiltration into the ground until it emerges, together with the amount of time spent in the subsurface will deliver different types of water. Geological phenomena like earthquakes or natural radioactivity also influence mineral water and its commercial value, so they should be taken into account when opening a bottling plant at a certain source.

5.2.1 The birth of the spring

Precipitation may fall in a certain area, but the source born from that rain may appear several kilometres away from where the rain appeared. Fissures and voids in the rock, filtrations, karst regions or porous soils can transport underground water for quite a distance (Price 1985). One of the most spectacular cases of underground water travel in Catalonia can be found in the Pyrenees, on the border between the Aragonese Ribagorça region and the Catalan comarca of the Val d’Aran, where a large karst system exists. Since it is topographically part of the Ebro basin, rain which falls at the place known as the “Forau d’Aigualluts” should eventually become part of the Ebro River and en up merging with the Mediterranean Sea in Southern Catalonia. Instead, it flows towards the Garonne River, which heads towards Bordeaux and the Atlantic Ocean. The reason for this dramatic change of basin is that water falls through a sink hole which, after travelling during almost four kilometres underground, ends up emerging though a water fall at the Uelhs deth Joèu source (Figure 5.4) (Monterde 1998). The Uelhs deht Joèu underground river and subsequent source is a quite remarkable example of how water can travel from one place to another below the surface and of how a source of water is born.

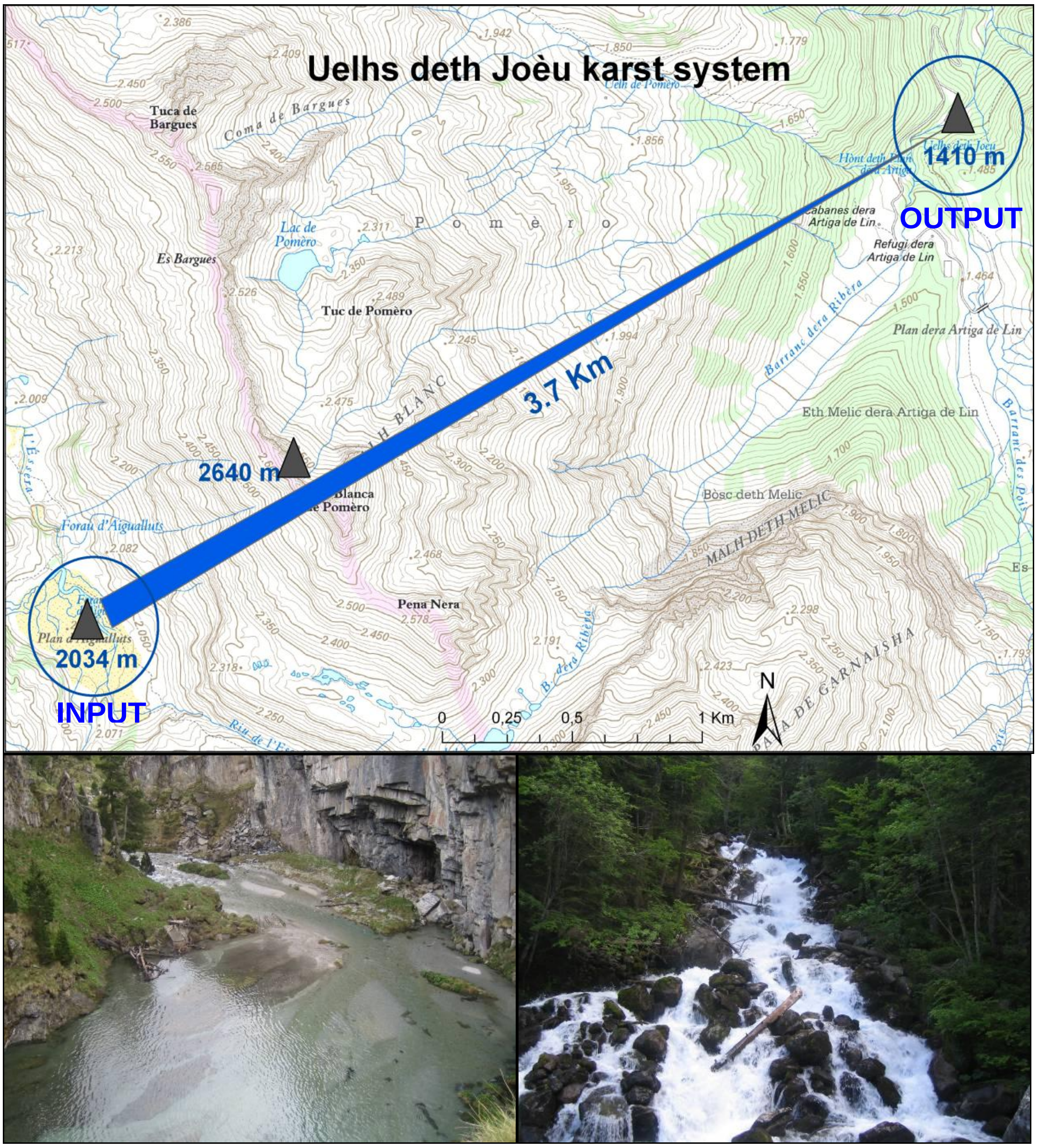


Figure 5.4. Uelhs deth Joèu karst system diagram (Top). Forau d'Aiguallut sink hole (Left). Uelhs deth Joèu waterfall (Right).
Source: Author's work. Topographic cartography produced by the Institut Cartogràfic de Catalunya.

Springs can appear by a variety of geological reasons, but there are four main scenarios which explain their existence. The simplest one is when the water table so high that intersects the land surface and water emerges (figure 5.5a). A second type of spring occurs when water saturated permeable material, such as sand, lays on top of an impermeable layer, such as clay, and water starts flowing horizontally until it finds an exit (figure 5.5b). The third kind of spring happens when water that has been travelling underground meets a geologic fault and starts travelling using it. At the point where the fault intersects with the surface a spring is born (figure 5.5c). The last type of common spring occurs when sedimentary rocks become folded and crumpled and by telluric forces. Rainfall which falls at the top of a mountain can travel deep into the earth and, following the shape of the fold, emerge at the point where the crease meets the surface (figure 5.5d). If a well is dug deep enough into the fold an artesian well can be created (Chapelle 2005).

Depending on the geological origin of a source and the geological composition of the subsurface, water may have travelled different distances underground before emerging. Distance travelled underground and time spent below the surface is what gives mineral water its name, because it is then when minerals are dissolved by water before emerging to the surface (Price 1985). Waters which have travelled a short distance underground, or which are more superficial, are more likely to be polluted by human or animal waste than deeper circulating waters, which have had time to become filtered by the ground. On the other hand, water which has travelled deep underground will have more time to react with rocks and will therefore have higher amounts of mineral dissolved, which can transform water into an undrinkable liquid (Chapelle 2005). Time spent in the subsurface can range from a few hours to thousands of years, and the resulting water coming from a source will radically differ depending of the time elapsed underwater. Time spent underground, together with the types of material water passes through before emerging, creates different kinds of mineral water. The third factor that affects the characteristics of underground water is sub superficial temperature. If water becomes heated by geothermal energy it can augment its temperature, increasing its mineral dissolving capabilities (Asociación Nacional de Empresas de Aguas de Bebida Envasadas 200?).

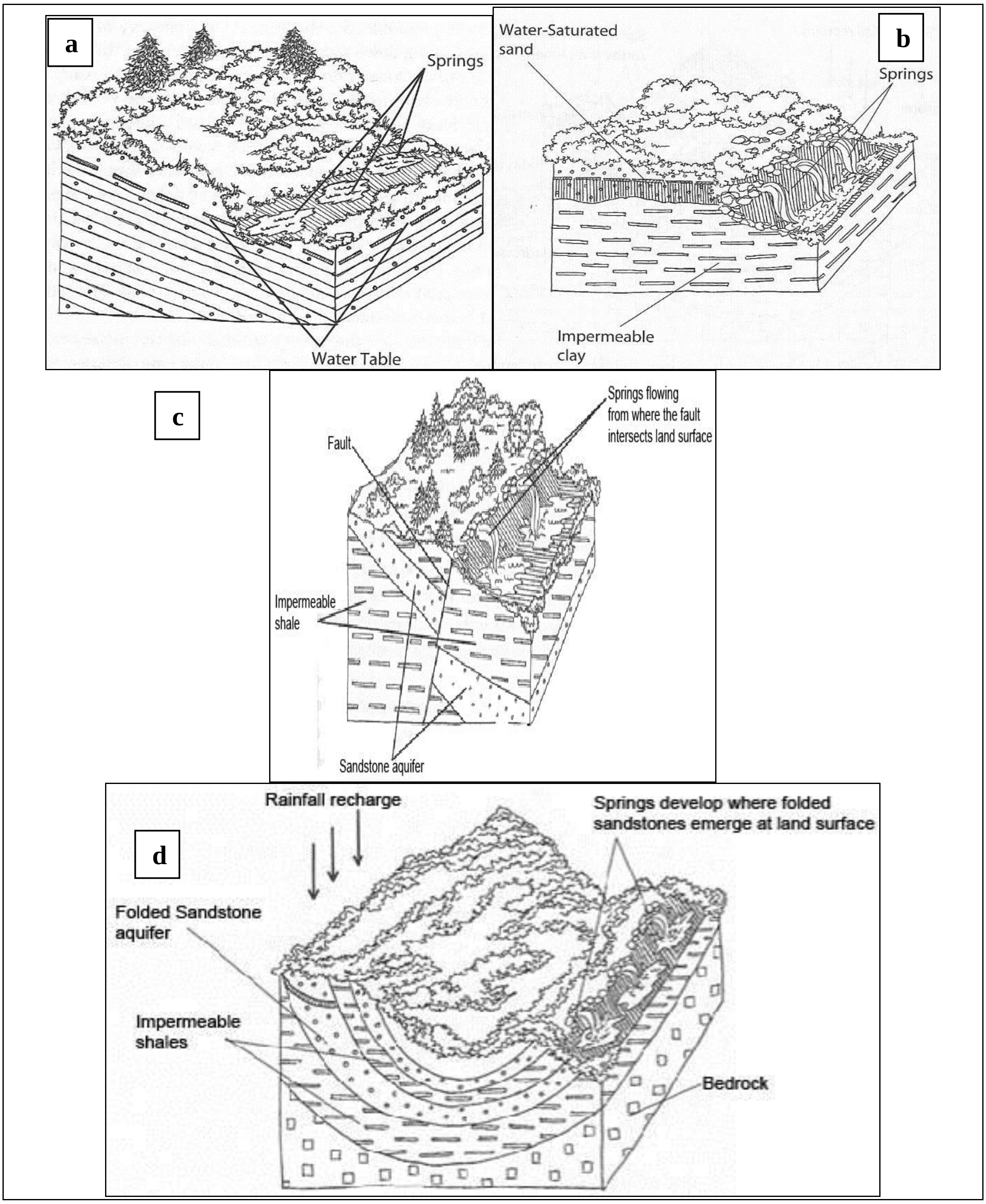


Figure 5.5. Geological origins of a spring.
Source: Adapted from (Chapelle 2005)

5.2.2 What makes mineral water mineral

Different types of mineral water can be classified into different categories depending of different geological and chemical factors (Mascha 2006, Asociación Nacional de Empresas de Aguas de Bebida Envasadas 200?):

- By its temperature
  - Cold water: equivalent to the annual average temperature of the area where the source is located.
  - Thermal water: 4 degrees above the annual average temperature of the area.
- By its effervescence:
  - Without natural gas
  - With natural gas
    - Carbonic gas
    - Sulphuric gas
- By its acidity:
  - Acidic: pH less than 6.9
  - Neutral: pH of 7
  - Alkaline: pH more than 7.1
- By its level of mineralisation (dry residue):
  - Super low: less than 50 mg/l
  - Low: between 50 mg/l and 250 mg/l
  - Medium: between 250 mg/l and 800 mg/l
  - High: between 800 mg/l and 1500 mg/l
  - Very high: more than 1500 mg/l
- By its mineral composition
  - Chemical criteria: Predominant (>50%) anion and cation link.
  - European legal criteria:
    - Bicarbonated water: >600 mg/l of bicarbonate
    - Sulphated water: >200 mg/l of sulphates
    - Chlorinated water: >200 mg/l of chlorine
    - Calcic water: >150 mg/l of calcium

- Magnesic water: >50 mg/l of magnesium
- Sodic water: >200 mg/l of sodium
- Fluorinated water: >1 mg/l of fluorine
- Ferruginous water: >1 mg/l of iron bivalent

- By its hardness (calcium and magnesium combination):
    - Soft: 0-17.1 mg/l
    - Slightly hard: 17.1-60 mg/l
    - Moderately hard: 60-120 mg/l
    - Hard: 120-180 mg/l
    - Very hard: >180 mg/l

Each mineral water has a different combination of all the described factors, making each spring unique. Some springs have a combination of factors that makes them undrinkable, while others have a series of characteristics that renders them as medicinal, a fact well known by hydrotherapists. Due to the varied geology of Catalonia, many types of mineral water can be found, from very low mineralisation soft still springs to highly mineralised hard carbonic waters, but only the most appreciated by consumers have been bottled at some pointing history.

Since the mineral composition of mineral water has a strong relationship with the type of rocks it passes through, exploited sources have historically been concentrated in three main areas with an adequate geology: the valleys of the Pyrenees, the Catalanid System and to a lesser extent some corrugated areas of the Central Catalan Depression (Figure 5.6). Industrially bottled mineral waters are mostly located in complex geological areas, with faults, folds, materials from different eras; where water can obtain minerals that can render it as unique. Mineral water bottlers usually look for waters with rare but sought after mineral compositions to differentiate their product from other mineral water brands. If a spring was potable and medical properties could be explained because of its consumption, then the probability of selling it for a profit increased. This is why the Pyrenees and the Catalanid System, two geologically complex areas, are the regions which concentrate most of the towns with mineral water industries, because some of the most prominent examples of Catalan spa towns like Caldes de Boí, Ribes de Freser, La Garriga or Caldes de Malavella are also found there. The complex geology of both areas means that folds and faults are very common, which added to higher levels of precipitation, creates an ideal environment for the existence of springs (Ufrecht 1997).

Geological complexity means that within a small area many types of rocks and minerals from various origins can be found at different depth levels. Such a rich underground has the potential to generate many types of mineral water, which explains why sometimes a wide variety of types of water can be found in a small region or even within the same village.

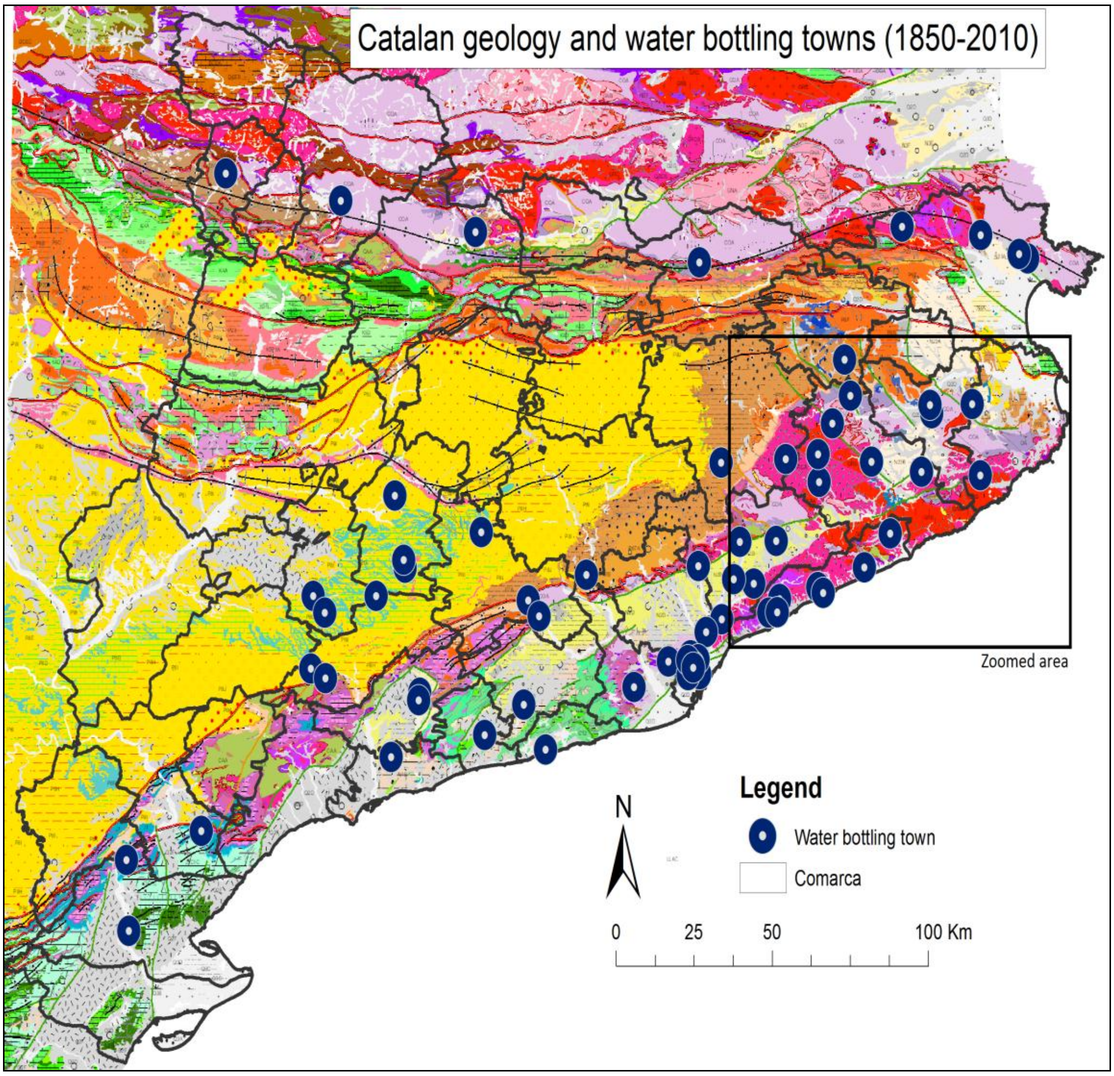


Figure 5.6. Catalan geology and water bottling towns (1850-2010)
Source: Author's work (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al.

2002). Geological map obtained from (Servei Geològic de Catalunya, Institut Cartogràfic de Catalunya 2005).

Bottled mineral water in Catalonia comes from a wide variety of geological backgrounds, including volcanic, plutonic, metamorphic and sedimentary rocks, each with different properties and flavours. A fact that proofs the existing relationship between geological complexity and profusion of exploited springs is that the area with the highest density of historically bottled springs in Catalonia has one of the most varied undergrounds of the country. If a more detailed examination of an area with a high concentration of bottling plants is done, the relationship between complex geology and the industrial exploitation of springs is more apparent.

As figure 5.7 shows, the South-eastern area of Catalonia concentrates 21 of the fifty towns that have industrially bottled water at some point in history between 1850 and the year 2010. The described area is comprises the northern part of the Catalanids and the first foothills of the Transversal range and contains many mountains and flatlands, crossed by many faults and folds. A rich geological composition exists in such a relatively small region, with areas made of granite, basalt, arkoses, slate, clay, conglomerate or lutite just to name a few of the materials which can be found (Miranda i Canals, Roca i Adrover et al. 2010). Such geological richness influences the underground waters which finally emerge to the surface through springs, so many types of mineral water can be found. Within a distance of less than 25 km, one can find the bottling factories of the town of Caldes de Malavella, one of the highest mineralised waters in Europe with a TDS[55] of over 4,000 mg/l and natural gas or the scarcely mineralised and still water of Sant Hilari Sacalm with a TDS thirty times lower (Baeza Rodríguez-Caro, López Geta et al. 2001).

Therefore, areas with a complex geology are more likely to hold springs which attract mineral water bottlers. The only exception can be found in the inner area of the Central Catalan Depression, composed mainly from layers of sedimentary strata, which has historically had some exploited mineral water sources. Even if it has a relatively simpler geological composition springs in this area are not randomly located; they are in uneven

[55] Total Dissolved Solids

areas which do not have a unique geological type of underground and are on geological faults (Miranda i Canals, Roca i Adrover et al. 2010), so general rule remains valid.

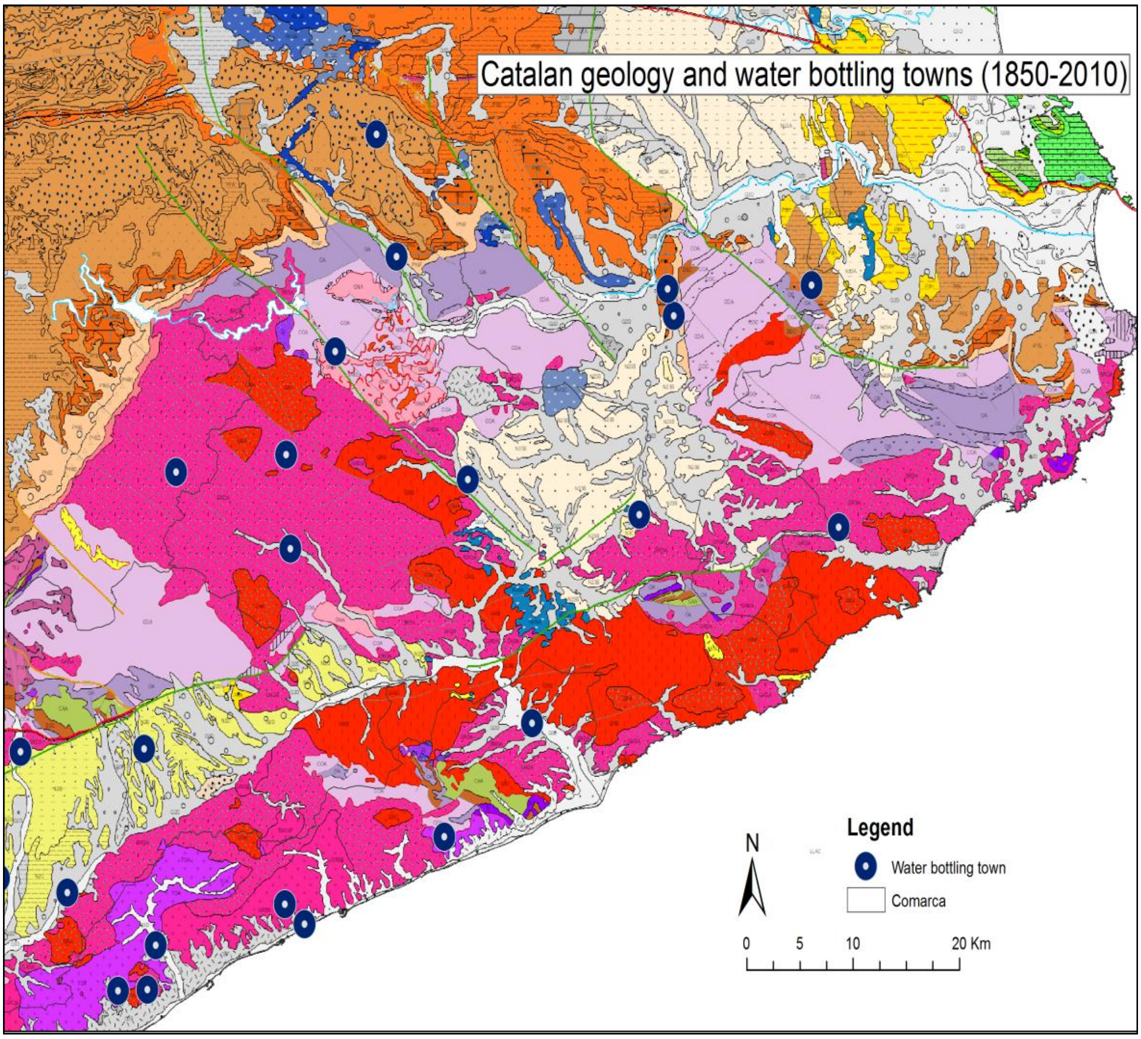


Figure 5.7. Geology and water bottling towns (1850-2010) of South-eastern Catalonia.

Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002). Geological map obtained from (Servei Geològic de Catalunya, Institut Cartogràfic de Catalunya 2005).

5.2.3 Aquifers and mineral water

Closely related with geology, the mineral composition of spring water also depends on the type of hydro-geological area from which water emerges. In Catalonia, most exploited sources have historically been located on the fringe between different types of aquifers (Figure 5.8). Out of a sample of fifty-five towns which have held bottling water companies at some point during the last 160 years, fifty-one of them are located on the line between two different hydrological areas, with twenty-three different types of hydro-geological combinations. The most common location where bottled water has been obtained during that period has been on the contact zone between granitic hydro-geological areas and new mixed materials, with fourteen occurrences. Sources located far away from contact zones between different hydro-geological areas are exceptional, with only four occurrences, three of which are linked to granitic aquifers.

The reason why exploited sources are located between different types of aquifer has not been found. After checking relevant literature and asking several renowned hydrologists no plausible explanation has been found. However, as figure 5.8 shows, a relationship between towns which have held a bottling plant and frontiers between hydro-geological areas clearly exists. It remains to be explained why does this relationship exist, but it will have to be explained in future research. A tentative answer may be that water obtained from areas between two types of hydro-geological zones are more appealing to consumers and therefore to producers, but it has not been possible to prove so. In the meanwhile, it is just a objective fact which remains unexplained for the time being.

	Gravel, sand and clay	Conglomerate and sandstone	Limestone and dolostone	Limestone and marl	Conglomerate, sandstone and marl	Marl and evaporite	Sandstone, slate and schist	Granite	Mixed neogene materials
Gravel, sand and clay									
Conglomerate and sandstone									
Limestone and dolostone	1 1 1 1 1								
Limestone and marl	1 1								
Conglomerate, sandstone and marl	1	1	1	1 1					
Marl and evaporite	1	1	1 1	1 1	1 1				
Sandstone, slate and schist	1		1						
Granite	1 1 1 1						1 1	1 1 1 1	
Mixed neogene materials	1 1 1 1 1			1	1	1	1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1	

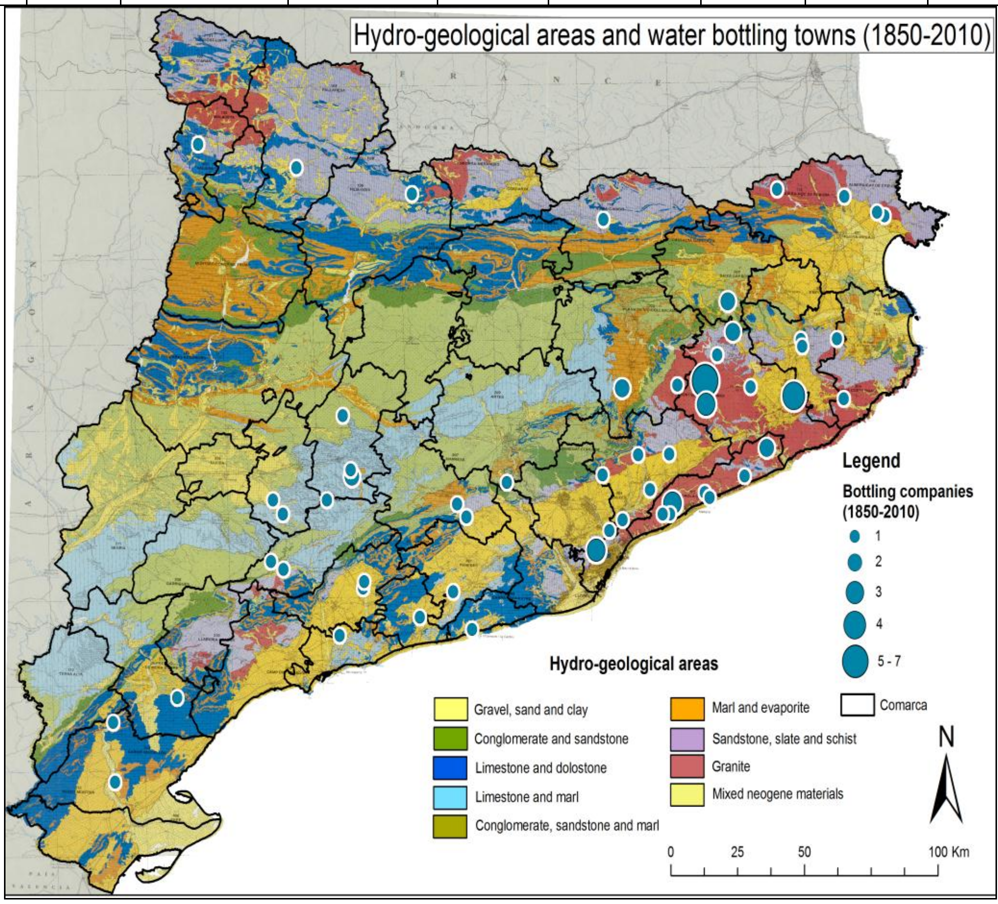


Figure 5.8. Table of the location of water bottlers (1850-2010) in relation with the type of hydro-geological area (Top). Bottling towns and hydro-geological areas map (Bottom).

Source: Author's work from (Servei Geològic de Catalunya, Institut Cartogràfic de Catalunya 1992), base map obtained from (Servei Geològic de Catalunya, Institut Cartogràfic de Catalunya 1992)

5.2.4 Earthquakes and mineral water

Existing literature reveals a relationship between earthquakes and mineral water. For example it has been observed that subtle changes in the composition of mineral water occur before an earthquake occurs (Grant, Halliday et al. 2011). Earthquakes can also affect the subsurface's water level increasing or decreasing it depending on the seismic activity (Gazdova, Novotny et al. 2011), or influence the underground water temperature (Bolognesi 2000). Therefore, the interaction between mineral water and earthquakes is well known, but it challenges one of the most sought after characteristics of bottled mineral water, its stability. If a source has rapid changes in its gas contents, its chemical composition, its temperature or its flow it can lose its appeal to consumers, and nowadays those changes can even cause the loss of its legal condition as mineral water (European Union 2009a).

One could therefore deduce that mineral water bottlers tend to avoid areas with high telluric activity to keep their product as stable as possible, but reality shows us otherwise. As figure 5.9 shows[56], towns which have had or have mineral water bottling facilities are mainly located in areas which have a high density of earthquake occurrences. As it has already been explained, mineral water bottlers have a tendency to be located in complex geological areas to obtain a wide range of water with different flavours, textures or compositions than their competitor and therefore obtain a niche in the market. The problem is that geologically complex areas are more likely to have a high seismic activity, so the risk of suffering an earthquake that influences the quality or characteristics of the water is higher.

Fortunately for mineral water bottlers –and Catalans-, Catalonia can be defined as seismically tranquil since it lays outside of the main hotspots of the planet, but even calm areas are not strange to violent outbursts of the Earth's crust (Fontserè i Riba 1991). Historically, there have been great earthquakes which have affected Catalonia, like the

[56] The earthquake data has been obtained with two different levels of detail due to the lack of proper measurements in the past. On one hand, a list of all 918 major recorded earthquakes through history up to the year 2000 has been included. On the other other hand, all earthquakes recorded by the Servei Geològic de Catalunya between the years 2001-2011 has been also used to create the map.

seisms occurred in the years 1427 and 1428 which killed hundreds of people in Catalonia[57] (Instituto Tecnológico Geominero de España 1988). Even if major earthquakes are possible and do happen, the periodicity between them is very low (Jiménez, García 2008), and therefore they are quite exceptional. Even though, in the period 2001-2011[58] Catalonia and its neighbouring areas -40º 10'N' 43º 20'N / 0º 20'W' 4ºE- have experienced 3708 earthquakes, a high value for an area described and seismically tranquil, but this high number is due to the high sensibility of modern seismographs, which can even detect earthquakes of negative magnitude (Filiatrault 2002). The biggest earthquake of the period, occurred on 17/11/2006 near the Col du Turmalet in the French department of the Hautes-Pyrénées, and it had a magnitude of 5.1M_L. The average magnitude of all the seisms of the period was of 0.96 M_L (Nobajas 2011). It is therefore proven that, even if they exist and can be devastating, telluric movements in Catalonia are not as important as in other areas of Europe or the World.

Even if earthquakes in Catalonia are comparatively weak and their occurrence is spread in time, the ones that have affected Catalonia have not left the mineral water industry unharmed. A first example can be found in the town of Amer, located 25 kilometres from Girona and where the 15th century earthquakes had a big effect (Instituto Tecnológico Geominero de España 1988). Juan Mariana, a relevant Jesuit historian who lived between 1535-1624 (Braun 2007), describes in his *General history of Spain (de Mariana, Espinosa y Malo,Félix de Lucio et al. 1678:76)* how the earthquakes destroyed Amer and, more relevant for this thesis, how it influenced underground water:

> *"Around that time[59] Catalonia's soil shouted and shook all around, from Tortosa to Perpignan. Near Girona there was a town called Amer, where two mouths of fire opened and roasted anybody who got closer than a distance of two stone's throws. From another mouth, close to the ones of fire, black water emerged and joined a river (presumably the Sameroca river) at a distance of half a league. The town became destroyed and all the fishes of the river died. The stench of the water was so bad that birds which flew over the town flapped their wings. The*

57 Including Northern Catalonia, a constituent part of the country in the 15th century (Buffery, Marcer 2010, Instituto Tecnológico Geominero de España 1988)
58 Up until 20/09/2011
59 The 1420s (Madoz 1845; 1850)

smell was so strong that it was even felt in the city of Girona, located four leagues away. Amer was afterwards repopulated again."[60]

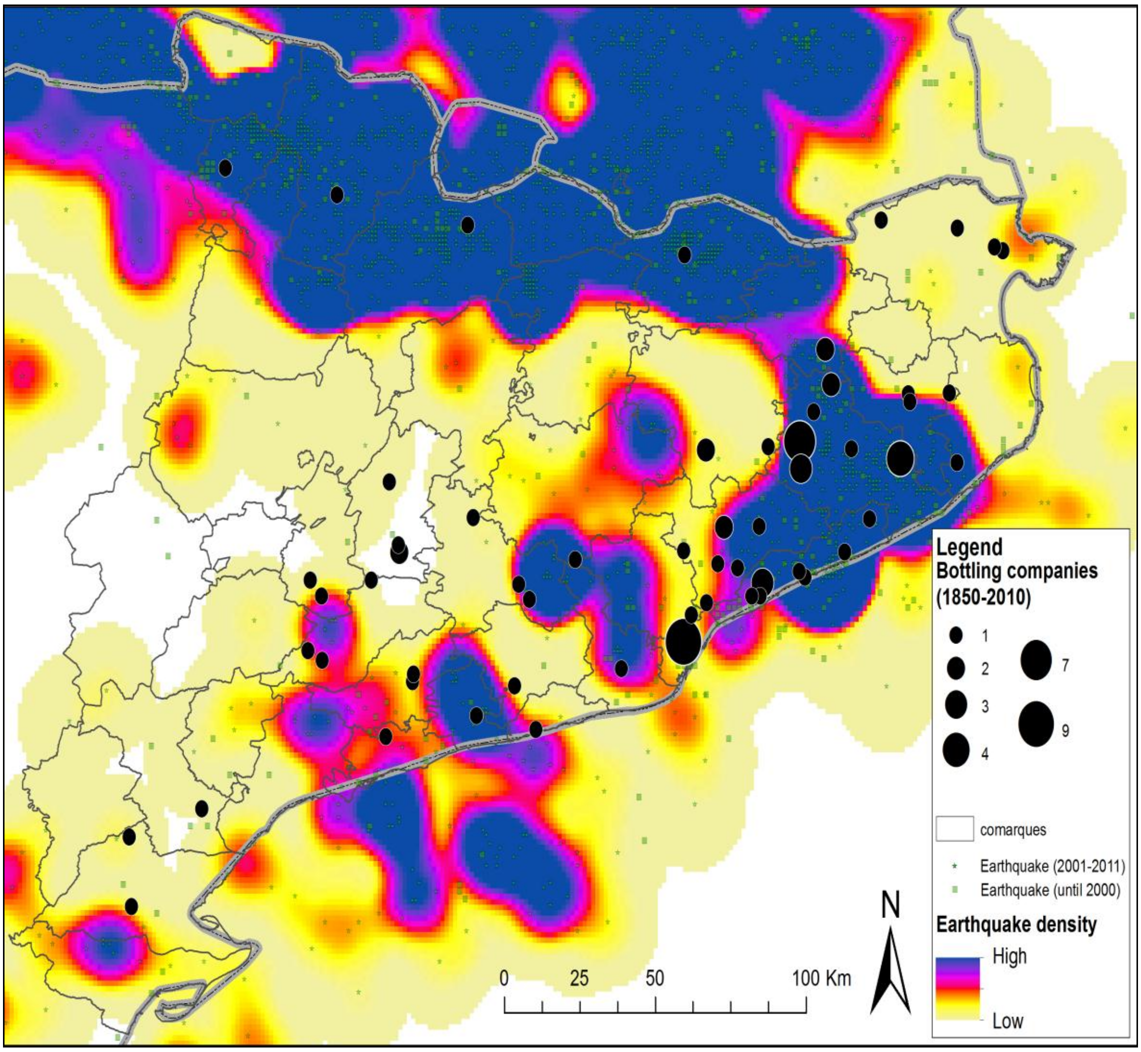


Figure 5.9. Bottling towns (1850-2010) and earthquakes.
Source: Author's work from (Servei Geològic de Catalunya, Institut Cartogràfic de Catalunya 1992), earthquake base obtained from (Nobajas 2011) and (Susagna Vidal, Goula Suriñach et al. 1999)

The chronicle of the seismic episode was written by Mariana one hundred and fifty years after it happened, so its repercussions may have been exaggerated and tweaked due to the chronological distance, but even so, they give a good idea of how earthquakes have

[60] The original text is: "*Por este tiempo cada dia en Cataluña bramava la tierra y temblava toda, desde Tortosa a Perpiñan. Junto a Girona estava un pueblo, llamado Amer, en que se abrieron dos bocas de fuego que abrasaban a los que llegavan a dos tiros de piedra. De otra boca, junto á las de fuego salia un agua negra, y á media legua se mezclaba con un rio (que debia ser el Sameroca), con que aquel pueblo se destruyó, y los peces del rio murieron. Era el olor del agua tan malo, que las aves batían las alas quando por allí pasaban; estendiase tanto que llegaba hasta Girona, con estar apartada de alli, y distante quatro leguas. Repoblóse Amer*"

historically influenced mineral water. Stinking subsurface water is a feasible phenomenon which has been documented before and after an earthquake occurs (King 2006), so it is a part of Mariana's narration which can be believed and proves earthquake influence in mineral water in Catalonia. The episode described by Mariana is especially relevant because Amer is a town with an important tradition of bottling its mineral water. Water from the Fonter source has had its water bottled since 1903 and the in the year 1994 Font Picant started selling water from the homonymous source. As figure 5.10 shows, the location of one of these sources is right on top of a quite significant fault, which forms part of an important fault system, which would explain why the earthquakes of the 15th century were so severe in Amer, and why the water of the sources had such a sudden change in their composition.

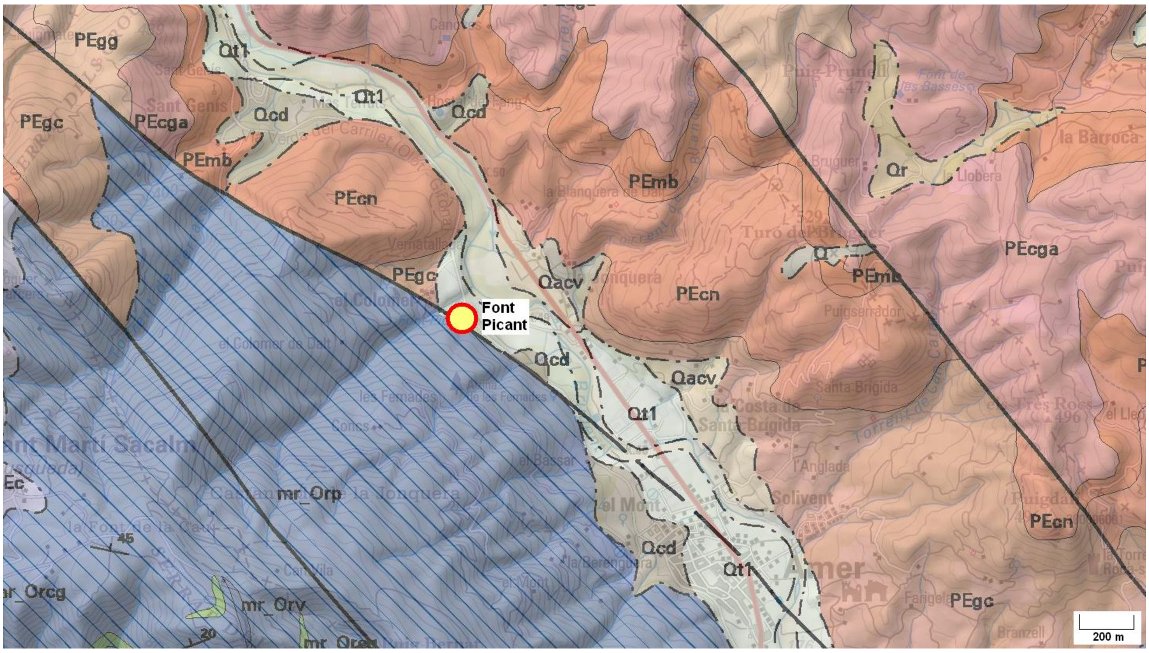


Figure 5.10. Font Picant source within the geology of Amer.
Source: Edited from (Servei Geològic de Catalunya, Institut Cartogràfic de Catalunya 2005). Oriented towards the North.

The chronicle of how the mineral water of Amer changed after an earthquake is not the only reference which can be found in Catalonia. Caldes de Malavella, allegedly the most important spa town in Catalonia, has had its share of problems due to earthquakes. One of the most powerful earthquakes Europe has experienced was the one which occurred in Lisbon on All Saints Day 1755 (Kozak, Cermak 2010). The earthquake was so intense that it was strongly felt in many distant areas of the world, including Catalonia.

Chronicles from the mayor of Caldes de Malavella reveal that the citizens of the town were hearing mass due to the sanctity of the day when the earth started shaking for as long as “an Ave Maria lasts”. When the town folks went outside the church they observed how the flow of the springs located in the town had increased and became turbulent with an ashy colour for six hours. After that time, the water acquired a reddish tonality and lumps of mud of the same colour were extruded by the sources. The following day most springs stopped their water gush and the rest saw their flow reduced to a tenth of their normal surge and the decrease of their water quality redeemed them as unhealthy (Rodríguez de la Torre 1984). It took a year for springs to recover to the normal flow they had before the earthquake occurred (Font i Sagué 1904).

A more recent but similar episode took place not long ago. On December 19, 2010 an earthquake with its epicentre located two kilometres under Caldes de Malavella and an intensity of 3.7 M_L took place (Nobajas 2011). The earth’s movement was felt by the citizens of Caldes de Malavella, but it did not cause material or personal losses (Redacció diari Avui 2010). After the earthquake, the flow of the springs was reduced and some sources even became dry, a fact that deeply worried all the companies which obtain their revenue from mineral water (Sebastián 2010). A month and a half after the earthquake, the flow of the sources had recovered and was similar to the one that existed before the seism (Delegació de Catalunya del Col·legi de Geòlegs 2011).

Just like Amer, Caldes de Malavella is located in an area of complex geology. The town is surrounded by many faults, folds and materials of different origin (Figure 5.11), which explains why it has been the epicentre of some earthquakes, but also why its water is thermal or why it has natural gas. Therefore, even if it is an area with a higher risk for mineral water bottlers due to its instability, bottlers and bathhouses have chosen it for its special water. It is a case where what gives the wealth is at the same time what can take it away. For this reason, even if bottlers would have preferred setting their extraction plants in more unwavering areas, they chose to locate their industries in unsteady spots because those mineral waters had higher appreciation from consumers, and therefore higher revenues.

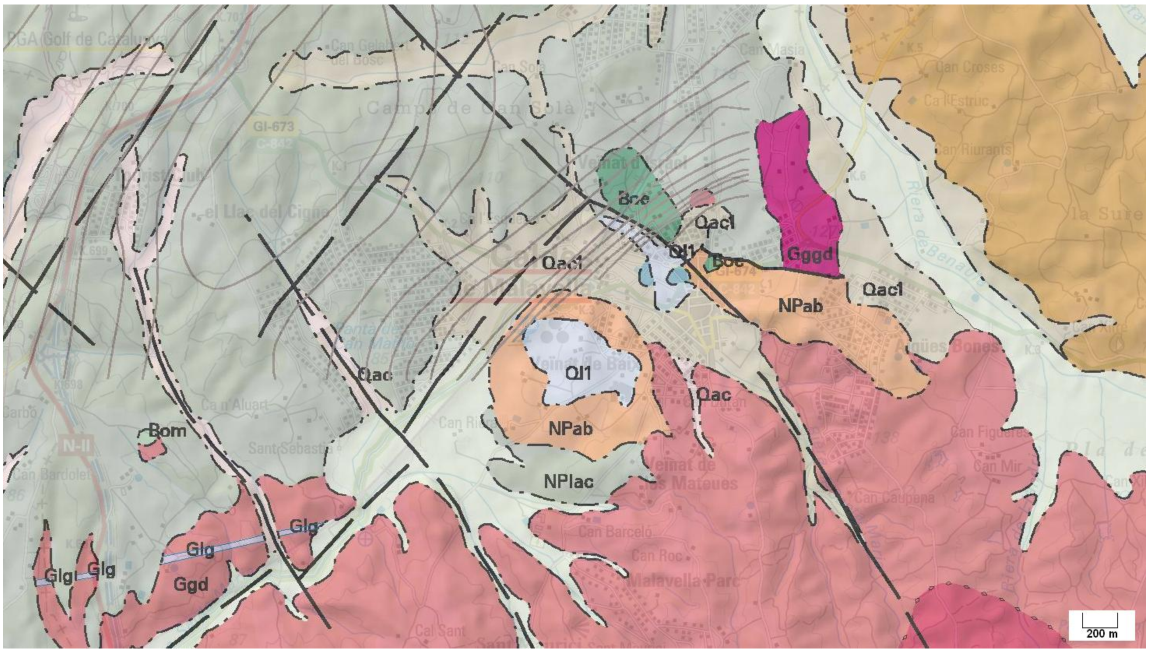


Figure 5.11. Caldes de Malavella (in the middle of the map) and its geology.
Source: Edited from (Servei Geològic de Catalunya, Institut Cartogràfic de Catalunya 2005). Oriented to the North.

5.2.5 Radioactivity and mineral water

Natural radioactivity is a common phenomenon which can influence some mineral waters, which can be considered as naturally radioactive waters. The radioactivity of mineral water is a perfectly natural substance usually produced by the decay of minerals containing thorium and uranium, which permeate into the water in the underground, which (Chin 2006). Proclaiming that a mineral water brand is radioactive to sell more units may seem eccentric by today's standards, but during the first decades of the 20th century it was a popular characteristic, not only of water, but also of many other products (Clark 1997).

With the discovery of radioactivity in 1896 by the French scientist Henri Becquerel (O'Riordan 1996) the new property became applied to many products as a popular revitalising and healing invention. The origin of this misunderstanding has to do with mineral water. In 1903 it was discovered that many of the renowned European spas had radioactivity emanating from their waters and, due to the relationship between health and mineral water, studies were done to check if radioactivity was the healing property in mineral water. Tests carried out in Vienna and at the University of Berlin, together with observations that miners working in uranium mines had less arthritis and rheumatism because they inhaled radium gas, meant that doctors embraced radium therapy (Clark 1997). In 1913, the American journal *The Medical World* explained that radium emanation was an effective way of treating "arthritis, neoplastic neuritis, gout, chronic rheumatism" and that radioactivity had been "recognised by leading European cities and spas", which had emanatoriums of radioactive gas.(Unknown author 1913).

The first bathhouses which discovered they had radioactive water were located in the Austrian village of Bad Gastein, a spa town located 100 kilometres south of Salzburg, and in the Czech town of Jáchymov, located near the German border. Both towns had an important role in the development of radioactive mineral water.

Bad Gastein allegedly was the first spa town where traces of radioactivity were found in its mineral water. The discovery amused many Germanophone doctors who promptly studied the healing properties of the water. In 1904 Professor Neusser prepared what became known as “artificial Gastein waters” by mixing standard mains water and uranium in a bathtub for fourteen hours. The amount of radiation was equal to the one found in natural Gastein water, and when given to ill people “*favourable results were obtained in chronic joint rheumatism, in arthritis and neuralgia, even where before ordinary water baths or hot air baking cures, etc.. had been used in vain*.” (Fuerstenberg 1913:12). The comparison to standard mineral water is important, because it proved that mineral water with radiation had improved healing effects and therefore it was better than standard mineral water.

Jáchymov is a town tightly linked to radioactivity and claims to be the hometown of the first radium spa, which opened its doors in 1906 (Rotter 2008). It is also known that the experiments that led to the discovery of radium by Pierre and Marie Courie were carried out with ore from Jáchymov (Friedrich 2011). The town had important uranium mines and until WWI it had the biggest uranium processing plant in the world (Heinrich 1958). Such a strong relationship with radioactivity led to the establishment of the St. Joachimsthal Institute[61], which later became known as the Institute for Radium Research (Ogilvie 1986). In 1914 a doctor of the Institute described how he treated patients with radioactive mineral water from the springs close to the Institute. Amongst other treatments, like combining mineral water, radioactivity and electricity all at the same time in a bathtub, the doctor gave between half a litre and one litre of bottled radioactive mineral water to his patients as part of the treatment (Pitcher 1914).

Prompted by the discovery of the admirable properties of radioactive water many mineral water bottlers and spas hoped to find radioactive elements in their mineral water as a way of increasing their revenue. A good example can be found at the famous Saratoga Spring, located in the state of New York and which has been bottling water since 1876 (Holmes, Stonequist 2000). By the turn of the 20th century the business was slowing down, so the owners tried to boost it by imitating the most prominent European spas and analysed their water in search of radioactivity. When they discovered that their water was radioactive they enthusiastically promoted this characteristic and started treating people

[61] Sankt Joachimsthal is the German name of Jáchymov

with the new techniques described in Europe. A similar story happened at the largest spa of the USA, Hot Springs in Arkansas (Clark 1997).

Since doctors and scientists backed the healing effects of radioactivity, many daily products where enhanced with radioactive compounds, mainly radium. Examples are Radione tablets for extra energy, Nutex radium enhanced preservatives[62], Burk & Braun Radium chocolate, Doramad radioactive toothpaste (Figure 5.12), Radio-Bleu eye drops, the beauty cream Tho-Radia[63] which included thorium and radium, (Epstein, Jr. et al. 2009).

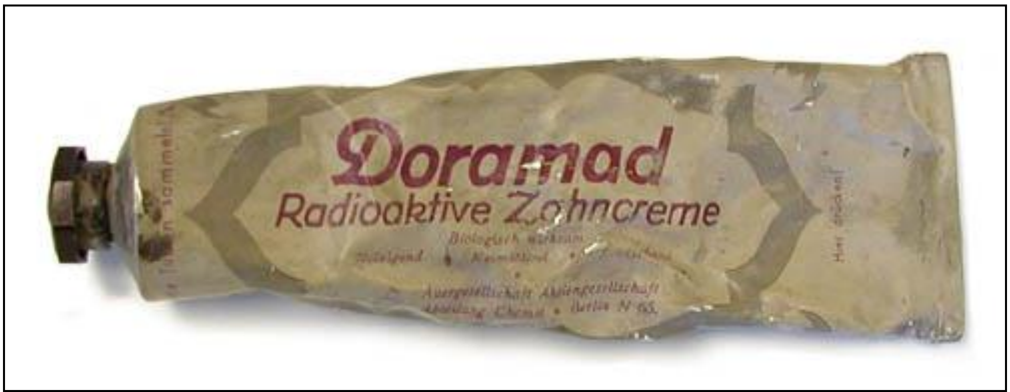


Figure 5.12. Doramad radioactive toothpaste.
Source: (Oak Ridge Associated Universities 2009a)

Even if other products existed, the most popular way to obtain a dose of radioactivity was to mix standard water and radium using two different techniques, radioactive jars and radioactive emanators. Radioactive jars worked like any standard jar, but between the water container and the tap a radioactive filter was added. Perhaps the most popular water jar was the Radium Ore Revigator, of which hundreds of thousands of units were sold between 1922 and the early 1930s (Figure 5.13). The prospect stated: "*Results overcome doubts. The millions of tiny rays that are continuously given off by this ore penetrate the water and form this great HEALTH ELEMENT-RADIO-ACTIVITY. All the next day the family is provided with two gallons of real, healthful radioactive water . . . nature's way to health.*" (Oak Ridge Associated Universities 2010). The other option to drink artificial radioactive water was to purchase an emanator. Its working principle was

[62] It was believed that a side-effect of radioactivity was the increase of the sexual desire
[63] Invented by Alfred Curie, who was fortunate to share his last name with the discoverers of radioactivity

similar to the one used in the jars, to mix a radioactive object with water so it obtained an adequate level of radioactivity, but without the water receptacle. They were sold in different shapes and materials, from concrete cones to clay pots.

Most of these products were not harmful because the amount of radiation they held was very small and in many cases their radioactive half-life was of just a few days, so by the time the product was ingested it had lost most of it radioactivity. In fact, most of these products could be considered fraudulent, since –fortunately- they did not provide the amount of radiation promised in their prospects. In a study published in the Journal of Chemical Education in the year 1933, the lack of radioactivity in the water enhanced using radioactive jars was exposed[64]:

> "*It is concluded that steady drinkers of water from even the most active type of generators do not stand in danger of contracting radium poisoning. The alleged therapeutic value of slightly radioactive waters probably rests more on the larger daily doses of water drunk than on the radon contained therein."* (Schlundt, Fulton et al. 1933:185)

Radioactively enhanced products began becoming a problem when the techniques to incorporate radioactivity to different materials improved and the price of doing so decreased. By late 1920s and early 1930s some products achieved high levels of radioactivity, something broadly advertised in their packages. The most famous example of how radioactive products increased their radioactive power is the radioactive water Radithor (Figure 5.13). In 1925 "Dr." Bailey, a self-proclaimed doctor who in reality was a Harvard dropout, invented the radioactive water Radithor, which claimed to contain at least 1 microcurie each of Ra-226 and Ra-228. He was so convinced that his product was radioactive that he offered $1000 to anybody who could prove that his radioactive water had less radioactivity, something nobody did (Peña 2003). It was Radithor, with its elevated doses of radiation, which started the beginning of the end of radium enriched waters. Eban Byers was a successful golfer and industrialist who, after injuring his arm by falling from a berth (Unknown author 1932), decided to drink Radithor as a means of

[64] Amongst the radioactive jars tested the Radium Ore Revigator was included

improving his health. He became so amused by the effects of the beverage that he drank one to three bottles of Radithor every day for several years and enthusiastically recommended it to his friends. At one point he started feeling ill and doctors diagnosed he suffered from radiation poisoning and started treatment, but it was too late. The description made by his attorney of his condition is quite compelling:

> *"Young in years and mentally alert, he could hardly speak. His head was swathed in bandages. He had undergone two successive operations in which his whole upper jaw, excepting two front teeth, and most of his lower jaw had been removed. All the remaining bone tissue of his body was slowly disintegrating, and holes were actually forming in his skull."* (Unknown author 1932)

Eban Byers ended up dying shortly after and his death and the autopsy revealed that he had distributed within his bones 36 micrograms of radium, when ten micrograms was considered fatal (Unknown author 1932). The dead of mister Byers was quite a shock and the New York Times[65] published a headline which read "*The Radium Water Worked Fine until His Jaw Came Off*" which caused the American Food and Drug Administration to investigate the healthiness of radium enhanced products. The investigation proved that the consumption of radioactive products was a dangerous folly, which meant that most manufacturers were put out of business (Lew 2009).

The radioactive water hype also influenced mineral bottled water. As it has already been explained, many spas tried to boost their businesses by the discovery of the radioactive properties to their water, so if they found them they advertised their mineral bottled water as radioactive. Many bottled water brands from across the world, mainly in Europe, but also in the United States followed this marketing strategy. Some water brands which advertised themselves as "radioactive at the source" were Bussang, Velleminfroy or Pestrin in France, Sequoyah-Baths and Berkshire Hills in the United States, Lurisia in Italy (Unknown author) or Lanjarón (La Vanguardia 1915) and Busot in Spain (La Vanguardia 1917).

[65] Some sources claim that it was published in the Wall Street Journal

Figure 5.13. Revigator jar (left) and Radithor water (right).
Source: (Oak Ridge Associated Universities 2010, Oak Ridge Associated Universities 2009b)

In Catalonia, radioactive water also had its share of popularity. As soon as 1906, in the welcoming conference of Pedro Genové as a new member of the Royal Medicine Academy of Barcelona, Dr. Bertrán Rubio explained that radioactive water could be used as a healing method (Unknown Author 1907). The following year, the spas from Vallfogona and l'Espluga de Francolí advertised themselves as having radioactive water and in 1910 the spa from the Puda of Montserrat declared having radioactive water (La Vanguardia 2011g). In 1914 the Caldes de Boí spa advertised its water as being radioactive (La Vanguardia 1914), and the same year an article published in the press praised the healing and invigorating effects radioactive water had in the author (Bofill 1914). In the following years waters from the bathhouses Martí and Orión in Santa Coloma de Farners, Cardó in Benifallet, Montagut in Ribes de Freser, la Puda in Banyoles, Sant Vicenç in el Pont de Bar, Blancafort in La Garriga and all the spas of Caldes de Montbui advertised themselves as radioactive. A hotel located in the town of Viladrau also advertised the waters of the town as radioactive (La Vanguardia 2011g). As this long list shows, many spas, most of which had existed decades before the discovery of radioactivity, analysed their waters in the search of radioactive elements and those which succeeded broadly advertised their newfound therapeutic characteristic.

Regarding bottled water, Catalonia also had some radioactive examples. The first bottled water to be advertised as radioactive was Palou water. The water was obtained from the appropriately named Font del Radium (Radium Source) located in a former town near the city of Granollers. The water was distributed by the successful and famous chemist Dr. Andreu and claimed to have a radioactive power of 490 volts per litre and hour (La Vanguardia 1923).

A prime Catalan example can be found in the aforementioned Amer Palatin[66] bottled water. Mineral water from Amer had been sold since 1903, and advertised itself as “bicarbonated, calcic, acidic, carbonic and cold”. Until 1916 the water did not mention its radioactivity, but in 1917 the advert changed to “carbonic and radioactive”. In a remarkable series of graphic advertisements of the water Amer Palatin (Figure 5.14), starting in the year 1925, the water advertised itself very explicitly as radioactive, including the word in its labelling. The company kept advertising its radioactive properties in the press and in its label well into the 1940s, more than a decade after Eban Byers died from radioactive poisoning.

Figure 5.14. Joint advertisement of Rocallaura and Amer Palatin bottled mineral waters in 1925.
Source: Edited from La Vanguardia, 20/12/1925, pg. 25 (La Vanguardia 2011g)

[66] The predecessor of Fonter (Navás 1929)

A third water bottling company which advertised itself as radioactive was Agua Vall-Par, obtained from the hills of the Collserola range in the city of Barcelona. The water was mainly sold in the city and also described itself as being radioactive, which added to an appropriate location close the city ensured that "the water arrived to the consumer without losing its radioactivity" (Figure 5.15). Like Amer Palatin, the radioactive reference did not disappear after the death of Eban Byers, it went on until the year 1935.

Figure 5.15. Vall-Par advertisement (1935).
Source: Edited from La Vanguardia, 21/03/1925, pg. 3 (La Vanguardia 1935)

The radioactive hype in Catalonia, like in the rest of Europe and the USA, saw its popularity decrease with the discovery of the negative and lethal effects it had on the human body. Even though, as it has been mentioned, some water brands and spas continued advertising themselves as having radioactive properties years after the realisation of the negative effects they had, but from the mid 1930s onwards the radioactive thrill was watered down and eventually disappeared.

A remarkable fact is that many current mineral water brands come from spas, towns and sources which in the first third of the 20th century claimed to be radioactive; something that if it was known by the general public could mean great loses for the owners of those brands. Many water enterprises stopped advertising themselves as radioactive, so any reference to radioactivity was erased from labels and commercials. But a question that remains unanswered is, if water from several sources still commercially used nowadays was radioactive, is that still true today? The quick answer would be yes, but the reply is not as simple.

As it has already been explained, the presence of radioactivity in certain waters is a natural phenomenon, just like bananas, carrots or Brazil nuts also have radioactive components in them (Kouzes 2003). Therefore, natural radioactivity in normal circumstances is not a health hazard. It should be checked if all the springs which had their water advertised as radioactive were really so, and if they were which was the level of radiation they contained. The most probable fact is that levels of radiation were quite low, insufficient to cause long term illnesses even to keen consumers. It should also be checked which radioactive compounds were found in the water, because depending on their half-life the time lapse that went by between the bottling of the water and the consumption of it could mean that most radioactivity had gone away. Today, the European Union does not enforce the labelling of radioactive components in bottled water (European Union 2003), nor it imposes the analysis in search of radioactive components, only radio-actinological properties are analysed at source are carried out. Since a lack of legislation exists, it is not easy to know the current levels of radioactivity of bottled mineral water, so only results from independent analysis can be found.

Scientific research from different countries has shown that while most bottled mineral waters have radioactive elements, only a few have enough radioactivity to surpass the limits established by the World Health Organisation (WHO), 0.1 mSv/year[67]. In an analysis of 43 mineral water brands from Spain, France and Portugal, only two were over the limit of radioactive material, while another one was on the fringe, surpassing it depending on how the quantity was calculated (Martín Sánchez, Rubio Montero et al. 1999). A similar test done with 21 bottled waters from Northern Italy identified two brands as being over the radiation limit, one of them being 250% more radioactive that what the WHO recommends (Rusconi, Forte et al. 2004). In the UK, an analysis of 175 samples of mineral water sold in the country led to the conclusion that only two significantly surpassed the recommended limit –the same ones found in the Spanish analysis-, while a third one was marginally above the limit (Food Standards Agency 2004).

The two brands which in two reports render themselves as excessively radioactive are Pedras Salgadas from Portugal and Vichy Catalan from Caldes de Malavella, but according to Vichy Catalan, they have introduced systems to reduce the amount of radiation, so it is not so radioactive anymore (Food Standards Agency 2004). Although the thought of having several brands of mineral water classed as radioactive may be alarming, calculations are made assuming a consumer who drinks two litres of the analysed water every day during a year, something that due to the characteristics of Pedras Salgadas and Vichy Catalan is highly unlikely. Furthermore, the amount of radiation given by the waters classified as radioactive is very small compared to the amount of radiation to which humans are exposed, both from natural and human origin (Food Standards Agency 2004). European bottled mineral water consumers should not be therefore especially concerned about radioactivity in their brand of choice. A different problem arises when mineral water is given to young children since the amount of radioactive intake depends on the weight of the person, but given that waters declared as more radioactive are not recommended to children due to their high mineralisation it should not be a concern.

[67] The limit recommended by the WHO is in some cases lower than the legal limit

If such a little percentage of mineral water brands has significant levels of radioactivity, it could be deduced that most advertisements during the radioactive hype were exaggerated, if not invented. As it had happened before with other products like emanators or radium jars, the potential radioactivity of mineral water was very limited and just a commercial strategy. Since the turn in the consideration of radiation as a positive property for water to have, mineral water brands from formerly declared radioactive springs have veered away from their origins and do not mention it at all in their webpages or labels. It is however interesting as an example of a natural property of water which was previously sought after and is currently avoided when starting a new mineral water bottling plant

5.3 The environment

While being a physical characteristic of the planet, the characteristics and valuation society gives to the existing environment is highly dependent on the zeitgeist each historical period has. The human perception of a fixed characteristic of the environment can change depending on the cultural background, the economic situation, the historical context or technical improvements (Brookfield 1969). Therefore, a singular environment can be seen as positive or negative depending on the perception of the observer. Changes on the perception of the environment and its externalities have influenced where bottled mineral water has been produced and which springs consumers have preferred. Here, two factors which have to do with the environment and that have changed through time will be analysed, pollution and nature.

5.3.1 Lack of pollution

Apart from the spring's flow and the geology of the source, a third factor when choosing water from a spring to sell it bottled, is to make sure that the water is potable and that the source will remain pouring clean water all year long and in following years. Groundwater can become polluted by many factors which have changed through centuries. At the present time, aquifer contamination can be classified into four classes depending on what originates the pollution (Fried 1975):

- Agricultural: fertilisers, pesticides, herbicides, minerals or salts used to improve the growth of crops can pollute groundwater. Also, faecal matter from farm animals like cattle or swine can affect the quality of groundwater.
- Industrial: used waters from industrial processes can transport chemical compounds, trace elements or radioactive products underground and pollute the aquifer. Also the breaking of industrial pipes can be a source of contamination from hydrocarbons or other toxic products.
- Domestic: the breaking of septic tanks, leaks from pipes carrying blackwater or untreated domestic water mixed with cooking oils or detergents can be a source of underground pollution.
- Environmental: usually caused by the intrusion of seawater into coastal aquifers. Such intrusion can be caused by any of the other factors due to excessive exploitation of groundwater.

Intensive agriculture, industrialisation and population density have dried, salinised and polluted aquifers for decades, and this has changed the location of the exploited sources through time. Areas which its groundwater was suitable to become bottled a century ago may not be suitable nowadays, which has meant that the distribution of water bottlers has changed through time to skip groundwater pollution. Domestic groundwater contamination and industrial pollution has been traditionally limited to areas surrounding densely populated areas or industries, while environmental pollution is relatively recent (Fried 1975). In Catalonia, the type of subsurface water contamination which has a larger diffusion is the one that has its origins in agriculture, and more specifically pollution of groundwater by nitrates.

Nowadays the underground water of 421 Catalan towns -44% of the total and 35% of the Catalan surface- is contaminated, with different levels of severity, by pollutants of agricultural origin (Departament de Territori i Sostenibilitat 2010). In contrast, during the first century of mineral water bottling (1840-1940), the level of pollution of underground water was not as intense as nowadays (Nemerow 2009). The change from an agriculture which heavily relied in the labour of people and animals, to a highly mechanised cultivation, meant that the levels of production of the fields increased dramatically (Giralt i Raventós 2008). Multiplying the productivity of land, which included higher crop densities or not leaving the land fallow, meant that soil nutrients became scarce. To compensate this, tons of nutrients had to be imported to fertilise the fields, being quite prominent the use of nitrates from Chile (Addiscott 2005). At the same time, the use of pesticides and herbicides to guarantee healthy crops and increase the agricultural production meant that chemicals where poured on the fields (Hamilton, Crossley 2004). Some of these exogenous products ended mixing up with irrigation or rain water and filtered to the underground and into the aquifers (Canter 1997). At the same time the raising of farm animals became heavily intensified and soon Catalonia had more pigs, cows and sheep than human inhabitants, something that still occurs today (Institut Català del Crèdit Agrari, Institut d'Estadística de Catalunya 2002). Farm animals produce tons of faecal matter every year, which have a high content of nitrates. Traditional farming used those residues as manure to fertilize the fields, but with the intensification of animal raising the amount of fertiliser produced was too large for the soil to absorb. Part of the exceeding manure filtered below the surface and became mixed with groundwater, polluting and contaminating it with nitrates (Jofre i Torroella, Institut d'Estudis Catalans 2003).

Ingesting water polluted by nitrates –more than 50 mg/l (L'hirondel, L'hirondel 2002)- during long periods of time can seriously affect the health of consumers. If newborn infants drink water polluted by nitrates their haemoglobin can be converted into methaemoglobin, which implies that red blood cells lose their oxygen carrying capacity.

Adults have enzymes which can convert methaemoglobin back to haemoglobin, but newborn babies have lower levels of them, so if they drink water with high concentration of nitrates they can have cyanosis, anoxia, brain damage or even death (McCasland, Trautmann et al. 1985). Adults who drink water with high concentration of pollutants can convert nitrates into nitrites, which can combine with amines and form nitrosamines, a proven cause of cancer (McCasland, Trautmann et al. 1985).

Water with nitrates does not have any different look, feel or taste than perfectly healthy mineral water, so only water which has been previously analysed can be identified as polluted or clean. Historically, water began being analysed in the 18th century, and systematic analysis of mineral water started in Catalonia and Spain with the creation of the "Cuerpo de Médicos Directores" in the year 1816 (Barriobero Martínez 2002). Even though, earliest water analysis did not stress the importance of nitrates in water, maybe because of lack of concentration, maybe because it was not considered as a dangerous element (Cabanes 1832, González y Crespo 1840). As time went on and the effects of continuous nitrate intake became better known, many waters which had been considered healthy were identified as not potable. The increasing presence of nitrates in many areas of Catalonia due to intensive agriculture and farming meant that some springs which had had their water bottled and sold were now located in areas that had been identified as potentially affected by nitrate pollution, which meant that their business became endangered or terminated.

Many water bottling industries which have been unsuccessful and have ceased their economic activity, were located in areas today considered as potentially contaminated by nitrates by the Catalan Government. Between 1840s and the year 2010 at least 89 springs have had their water bottled, of which 63 have stopped production, which means that on the year 2010 26 bottling plants exited in Catalonia[68], which means that 71% of the sources have stopped being used industrially. If the presence of nitrates in groundwater is taken into account, it turns out that 84% of the companies which exploited water from areas nowadays affected by pollution have ceased their activity, while only 60% of

[68] Catalonia had 26 natural mineral water bottling plants recognised by the EU in the year 2010. Other water bottling plants exist, but according to EU law they are not natural mineral water (European Union 2010)

enterprises which had their sources located in an area free of nitrates have closed (Figure 5.16). Since the negative effects of nitrate pollution were discovered, newer companies have been established in areas not affected by them to avoid potential sanitary problems. For example, only four companies were created in contaminated areas after 1930, and all of them have stopped bottling water from those sources. In fact, the only companies which have remained selling water obtained from areas which are potentially polluted by nitrates opened their business before the year 1930, so they were established long before nitrate pollution was discovered.

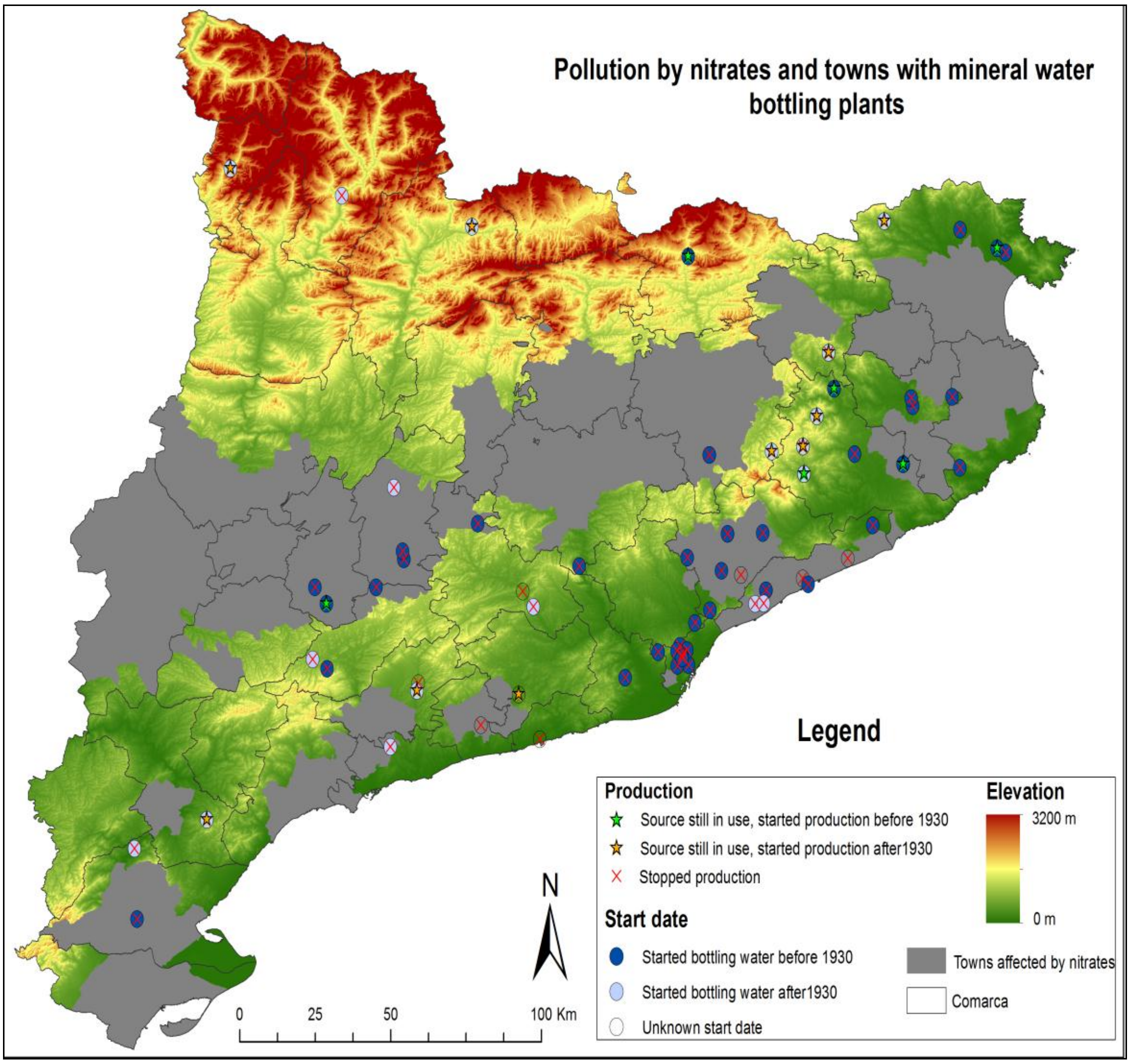


Figure 5.16. Bottling towns and areas potentially polluted by nitrates.
Source: Author’s work from (Servei Geològic de Catalunya, Institut Cartogràfic de Catalunya 1992) (Departament de Territori i Sostenibilitat 2010)

While it is comprehensible that springs in areas with potentially polluted groundwater ceased their activity, it may result surprising that springs located in areas which have potentially hazardous water are currently being bottled and sold. The reason why they keep their production mainly responds to two reasons, one conceptual and one historical. First of all, areas defined as polluted by nitrates are potential, which means that not all the water found in the area may be polluted; it depends on the local geology of the area (Agència Catalana de l'Aigua 2004). According to the European Union, an area has to be designated as vulnerable to nitrate pollution if agricultural areas with a significant contribution of nitrates to the basin can be found (Dirección General de Medio Ambiente. Comisión Europea. 2002). Therefore, if an area is designated as vulnerable to nitrates it does not necessarily mean that all groundwater found in the assigned zone is polluted. For example, in the same area an aquifer may be polluted by nitrates while water from a spring nourished by a different aquifer can be perfectly healthy (Figure 5.17).

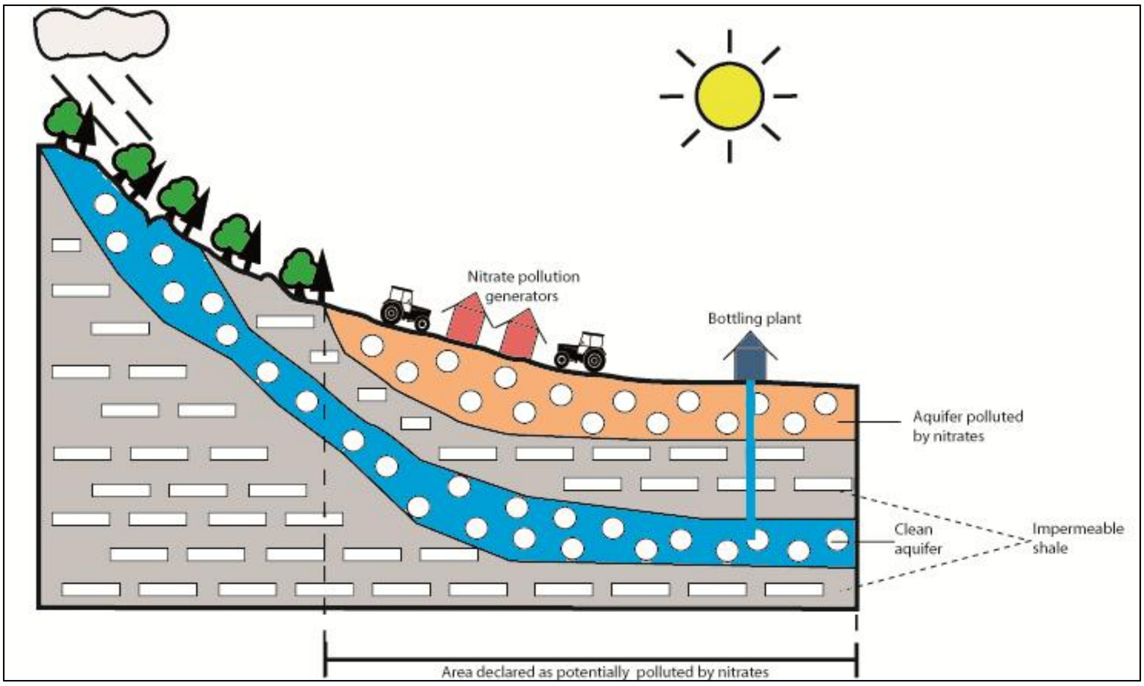


Figure 5.17. Diagram of how a mineral water bottling plant can obtain potable water in an area designated as vulnerable to pollution by nitrates.
Source: Author's work.

It is remarkable that only bottling plants which started their production before 1930 have remained open even if the area where they are located has been declared as vulnerable to pollution by nitrates, while no bottling plant opened in those areas after 1930 has remained open for business. In fact only 16% of the bottling plants stablished after 1930 were located in areas nowadays defined as potentially polluted –all of them currently out of business-, while 44% of the sources which started their business before 1930 were located inside areas declared vulnerable to nitrates, and five of them remain open.

Even if groundwater contamination references go back to the 1840s, broad consideration to underground pollution is relatively recent, with the first detailed description of how contaminants found their way and travelled to the subsurface dating from the year 1962 (Nemerow 2009). It is not strange then that bottlers located in potentially dangerous areas which had potable water kept on selling their water until the aquifer from which water was obtained became blatantly polluted.

As preoccupation by the general public about groundwater contamination grew, bottlers located in areas considered as potentially dangerous struggled, while new entrepreneurs tried to avoid those areas to ensure a good acceptation by costumers and minimise the possibility of their aquifer becoming contaminated. This dual process of closures and new openings away from potentially polluted areas meant that almost all Catalan mineral water bottlers -94% in the year 2010- were located on the areas not considered at risk of pollution by nitrates. The remaining 6% of bottlers, which corresponds to five springs, are located in two towns that have common characteristics, Caldes de Malavella and Rocallaura. The bottling activities of all five sources started before 1910 and are limited to spa towns, so they have a long tradition of mineral water bottling and have gained a strong reputation amongst Catalan and international consumers, specially water from Caldes de Malavella, which can be found virtually anywhere in the world. The fact that these mineral water bottlers are located in areas nowadays considered under the influence of pollution by nitrates, as it has been explained before, does not mean that their water is polluted. On the contrary, some of the finest Catalan waters can be found amongst these sources since they come from deep underground aquifers and have very high levels of mineralisation (Mascha 2006). Therefore, they have been resilient to the negative effects the declaration of the areas vulnerable to nitrate pollution had in other companies with less tradition and less loyal customers.

Since pollution by nitrates in Catalonia mainly affects agricultural flatlands and valleys, the location of new bottling companies has avoided those areas and entrepreneurs have searched for water sources located at higher altitudes. As table 5.1 shows, mineral bottling plants which started their business before 1930 were mainly located at low altitudes, with only 20.4% of exploited sources placed over 500 metres above sea level. New bottlers who opened their business after 1930 chose higher springs to avoid the chance of having their source of revenue contaminated. Therefore, 40% of new bottlers located their sources over 500 metres above sea level, with two of them located over 1000m. In fact, the average elevation of mineral bottling plants opened before the year 1930 was 246m, while exploited sources which started their business after that year more than doubled their average height, achieving 503m.

Table 5.1. Elevation of mineral water bottled springs

	Before 1930		1930-2010	
Elevation (m)	**N**	**%**	**N**	**%**
0-100	16	32.7	2	8
100-500	23	46.9	13	52
500-1000	10	20.4	8	32
+ 1000	0	0	2	8
Total	49	100	25	100
Avg. Elevation	246 m		503 m	

Source: Author's work.

The search of higher springs has meant a change in the location where bottling plants have been established, from lower lands to more mountainous areas further away from population centres. For example, sources bottled before 1930 were located on average 56 km away from Barcelona, while the ones that opened after 1930 were located 82 km away from the capital of Catalonia[69]. Another fact that illustrates the process of moving away from densely populated areas is that before 1930 at least 26 mineral water bottlers were located within 50km of the centre of Barcelona, but nowadays, no mineral water bottling plant can be found within 50km from Barcelona (Figure 5.18).

[69] See table 6.1for more detailed information

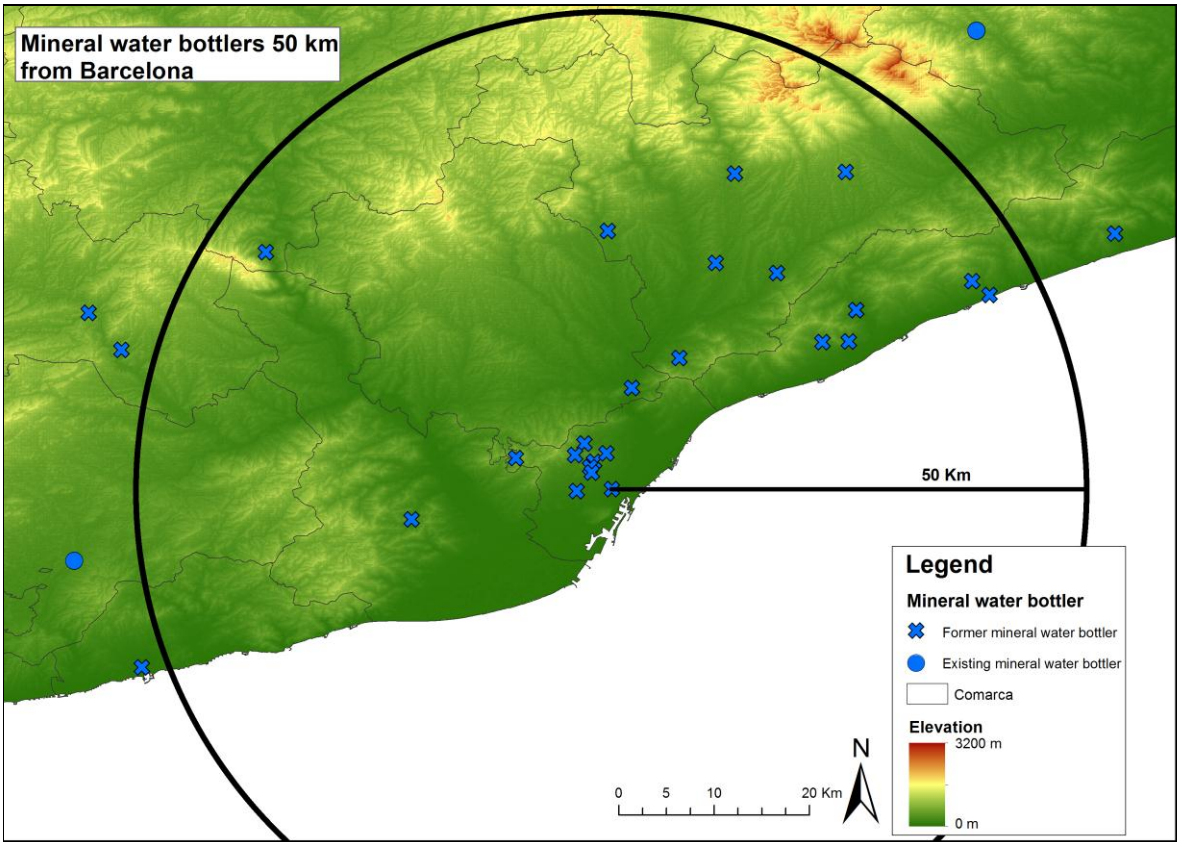


Figure 5.18. Former and existing mineral water bottlers 50kms around Barcelona city centre.
Source: Author’s work.

5.3.2 Nature and bottled water

Related to pollution, changes in how society perceived and valued nature also influenced the location and advertisement of sources. During the industrial revolution a factory's smoking chimney was seen as a symbol of progress and wealth (Crowther 1972), so springs close to a factories or human agglomerations were not strange. For instance, during the first third of the 20th century Barcelona had within its city limits at least nine mineral water bottlers (Table 5.2).

Table 5.2. Mineral water brands located in the city of Barcelona

Brand	1st Found Reference
Agua Fargas	1903
Agua Radial	1909
Santa Rita	1910
Agua Val-Par	1913
Agua Sarva	1914
Fuente Tenebrosa	1916
La Mina	1917
Mont-Alt	1920
Agua Stirling	1923

Source: Author's work.

The idea of using a spring located in a city, or very close to it, to sell its water bottled may strike as surprising when seen with today's eyes, but one hundred years ago it was a reasonable option. Having a spring close to a city meant taking advantage of its proximity to consumers, so transportation costs were lower than those of water which had to be shipped from the countryside. The obvious downside was the higher risk of having the water polluted and losing the consumers' trust, but even if they were very close to the city they were mainly located in elevated and scarcely populated areas where pollution was less likely to occur (Figure 5.19).

The relationship between bottled water and nature can be observed in advertisements. Spas advertised themselves by describing the beneficial properties of their waters and the illnesses they could heal, but also by enhancing the natural surroundings of the bathhouse. For instance, the press of the time described the excursions surrounding of the spa town of Caldes de Malavella as "*they are not tiring since the land is flat and* *undulating, and if you want to enjoy the charms that nature offers in spring, you will not feel disappointed*" (Roca i Roca 1901:4). The description of the natural wonders of the area where the spa was located was common because as part of the therapy patients were encouraged to take walks, so if a spa had pleasant surroundings it could attract more visitors. On the other hand, it is difficult to find advertisements or labels where mineral water bottlers depicted or enhances the surrounding area of the source. The lack of interest for the natural characteristics of the area around the spring is quite surprising compared to nowadays awareness, which has led to the creation of protected natural areas around bottled springs (Ministeri de la Presidència 2011).

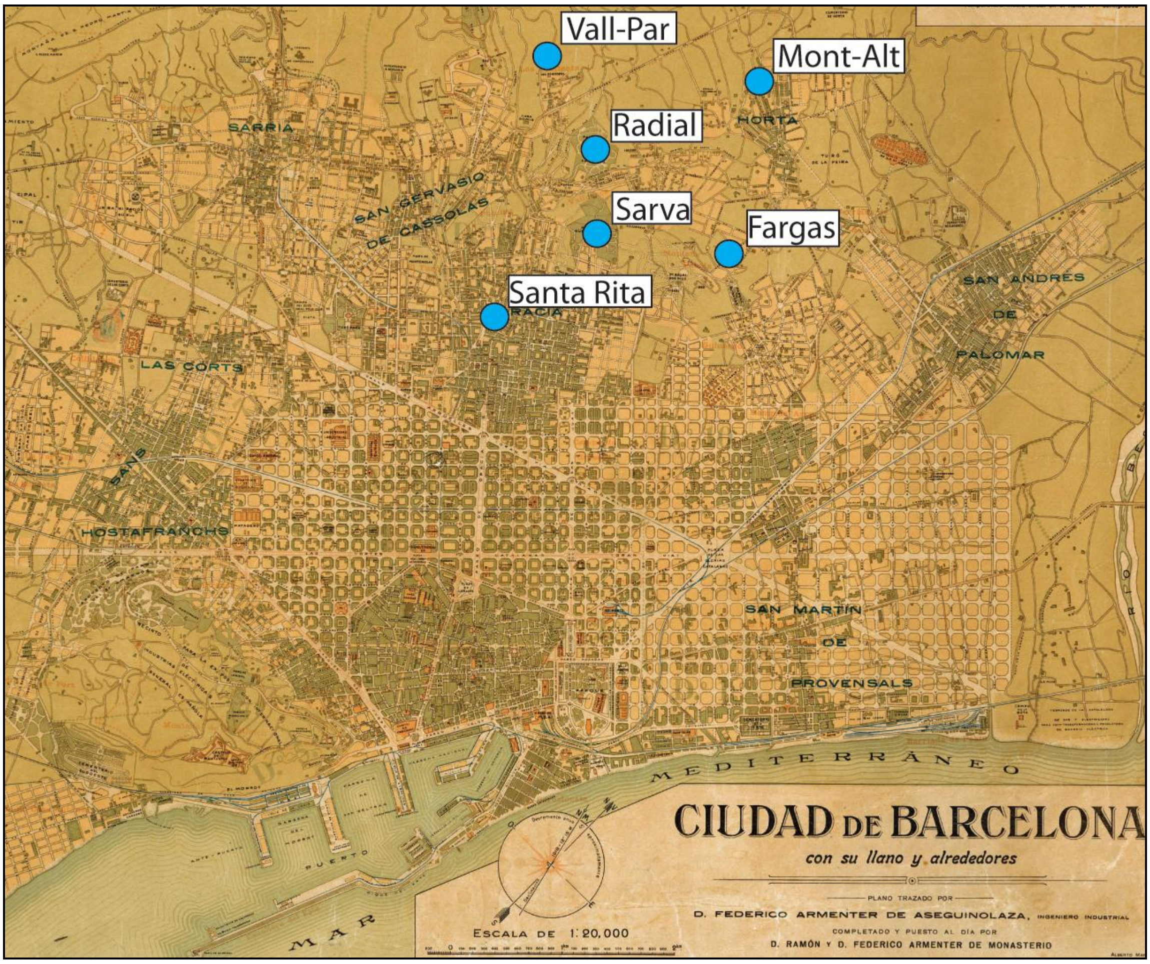


Figure 5.19. Location of Barcelona's mineral water springs and the city extension in 1915[70].

Source: Author's work. Base map by (Armenter de Aseguinolaza, Armenter de Monasterio et al. 1915). Digital copy of the map obtained from the Institut Cartogràfic de Catalunya.

[70] "Agua Stirling", "La Mina" and "Fuente Tenebrosa" were located outside the map limits, well in the forests of the Collserola range.

Early mineral water bottlers did not consider as an important part of the appeal of their product its close relation to nature, for them the most important characteristic of mineral water was its healing properties. Therefore they advertised their mineral composition and which illnesses they could prevent mitigate and heal, but not the natural origin of the water or the area where it was produced. Bottlers which had their origin in a spa usually had a picture of the building in the label or in the advertisements. A special mention has to be made to the Vichy Catalán, which did indeed picture the natural surroundings of the bottling plant, but it included a bizarre sight, a column of smoke (Figure 5.20). Smoke, as it has been mentioned, was seen as a sign of progress so it is not strange that Vichy Catalán, a modern company of the time, included it in its label. The drawing with the column of smoke can still be seen in the modern Vichy Catalán bottles, but much smaller and less central than in its original form.

Figure 5.20. Malavella water old label (left) and Vichy Catalán traditional logo (right).
Source: Author's work and (La Vanguardia 2011g)

Sources which did not have a spa associated to them mainly chose to either have the name of the source or of the brand without any descriptive drawing or an image of the spring. An exception can be found in the advertisements of Jalpí water, where two pines are used as a logo of the spring. The reason why two pine trees are used as a logo may not correspond to the desire of promoting the natural surroundings of the source, but to illustrate the fact that the end of the word Jalpí in Catalan means pine tree (Figure 5.21).

An interesting exception to what it has been explained until now can be found in Mont-Alt water from Barcelona. The brand's logo, label and advertisements were composed by a bottle of water on top of a peak with a gush of water pouring down the mountain into the woods with a sunrise[71] over the sea in the background (Figure 5.21). The epic and magnificent image did praise the environmental location of the source, so it contradicted the principle that brands from springs not related to spas ignored the environmental surroundings of the source, but this contradiction can be justified. Mont-Alt in Catalan means "high mountain", so the illustration shown in the logo is an allegorical depiction of the brand's name. Even if the logo had to do with the name of the brand the lushing nature depicted in it did not fit with the iconic standard of the age at all, since at it has been explained, sources which had nothing to do with spas were quite oblivious to the nature surrounding the source. The reason to this exception is that Mont-Alt had plans to become a bathhouse in addition to a bottled water producer. In the Gaceta de Madrid[72] of 29/01/1927 it was announced that the water of Mont-Alt was declared of public utility because a spa linked to the spring had been planned and that it would start its activity during that year (Martinez Anido 1927). Even if the source had been bottling water for at least five years, a new law decreed on 27/07/1925 forced it to build a bathhouse because the spring was plentiful enough to serve both purposes, so the source was banned from selling water for several months until it proved it was going to open a bathhouse. Whether this spa it was finally opened remains uncertain since no proof has been found about its operation, but from what the Gaceta de Madrid states is seems that it was ready be fully functional in the bathhouse season of 1927. In any case, Mont-Alt water had a mixed vocation of selling bottled water and being a bathhouse, which may explain its unconventional label for the time.

[71] It should be assumed it is a sunrise and not a sunset because due to the position of the Barcelona only sunrise occurs over the sea.
[72] Nowadays known as Boletín Ofical del Estado, the Official Gazette of the Spanish government

Figure 5.21. Rubinat-Llorach water logo (top left), Fargas water advertisement (middle left), Mont-Alt poster (right) and Jalpí water advertisement (bottom).
Source: Author’s work, collector’s advertisements and (La Vanguardia 2011g)

The obliviousness to the natural surroundings of the source in most bottlers from before the 1930s contrasts with the apparent need modern bottlers have to proclaim how natural their water is. Most modern brands use natural symbolisms when labelling or advertising their products, sometimes basing their marketing strategy in being more natural than other mineral waters. Therefore, in modern bottles it is not unusual to see green mountains, animals, idyllic landscapes or blue colours with environmental slogans (Figure 5.22). A good example of how brands try to link their water with the natural surroundings of the source to improve their sales can be found in the description given to the press when the of the new label of Les Creus mineral water was presented (Puig 2011): "*The new labelling is a kind of abstract painter's palette, where the Mediterranean landscape and the topography of the Pyrenees converge*"

Figure 5.22. Veri mineral water label (left), Caldes de Boí water cap (right) and Viladrau water logo (bottom).
Source: Author's work and corporate webpages

Therefore, the contemporary urge to sell mineral water as a natural, pure, remote and virginal product was not followed by the first producers; it is a relatively new tendency. Modern brands, as their predecessors did before them, have adapted to the zeitgeist and to the consumers requirements, so the natural facet of mineral water has been enhanced over its mineral aspect, which prevailed in the first bottlers.

5.4 Physical limitations to the location of mineral water bottling plants

Physical conditionings to the industrial bottling of mineral water have historically been determined by where springs flowed, but certain physical limitations meant that not all sources were potentially suitable to be industrially exploited. Compared to human conditionings, physical limitations have remained more stable through time, but even minor changes have implied that areas where bottlers were successful decades ago, nowadays are not apt to sell their underground water without treatment, which renders them unsuitable to be sold as mineral water in Europe (European Union 2009a).

Climate change has transformed how, where and how much precipitation falls in Catalonia, which has had a direct effect in the amount of recharge aquifers have. Climate models for Catalonia state that precipitation will become progressively scarcer in the coming decades. Models also predict that rain will become more violent and less frequent. Temperature wise, it seems clear that maximum and minimum temperatures will increase, increasing the levels of evapotranspiration, which would also reduce the amount of water which could reach the subsurface (AEMET 2009). Changes in the speed of aquifer recharge have meant that areas on the fringe of being suitable to have their underground water bottled have seen their potential extraction business limited. The obvious problem when the inflow of water is reduced is that obtaining water is more difficult, if not impossible, but a parallel issue may arise, natural pollution. Certainly, the reduction of groundwater recharge or important changes in the level of the aquifer may change the mineral composition of water (Mühlerr, Hiscock et al. 1999), something highly undesirable when it happens to mineral water. Bottlers and consumers search for mineral stability when dealing with mineral water; in fact, the European Union currently enforces it in order to declare springs as natural mineral water sources (European Union 2009a). Therefore, climate change, in any direction, can have an effect on where appropriate mineral water can be found.

Geology is the most stable factor since geological time is not comparable to human time (Monroe, Wicander et al. 2006), so geological changes can be imperceptible by human standards. Even though, human action can alter the chemical and physical characteristics of aquifers, affecting the extraction of bottled water. Overexploitation of subsurface water can promote the intrusion of salty water or a change in the chemical characteristics of mineral water. Other factors regarding the geology of mineral water, like the geological composition of an area or the limits of hidrogeological areas are hardly affected by human activities and tend to change very slowly. On the contrary, some geological and geomorphical episodes can occur very fast. Landslides, volcanoes, earthquakes or tsunamis can suddenly render an area as unsuitable for the bottled water business or create a new spring. In Catalonia the most likely geological event which can get in the way of industrial water bottlers is the occurrence of earthquakes. A paradox occurs since almost all bottlers in history have located themselves in seismic areas when they should try and avoid the risk. Unfortunately for them, areas with high risk of earthquakes have more springs, and the quality of those is greater. Since fractures in the earth's crust allow the circulation of deeper water to the surface, ruptured areas are where some of the most preferred mineral waters emerge, but unfortunately for mineral water bottlers, these are areas suffer from many telluric movements, so bottlers are forced to risk their businesses to obtain higher revenues.

Groundwater pollution has been one of the most feared externalities to mineral water bottlers, so they have made every effort to avoid it, even if it has meant having to search for springs located in more remote areas with higher running costs. One of the main reasons to buy bottled instead of drinking water from the tap is that bottled water should have a better flavour and be healthier. Therefore, if a spring becomes polluted and either its taste or its cleanness is compromised, consumers will not buy the water again, forcing the company to close. As medical and analytical tests advanced many sources located near cities or areas of intensive agriculture, even if they still had clean water, were progressively abandoned and new cleaner exploitation areas were sought. The evolution of society's perception about nature has meant that natural element of the water has in many aspects taken over the mineral component of the water when marketing and selling modern brands.

In conclusion, the physical geography of an area is what makes mineral water mineral, so it is of paramount importance to it. Even if some factors are very stable in time, random but recurrent phenomena, like earthquakes or droughts, can change the properties or the flow of sources, causing them to be spoiled and impeding them being sold to the public. Historically, some mineral water bottlers that had chosen to bottle water from a spring which was not located in an environmentally adequate area were forced to close their business due to the difficulties they encountered. However, together with its negative characteristics, physical features can give mineral water its distinctive and unique properties which render it as a commodity. Therefore, if the selected spring from which to bottle water has the positive physical characteristics described in this chapter and lacks the negative ones half of the success if guaranteed. The other half has to be explained by the human conditionings to bottling water.

6. Location of mineral water bottlers in Catalonia, human conditionings

Introduction

As it has been explained in the previous chapter the geological conditionings needed to bottle mineral water have remained, apart from punctual exceptions, quite stable through time. Therefore, the start of the production, distribution and consumption of bottle water from mid-19th century onwards was not due to a change in the geological conditionings, but due to technical and cultural reasons. Some of these have already been explored: unreliable and potentially lethal public distribution systems, appropriate containers or the comeback of hydrotherapeutic procedures created the demand and the means of production necessary to generate a growing market. However, these factors do not fully explain why, from the wide choice of suitable sources producers had to bottle water from, they chose the ones they did. In this chapter, the human conditionings to the location of mineral water bottling plants in Catalonia until the 1930s are explained.

6.1 An entrepreneur

Albeit not a geographical conditioning, the first human requirement to commercialise water from a mineral source is an entrepreneur that becomes interested in selling and distributing a certain water to obtain a benefit. The first people who tried selling mineral water outside the spring's town were mainly of two types, doctors and landowners. However, in many cases they started joint ventures which would benefit both parts.

The fact that physicians became the first ones to see that a business could be made by selling water is not casual. Since the year 1816 the law stated that all bathhouses should have a "médico balneario", a doctor who would take care of the clientele by advising them about which treatment should they follow when using the waters of the spa (Rodríguez Sánchez 2010). Even if doctors based in spa houses had the duty of taking care of the wellbeing of their patients, they had no specific formation to do so as the only requirement they had was to pass a competition exam or being the doctor of a bathhouse for six consecutive years (Rodríguez Sánchez 1993). Physicians based in bathhouses gained their expertise in water treatment by a process of learning by doing, where they applied what they had learned during their degree to the environment they were working at. It was not until the year 1912, when a Medical Hydrology Chair was established at the Central University of Madrid, that bathhouse doctors were able to obtain a regulated formation (Rodríguez Sánchez 2010).

It was notorious that while doctors based in some of the most popular bathhouses had a decent salary and could live well, doctors who had the misfortune of ending up in less popular establishments did not have much income. Since physicians could choose which spa they attended depending on their seniority, it was not strange for young doctors to stay in an unpopular spa for a short time before moving to better locations where they could make a better living (Rodríguez Sánchez 2010). The movement between different types of establishments, together with the experience gained by dealing with water based treatments on a daily basis, gave those doctors a great deal of expertise and an insider knowledge of the needs their patients had once they left the spa. It was therefore not strange that when patients started asking to continue their treatments at home by having water shipped to their homes, spa doctors were the first ones to see an opportunity to increase the bathhouse revenue and popularity. This way, when a patient was forced to interrupt the treatment, the doctor could prescribe the consumption of water transported from the spa to the location where the client lived. Also, people who were too ill to go to the spa town could take advantage of the treatment using mineral water which was transported to their house.

Some spas tried to discourage the use of bottled water at home while at the same time they offered it as a service. This apparent paradox can be explained because of monetary reasons; spas made more revenue if people went to the spa, but did not want to lose the potential profit they could make by selling bottled water. A customer doing a standard treatment at the spa was a big source of revenue as the usual isolation of spas meant that they had to sleep, eat, shop and buy entertainment at the bathhouse or within the spa town, which meant that both the spa and the village benefited from the patients. Furthermore, many times the family and maids of the patients visited the spa as well, even if they did not require a treatment (Chambers 2002), which increased even more the amount of money generated by thermal establishments. On the other hand, selling water to patients, even if it was a profitable business, meant losing large amounts of income as it was a much cheaper way of being treated, but it was a profit that bathhouse owners did not want to miss.

An example of the paradoxical discouragement towards drinking spa water at home and the offering of it at the same time can be found in a brochure from the Panticosa bathhouse, located in the Aragonese Pyrenees near the border with Catalonia: "*Undoubtfully, the water from Panticosa gives the best results when drunk directly at the source (...) because all the gas remains within the water and it continues at an adequate temperature. However, if the patient is unable to attend the bathhouse (...) the water from Panticosa is delivered in boxes anywhere in Spain"* (Balneario de Panticosa 192?). From this text it is clear that the bathhouse was encouraging patients to go to their town to have a better treatment, while at the same time they offered an alternative to those not willing to do the trip there. A second example of the same pattern can be found in Galicia with a medical brochure from the historic spa of Cabreiroá: *"Tradition says that the* *therapeutic effect of our waters is greater if they are ingested at the source. However, the difference is not excessive, and given that many patients are incapable of coming to the spring, the domestic treatment* [with bottled water] *has the purpose of achieving the effect obtained at the spa or to reinforce other treatments."* (Murillo 1910). Again, the brochure stresses that the best option is to obtain the water directly from the source –i.e. doing a standard full board treatment-, but in case of necessity bottled water was readily available.

The links between bottled water consumers and spas were great during the starting stages of the trade, before bottled water became a commodity and it started being sold as table water. The strong bond between thermal water and medicine, and therefore physicians, was quite evident. Mineral waters with therapeutic component –mineral-medical waters- were mainly sold at pharmacies and prescribed by doctors. For example, water from Vichy Catalán, nowadays readily available at any Catalan supermarket, was exclusively sold at chemists during the first half of the 20th century (Piernas 2009). Bathhouses and their physicians tried to assure a preeminent role in the commercialisation of their water and to maintain a control in all the stages of the distribution process. For instance, in a report written by the Quinto bathhouse (Aragón), the importance the doctor had in the distribution of bottled water is well documented. It explained that bathhouse doctors issued a certificate which stated the name of the transporter, the amount of water, the destination and final price of each shipment (Balneario de Quinto (Zaragoza), Viñolas y Borrell et al. 1854). The purpose of this control was to avoid the increase of the price or the loss of produce during the transportation process. Therefore, it was the doctor who was in charge of prescribing mineral water to patients who were not able to stay at the spa, but he was the responsible of the commercialisation stages as well.

Seeing that the bottled water business could be profitable, it is not extraordinary that other doctors, which did not have links to bathhouses, tried to obtain a profit by opening new spas or by selling mineral water. There are many examples of doctors who, either by intuition or by chance, found a source of mineral water and started exploiting it either as a spa or just as a merchandise. Perhaps the most preeminent case is Dr. Modest Furest (1852-1939), the founder of Vichy Catalán in Caldes de Malavella. He was a physician who was interested in homeopathy and hydrotherapy and knew about the medicinal importance of the waters from Caldes de Malavella (Ferrer i Santaló, Gay 2003). In 1880 he purchased the Puig de les Ànimes, a small hill which had the remains of Roman baths and some associated springs (Llinàs i Pol, Merino 1991). Once the water was analysed and it had been proven that it was therapeutical, Dr. Furest applied for it to be declared as of public utility, which was granted by the central government in the year 1883. Six years later he started selling it bottled and in the year 1904 an associated bathhouse designed by the architect Gaietà Buïgas was completed (Ferrer i Santaló, Gay 2003).

Doctors not linked to spas, however, were not always as determined to find springs in order to make a business as Dr. Furest, sometimes it was the owner of a patch of land where a source was located who got them involved. Physicians were highly regarded in rural areas of Catalonia as they had a higher level of education than most villagers did, so if thermal water was found it was not strange that the discoverer would ask the doctor for advice. Usually, the doctor would take a sample of water and analyse it. If the water turned out to be potable and if it had the necessary components to classify it as medicinal, doctors would then act accordingly. Some doctors, as is the case of Dr. Bayés in Tona and the Ullastres bathhouse in 1876, created a joint business with the owner of the land to monetise the waters (Pladevall i Font 1989). In this case, the owner of the land discovered the spring and after contacting Dr. Bayés –the village physician- for advice, they decided to start the bathhouse and posteriorly sell the water bottled. Other doctors, like Dr. Llorach, after being told by a shepherd that the waters of a stream had laxative properties, analysed the waters and observed that the waters could be sold as a purgative. In this case, Dr. Llorach bought the land where the laxative source originated and afterwards opened the Rubinat-Llorach mineral water bottling plant, not sharing his discovery with the previous owner of the land (Puig, Mora et al. 2008).

As the Dr. Llorach example shows, the duality between encouraging customers to go take the waters at the spa and selling the same water in a bottled format were patients lived was obviously exclusive of those bottled brands which had emerged as a by-product of thermalism. Brands originated *ad hoc* to commercialise the water which emanated from a spring did not have such issues, they uniquely wanted to sell as many bottles as possible.

Some entrepreneurs did not have a link to bathhouses, but took advantage of them by looking for alternative sources located within spa towns. A good example is the case of water San Narciso, from Caldes de Malavella, where the family Pla i Deniel, owners of a thermal spring located very close to the old Roman bathhouse and the Prats spa, bottled and sold their water in 1870 (Ferrer i Santaló, Gay 2003).

With the change of model from mineral-medical waters to table water shortly after the turn of the 20th century the importance of the doctor decreased and anybody with the necessary capital and initiative could open a water bottling plant. However, the need to become trustworthy to the clientele meant that the link to spa towns was not always completely lost. For example, water Imperial –started in 1902 in Caldes de Malavella- was created by an industrialist who acquired the rights to sell its water bottled. He chose to display on their labels a drawing of the Roman bathhouse (Figure 6.1) which was located near the source (Ferrer i Santaló, Gay 2003). A similar case occurred with water Fournier in La Garriga, a traditional spa town.

Figure 6.1. Agua Imperial advertisement with the Roman baths depicted in the middle.
Source: Unknown author. Obtained from a collector's advertisement.

When bottled water became a commodity commonly consumed by many costumers, many entrepreneurs started bottling water from sources with no links to medicinal water.

A notorious example is water Sarva, obtained in the renowned Park Güell in Barcelona. Designed by Antoni Gaudí, the park was intended to become a high class urbanisation, but it was unsuccessful and almost no plots were bought. Eusebi Güell, the promoter of the urbanisation, tried to cut the losses the project had incurred in by, in the year 1914, bottling one of the sources which could be found within the park (Kent, Prindle 1992). Therefore, at that time there was no link between a doctor or a spa tradition and the production of water; it was regarded uniquely as a commodity.

Many other industrialists opened their mineral water bottling plants in places not linked to bathhouses. Up to nine springs located in the city of Barcelona were industrially used to bottle water, and towns with no spa tradition like Madremanya, Sant Climent Sescebes, Sant Daniel or Sant Fost de Campsentelles held bottling water businesses. A trend can therefore be established; the initial stages of mineral water bottling were led by people related to sanitary professions and as time went by the influence of those professionals decreased. It should however not be inferred from this trend that doctors totally lost their significance, as many spas which had not distributed their water outside their premises did so during the first thirty years of the 20th century. Examples of this are the aforementioned Ullastres spa or the Montagut bathhouse in Ribes de Freser[73].

To sum up, during the starting stages of the bottled water trade, doctors, by themselves or together with land owners or capitalists, were fundamental to the popularisation of the business. However, as bottled water became progressively popular, other individuals became interested in starting a mineral water brand. It was then, when bottled water was consumed as a commodity and not as a therapeutic measure, that doctors lost some of their influence and industrialists started most water bottling businesses.

[73] Even if administratively part of the town of Campelles, the waters from the Montagut bathhouse have been traditionally considered as part of the town of Ribes de Freser. Even the spa's train station was called "Aigües de Ribes". The modern bottling plant however, although located very close by the old bath house, it is legally located in the town of Ribes de Freser (Enciclopèdia Catalana 2012).

6.2 Production and consumption centres

6.2.1 Production centres

One of the biggest limitations the sale of mineral water had, when compared to other businesses, was that the production plant was attached to a source, greatly limiting the geographic mobility enterprises had. Chemical compositions, levels of carbonation or emerging temperatures, are some of the properties which give mineral water its flavour, and they vary from source to source. The attachment each brand has to its source means that once production has started, the enterprise cannot be moved to another place even if commercial conditions change. The only option is to close the factory and look for a new source.

However, as it has already been explained, Catalonia has thousands of sources which could be potentially be used as the source of a mineral water bottling business. The location of those springs, even if not evenly distributed across the country, is spread enough to allow a certain level of choice to those looking for a new source of revenue. It was therefore of paramount importance for those interested in starting a mineral water bottling plant to search for an adequate spring which, apart from having and adequate flow and favourable organoleptic properties, was in a location which suited the logistic needs of the factory.

Those who linked the production of bottled mineral water to an existing bathhouse had no option but to stick to the place the spa was located at. This was a serious limitation which was partially compensated by the prestige given to the brand by the bathhouse's reputation, as they were usually well known across the country. However, some spas were just too isolated from consumption centres to be considered as an option to produce bottled mineral water. As figure 6.2 shows, bathhouses which chose to bottle and sell their mineral water were located not very close but not too far from their nearest province capital –usually the largest city in the province. Most spas which chose to sell their water were between 20 and 60kms from the province capital, a distance which meant that they were far enough from cities to guarantee the quality of their waters but close enough to compensate the cost of transporting the water to the consumption centres. The only two spas which were further away from the aforementioned distance were the “Balneari del Porcar”, which was very close to its main market, the city of Tortosa (Montserrat y Archs 1889, Mitjà i Sarvisé, Associació Balneària et al. 1999) and the “Balneri Montagut”, which started selling water towards the end of the study period -1928- when a railway stop was established at the bathhouse (Mitjà i Sarvisé, Associació Balneària et al. 1999). On the other hand, spas which were located over 100kms away from a capital city did not decide to sell their water in a bottled manner. It should also be noted that apart from being far away they did not have any railway connection to cities.

It can therefore be argued that the distance from a spa to the nearest consumption centre was a decisive factor when the owners of the bathhouse had to choose whether starting a bottling business or not. Those spas which were within a reasonable distance to consumption centres, or had good connections to them, mainly chose to sell their water bottled, while those which were not well connected or very far away from major cities had to opt out and concentrate in their bathing business.

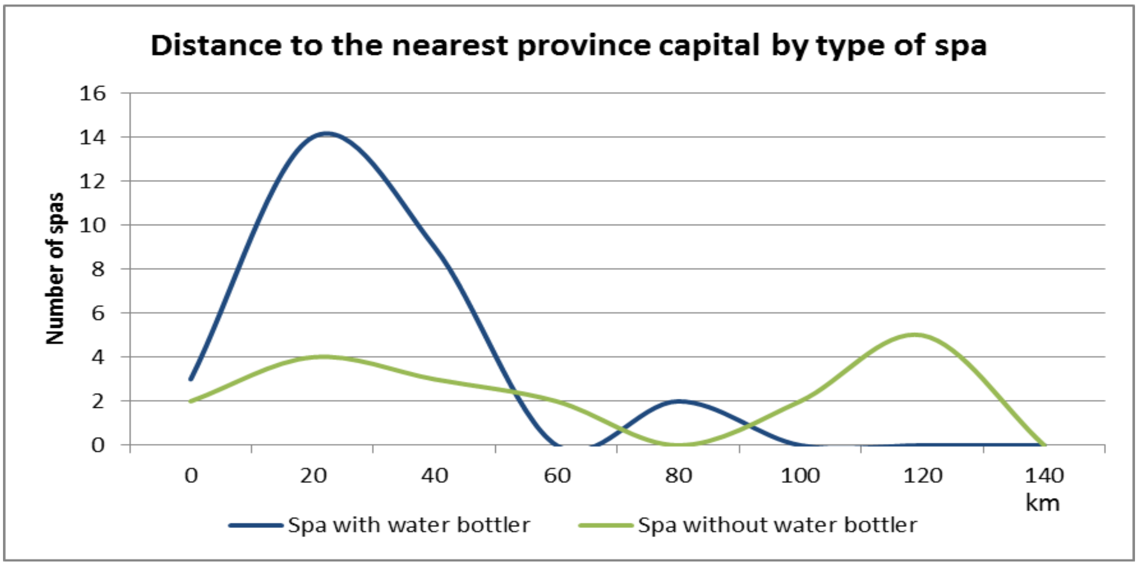


Figure 6.2. Distance to the nearest province capital by type of spa.
Source: Author’s work. Mineral water producers data: (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Bathhouses data: (Taboada, Carretero y Muriel 1898, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999)

Entrepreneurs who instead of linking their mineral water bottling business to a bathhouse elected to start a bottling business from scratch had much more flexibility when choosing which spring they used to fill their bottles. Obviously, they were not limited to the existing spa towns' locations, so they could choose which sources they used based strictly in economic criteria. One of the biggest burdens when establishing the cost of bottled water was the cost of transportation, so it is not strange that they tried to choose sources which, apart from having adequate organoleptic properties, had minimal transportation costs. This meant that newly created plants had the opportunity to locate their businesses as close to population centres as pollution and availability of sources allowed. Figure 6.3 shows that while most brands linked to a spa town were located at a certain distance from province capitals, those which were independent decided to locate their new businesses within 20kms from cities and none chose to locate their plants further away than 60kms.

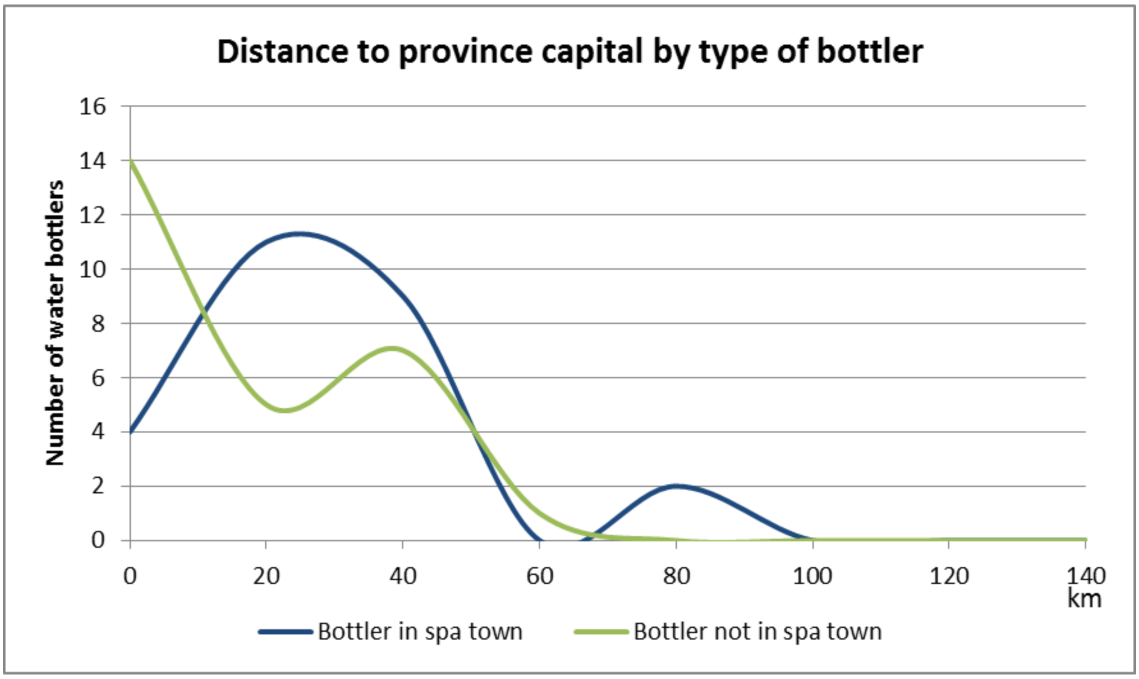


Figure 6.3. Distance to province capital by type of mineral water bottler.
Source: Author's work. Mineral water producers data: (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Bathhouses data: (Taboada, Carretero y Muriel 1898, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999)

If a geographical approach is chosen (Figure 6.4), all the differences between the location of spas and water bottlers become even more apparent. Those spas which were located far away from province capitals or that were no correctly linked with the railway system chose not to sell their water bottled before 1930. There are however some exceptions where spas which were adequately located to bottle their water did not do it, but they can be explained. For example like the Alcarràs bathhouse, which was very close to Lleida, closed its doors before bottled water business was mainstream (Mitjà i Sarvisé, Associació Balneària et al. 1999). In the case of the Font Santa bathhouse in Sant Pere de Torelló, it was a small spa (Mitjà i Sarvisé, Associació Balneària et al. 1999), which may have lacked the necessary capital to initiate the necessary investment needed to start a bottling business. The case of the Selva shire can be considered an exception as well since it was relatively badly connected to the railway network and was quite far away from the closest province capital. However, mineral water from this shire is highly regarded and nowadays is the largest producer of mineral water in Spain (Baeza Rodríguez-Caro, López Geta et al. 2001). Also, it is halfway between Girona and Barcelona, so it could sell its produce to both cities. Finally, there were roads linking those towns to the main railway network, as it will be explained later on.

It is therefore clear that an easy way of lowering the cost of transporting water from the bottling plant to the main consumption centres –i.e. cities- was to exploit local springs. This strategy, valid during the early stages of the industry, suffered from many drawbacks since the risk of having a spring affected by agricultural, industrial or domestic pollution increased with the closeness to densely populated places. It can consequently be stated that deciding to place a mineral water bottling plant near a city was a risky business. Therefore, companies that chose to place their bottling factories within or very near cities should have steadily struggled to keep the business running as cities grew and pollution expanded to previously clean areas. However, finding out how long bottling water industries lasted is not an easy task. Knowing the start date of most primogenital mineral water bottling companies is very difficult as many historical records have been lost in the mist of time. Knowing when they ceased their activity however, is in many cases close to impossible since only fragmented information about them has been found. This is why obtaining information that proves that enterprises closer to cities had shorter exploitation periods is not an easy task. Nevertheless, a proxy can be achieved by checking the location of companies which have remained in business since the beginning stages of the mineral water bottling trade and comparing them to those which having started around the same time succumbed and had to stop their business altogether.

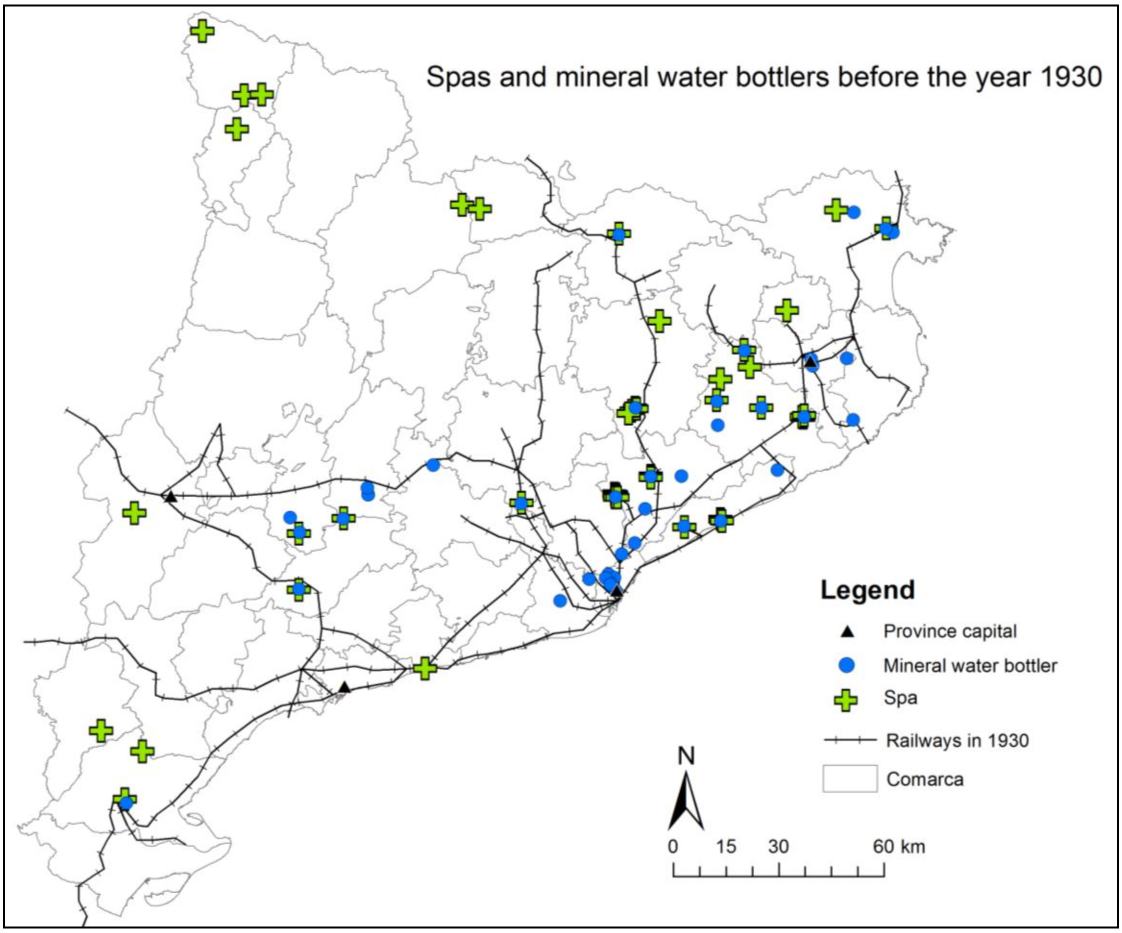


Figure 6.4. Distance to province capital by type of mineral water bottler.
Source: Author's work. Mineral water producers data: (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Bathhouses data: (Taboada, Carretero y Muriel 1898, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999) Railway data: (Font i Garolera, Majoral i Moliné et al. 1993)

Of the 49 springs that have been found to have a bottling plant associated to them before 1930[74], only nine are still functioning as mineral water bottling plants, while 40 have ceased their bottling activity. All nine plants still in production are quite far away from cities -especially Barcelona-. On the other hand, sources located very close to cities have not succeeded in maintaining their businesses open as easily. The fact that sources closer to province capitals –i.e. densely populated areas- have had a higher closure rates than those located far away from highly populated areas means that the distance to large human concentrations was an important factor when deciding to locate a mineral water plant but eventually became a setback. The result has been that of all the sources which had their water bottled and sold before 1930, only those located further away than 50 km in Lleida, 16 km in Girona, 48 km in Tarragona and 62 km in Barcelona have remained open though the 20th century. As it was mentioned in the previous chapter, Barcelona's case is quite paradigmatic since out of 23 sources located within 60 km from the city none of them has remained in business (Figure 6.5).

Even if this pattern could lead to thinking that sources became progressively distanced from major population centres, historical records show otherwise. Indeed, if the period 1840 – 1930 is observed in a detailed manner, the average distance to the nearest large town[75] or to Barcelona randomly fluctuated throughout the period (Table 6.1). If entrepreneurs had based their location when starting their bottling business in not getting too close to pollution centres, table 6.1 should show a progressive increase in the average distance to Barcelona or large cities. However, throughout the period bottling plants were located on average 20kms away from cities which had over 15,000 inhabitants. The case of the average distance to Barcelona is even more contradictory, as between the period 1911-1930 new bottling plants were established even closer to the city. This apparent contradiction can be explained because between 1911-1930 the bottled water rush occurred, so many new bottlers were established and since they wanted to make as much money as they could with the smallest investment they chose their springs as close to Barcelona as possible. This behaviour is well known by economists. When an economic sector is blossoming, many new enterprises try to take advantage of it and open their

[74] In total, 52 bottlers have been found but the location of only 49 is known.
[75] For the purposes of this research, it has been considered that large towns are those with more than 15,000 inhabitants

businesses as a means of making easy money. However, when the economic boom stops they are the first ones to close their companies (Hortalà i Arau 1996). It can therefore be inferred that between 1840 and 1930, unlike nowadays, bottlers did not choose a specific location based on the environmental reasons, only economical.

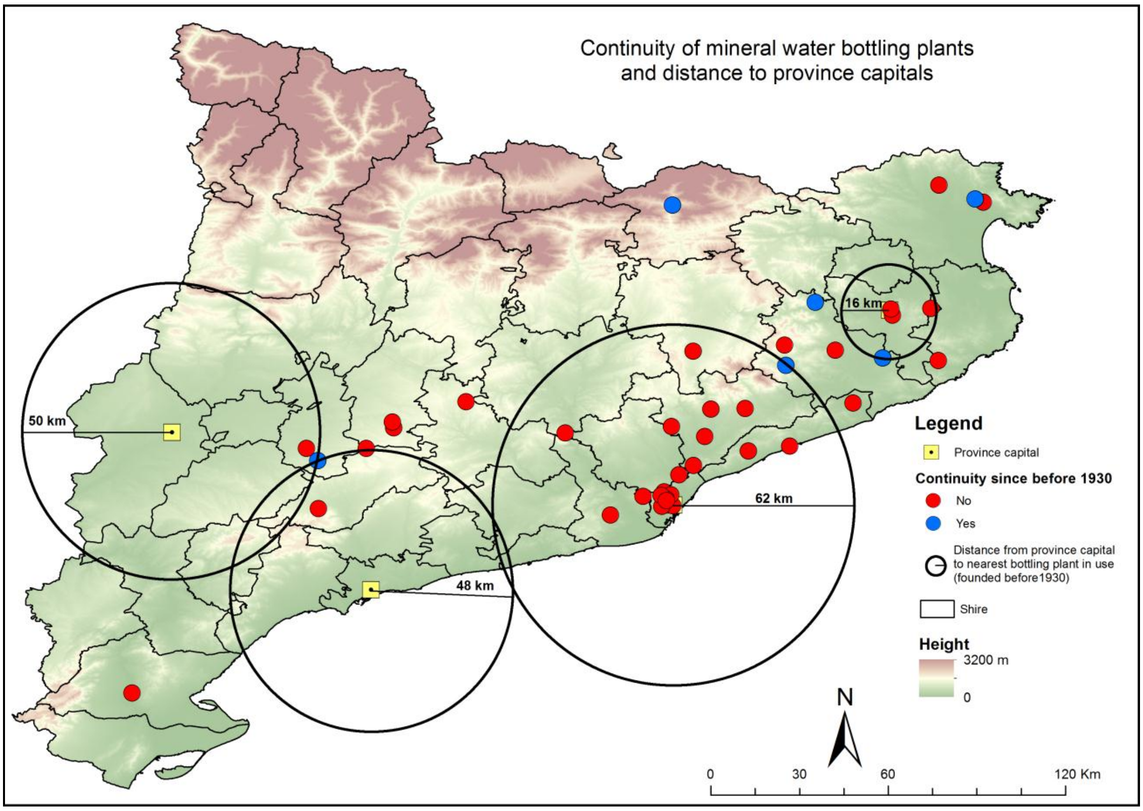


Figure 6.5. Continuity of mineral water bottling plants and distance to province capitals.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002); (European Union 2010)

Table 6.1. Distance of newly created mineral water bottling plants to the nearest city and Barcelona

		Distance to (km)	
Year	New bottlers	Nearest city >15000	Barcelona
Before 1887	3	14.9	61.3
1878-1887	6	21.8	71.4
1888-1900	6	23.4	61
1901-1910	16	19.8	61.6
1911-1920	11	19.3	39.6
1921-1930	7	18.7	47.8
2010	26	20.2	81.3

Source: Author's work from Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002); (European Union 2010). Population data from: (IDESCAT 2012a)

Another argument which can be extrapolated from table 6.1 is that those companies which were created too close to human concentrations to cut in transportation costs were especially sensible to changes in the environmental and economic situation of the bottled water business. This is why when the bottled water craze finished during the Second Spanish Republic and the Spanish Civil War, all of them struggled to continue their business and eventually had to close down. On the other hand, those companies which were located further away, and were linked to traditional bathhouses or had been created not as an easy way of making money, but as a planned and serious business, were more likely to continue operating throughout the sector's downturn. This can be observed in table 6.2, which shows the average distance to population centres of bottling plants which have been operating since before 1930 and those which having started at the same time stopped their activity. Those companies which have been able to continue their production until nowadays were located, on average, further away from population centres. Even if companies can go bust by a myriad of reasons, it is significant that only those located at a further distance from large conurbations were able to continue with their production of bottled mineral water.

Table 6.2. Distance of newly created mineral water bottling plants before 1930 to the nearest city and Barcelona

		Distance to nearest (km)		
Bottling plant status	**N**	**city >15000 (1930)**	**Province capital**	**Barcelona**
Still in business	**9**	26	36	83
Closed	**40**	13	27	50
Difference		13	9	33

Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Population data from: (IDESCAT 2012a)

The big difference in the success rate of bottling plants depending on the distance to Barcelona and its surrounding area is particularly relevant, as it is the largest Catalan conurbation by a big margin, currently representing 63.56% of the Catalan population ((IDESCAT 2012d, IDESCAT 2012b)). The growth of the city, both in population and extension, helped many nearby businesses as they had a larger market and their transport costs were lower than those of enterprises further away. However, bottled mineral water, due to its particularity of being linked to natural springs, suffered from this growth. Water sources within Barcelona's vicinity were put under ecological strain, something that not even lower transport costs could compensate. It was therefore only those sources located at a prudential distance -in the Barcelona case over 60kms- the ones which could continue bottling their water.

If a geographic approach is used (Figure 6.6), differences between the locations chosen by pioneer water bottlers and current producers can easily be observed. The first producers –those that started their mineral water bottling businesses before 1930- mainly located their factories very close to Barcelona or along the communication lines between Barcelona and Girona and between Barcelona and Lleida. The only exceptions are the aforementioned waters from Ribes de Freser and Tortosa. On the other hand, current mineral water bottlers are mainly located in the Catalanid mountain system, predominantly at the Montseny-Guilleries mountain range. There are also minor producers near the fringe of the Central Depression, but the main difference with previous producers is that nowadays mineral water bottlers can be found deep in the

Pyrenees, something that would have been unthinkable by the industry forerunners. These isolated bottling plants are far away from population centres and still do not have rail connections with them, so they contravene what earlier bottlers looked for, closeness to cities and/or good communication networks to them. The change in the location paradigm can be explained because current bottlers have more difficulty looking for adequate springs near population centres, but also by the existence of an adequate road network which lorries can use or the demand by consumers of natural environments near the factories (see chapter 5.3.2).

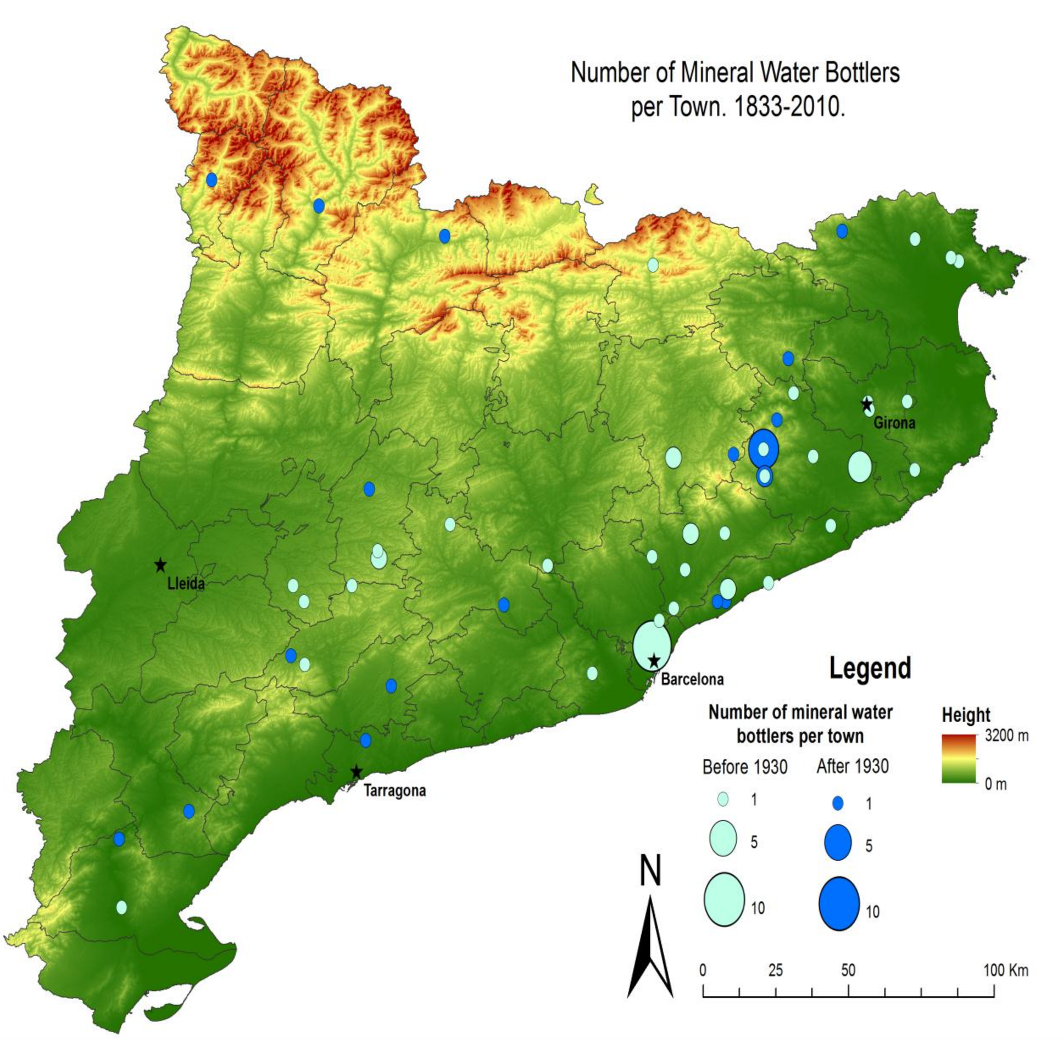


Figure 6.6. Number of mineral water bottlers per town (1833-2010).
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002); (European Union 2010)

6.2.2 Consumption centres

Since mineral water was a product of the zeitgeist, which achieved its highest levels of success between 1900 and 1930 as a way of drinking clean water and as an alternative to other existing drinks, its acceptance was higher in large cities (Marty 2009). It is true that many bathhouses did produce bottled water which was sold in the spa house, its village and neighbouring towns (María Rubio 1853), but its importance was relatively small. As an example of this type of local mineral water commerce, the case of Sant Hilari Sacalm can be explained. This town is relevant to the topic because nowadays is the town which has the largest production of bottled mineral water in Catalonia (Baeza Rodríguez-Caro, López Geta et al. 2001, Asociación Nacional de Empresas de Aguas de Bebida Envasadas 200?), but in the dawn of the bottled water business it had a more marginal role with only one source which was bottled and sold. The town however, had an important spa and a large clientele with some relevant visitors (Mirador 1934) and it blossomed around the bathhouse. Visitors would stay in purpose built homes and hotels and would take strolls around the town as part of their treatment or just as a way of socialising (Blancafort de Rosselló 1974). If they felt thirsty during those walks, a service of water sellers would offer their drinks to those wealthy visitors for some money. Perhaps the most famous water seller was a dumb person known as Jaumet del Flabiol – Little James of the Recorder, as he would use a recorder to make his presence noticed (Serradesanferm, Bosch 2005). Jaumet would fill earthenware containers in one of the many springs the town had (Figure 6.7) and transport them around the town using a little cart bought to him by the town visitors He became a well-known character of the town and after his death has become a local celebrity (Serradesanferm, Bosch 2005). As it can be observed, the importance these types of water distribution businesses were anecdotic at a macro level, so for the purposes of this thesis this type of bottled water commerce will be set aside.

Figure 6.7. Jaumet filling a container with spring water.
Source: (Unknown author 2012)

Large scale mineral water business needed a minimum amount of consumers to make the trade profitable, but also large cities had the biggest problems when it came to obtaining clean mineral water, so they became the largest markets for mineral water producers. This meant that long haul mineral water transport in Spain was mainly destined to larger cities, especially Barcelona and Madrid. As an example of their importance, only those two cities had water depots specialised in importing foreign mineral water (Marty 2009).

Historically, Barcelona and its surrounding municipalities have represented a large proportion of the total Catalan population, but it was the in the years between the beginning of the studied period and nowadays, that the percentage of population living in Barcelona's Metropolitan Area (BMA) grew spectacularly (Table 6.3). This increase in inhabitants meant that by the end of the studied period over half of the Catalan population lived in the area (IDESCAT 2012c, IDESCAT 2012e). As a consequence of this rise, a very large market was available to industrialists, but it also meant that population density rose, a fact that put the existing water services under strain. Both factors were ideal for mineral water sellers since a large demand existed and they could save money when distributing their produce, as by only selling to the BMA they could make a profit.

Table 6.3. Evolution of the weight of the BMA's population within Catalonia.

	Population		Relative Population Weight of the BMA within Catalonia	
Year	**BMA**	**Catalonia**	**%**	**1860=100**
1860	532,342	1,673,842	31.80	100
1887	718,143	1,843,549	38.95	122
1900	866,173	1,966,382	44.05	139
1920	1,131,147	2,344,719	48.24	152
1930	1,556,808	2,791,292	55.77	175
1940	1,681,826	2,890,974	58.18	183
1950	1,966,291	3,240,313	60.68	191
1960	2,566,733	3,925,779	65.38	206
1970	3,579,072	5,122,567	69.87	220
1981	4,236,047	5,959,530	71.08	223
1991	4,299,790	6,115,759	70.31	221
2001	4,392,393	6,356,889	69.10	217
2011	4,724,146	7,432,830	63.56	200

Source: Author's work from (IDESCAT 2012d, IDESCAT 2012b, IDESCAT 2012c, IDESCAT 2012e)

The existence of such a large and keen market meant that if entrepreneurs had the chance of using a spring which was located near or within the BMA they would choose it over further sources. On the other hand, existing spas or bottling companies had to use freight systems and lacked the flexibility newly created bottlers had. It is therefore not surprising that, as figure 6.8 shows, most mineral water bottlers chose to locate their businesses within or very close by densely populated areas. The concentration of bottlers within the BMA, clearly visible in the figure as the largest conurbation of the country, meant that those factories were taking advantage of their proximity to consumers to increase their profit and sell their product cheaper. The same phenomenon can be observed near other important cities of the country, where bottlers blossomed. Examples of this behaviour can be found in Girona, Vic, Figueres, Tortosa or Mataró. Bottlers which did not follow this pattern were existing spas which could not change their location and had to work with what they had. However, only those bathhouses which were properly linked to the transportation network managed to succeed. Finally, there were bottlers not linked to bathhouses and not near populated places, but they were always well connected to the transportation network.

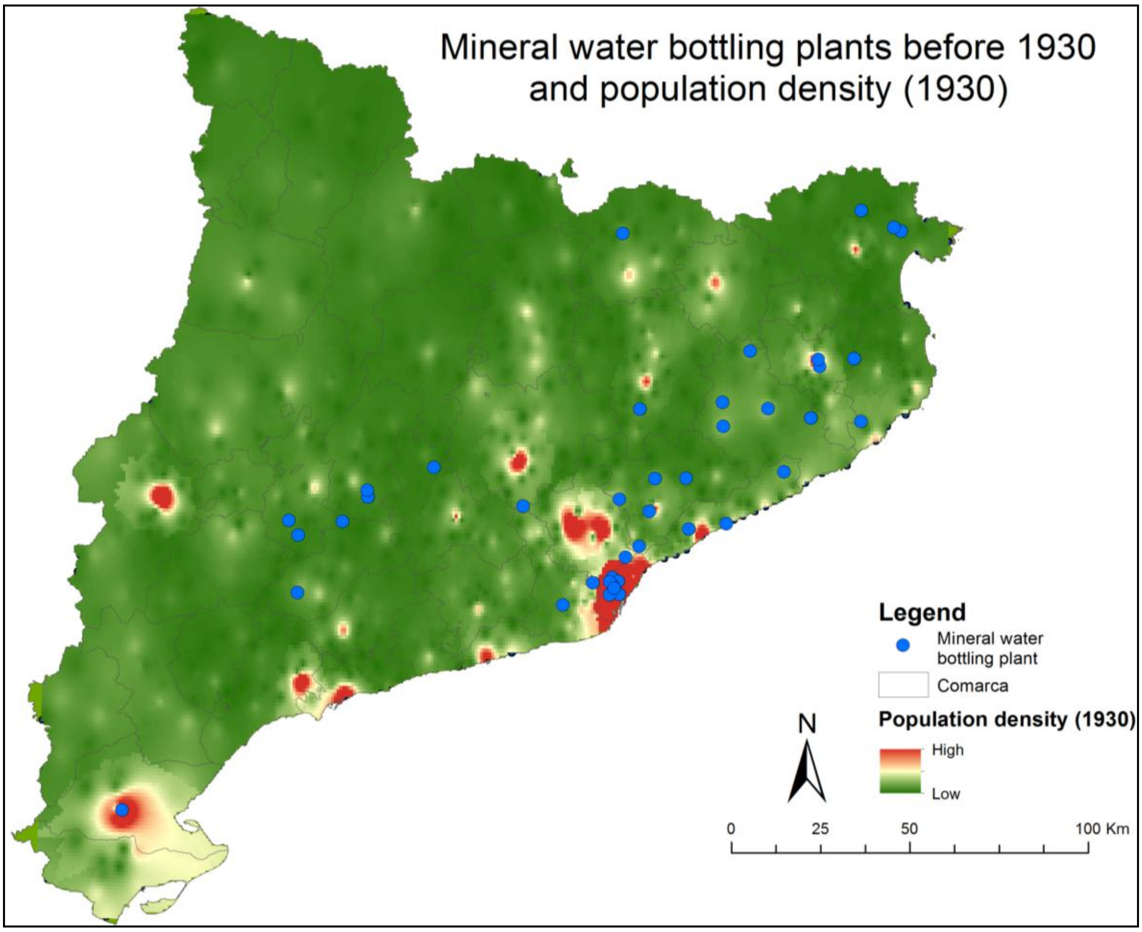


Figure 6.8. Mineral bottling plants (before 1930) and population density (1930). Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Population data from: (IDESCAT 2012c)

Even if a factory can go out of business by a wide variety of reasons, especially if such a long period of time is taken into account, the fact that those closer to larger conurbations were more prone to cease their activity it is quite relevant and consistent with the hypothesis formulated earlier in the thesis in chapter 5.3.1. It is therefore possible to observe that when a populated place grows, bottling plants in its neighbouring area tend to disappear and move further away.

If figure 6.9 is observed, it is clear that currently the location of springs used to fill and ship bottles is radically different to the places pioneers of the sector chose. Almost all the current mineral water bottlers are located in scarcely populated zones. Nowadays bottlers avoid densely populated areas as much as they can, locating their businesses in remote areas like the high Pyrenaic valleys. Successful mineral water bottling plants like Aigua de Boí, Pineo or Veri are located in areas which during the turn of the 20th century nobody would have chosen to start a mineral water company. This aversion to densely populated places is quite spectacular when compared with past trends as only one minor bottler could be considered to be in a densely populated place. The reason why producers of mineral water have behaved this way can be summarised in two reasons, the improvement of the transportation systems, mainly roads and lorries, and the consumers' desire to drink 'natural' water, as explained in chapter 5.3.2.

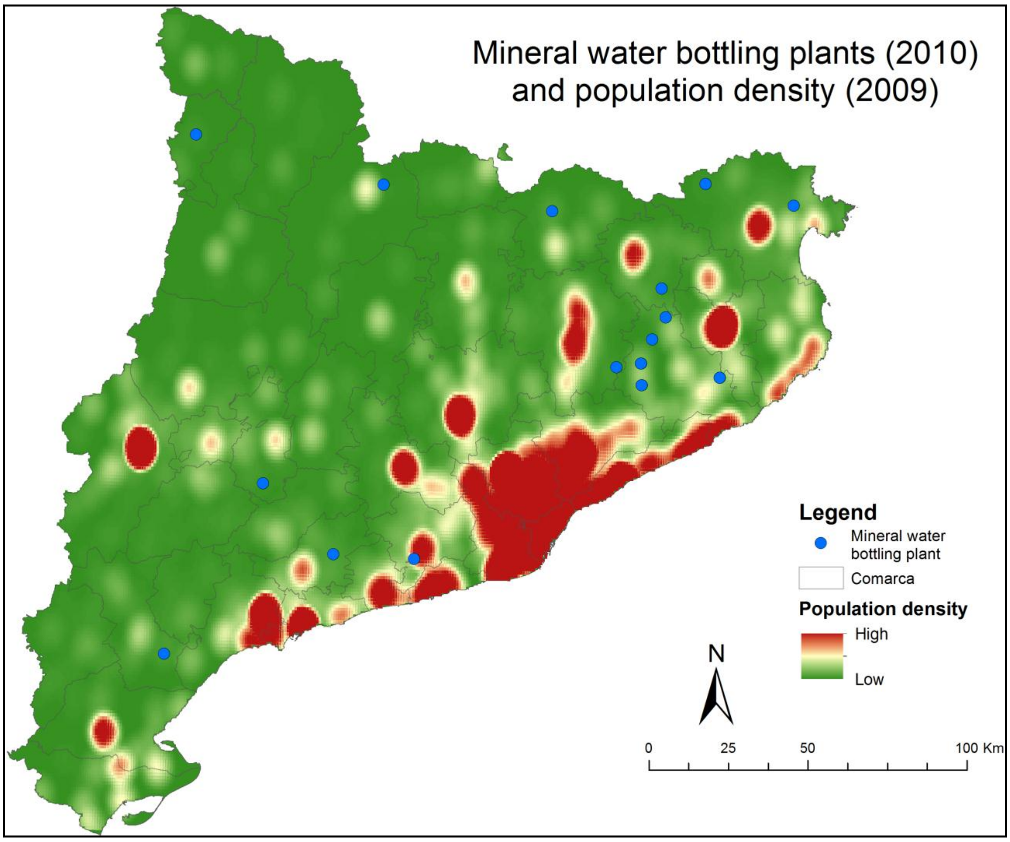


Figure 6.9. Mineral bottling plants (2010) and population density (2009).
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002); (European Union 2010). Population data from: (IDESCAT 2012c).

6.3 Bridging the gap

Two trends regarding mineral water bottlers can be inferred from what has been explained up to this point. On one hand those spas which were located within a certain distance to population centres and with adequate transportation links were able to start their bottling plants if an entrepreneur –who could be a doctor, the spa owner or an outsider-, chose to invest in it. On the other hand, new mineral water brands chose to locate their new businesses as close to population centres or transportations systems as possible. This meant that, even if mineral water is a not flexible location-wise, production centres were highly interrelated to consumption places either by proximity or transportation.

Those sources located near populated places, even if more sensible to changes in water quality, had the advantage that transporting the water to consumers was fast and cheap. However, the first bottlers of mineral water appeared in spas located at quite a distance of consumption centres and it was not until several decades later that newly created bottlers started producing near populated places. Therefore a need to transport mineral water to cities exited from the beginning of the industry. However, bottled water is a heavy item and therefore it is expensive and difficult to transport. One litre of water at four degrees centigrade exactly equals one kilogram (McTigue, Symons et al. 2010), so if the weight of the container used to transport it is taken into account, the final weight of the product was quite heavy. This meant that transporting water from the source to the consumers was an expensive and logistically arduous task which could only be compensated if the costs of transport were covered by the retail price of the final product.

Producers had two options, to sell the water at a very high price, or to try lowering the transportation costs. If mineral water was sold at a very high price, the consumer base able to purchase it would reduce, reducing the potential profit (Hirshleifer, Glazer et al. 2005). Furthermore, high prices would mean that consuming mineral would have a very high opportunity cost, meaning that consumers would chose cheaper alternatives like wine, cider or even boiled water (Mankiw 2012).

It is therefore not surprising that until transportation costs decreased, bottled mineral water was not a popular product sold in cities. The main factor which contributed to decrease transportation costs was a means of transport which became a synonym of the Industrial Revolution, the railway.

6.3.1 Railways

Even if the invention of the railway can be traced back to the Diolkos track way in Ancient Greece (Werner 1997) or to wagon ways powered by human or animal power (Lewis 1970), the invention of the modern mechanically powered railway can be set in the beginning of the 19th century in England (Clapham 1967). The use of steam powered locomotives revolutionised the world of transport by allowing the mass transportation of large amounts of goods and passengers at increased speeds and cheaper prices (Hoole, Simmons 1975).

The first modern Spanish railway was built in 1837 in Cuba several years after it appeared in England, to link la Habana and Bejual (Leza, Muñoz Sebastián 1992). However, it was not until 1848 that the first railway was built in Spain's mainland, more precisely in Catalonia, between Barcelona and Mataró (Pascual i Domènech, Nadal et al. 1999). The introduction of the steam railway in Catalonia helped to improve the transport networks to and lower the cost of moving goods from producers to consumers.

The mineral water industry was not oblivious to the popularisation of the railway and it soon took advantage of the ever-growing network. As figure 6.10 shows, the first three mineral water bottlers were located in towns which had a railway which was directly connected to Barcelona and the closest province capital. This fact is not surprising, as they were able to ship water to both cities by using the new transportations system, something which before was too expensive to make the business profitable. It should be noted that all three bottling companies were linked to spa towns.

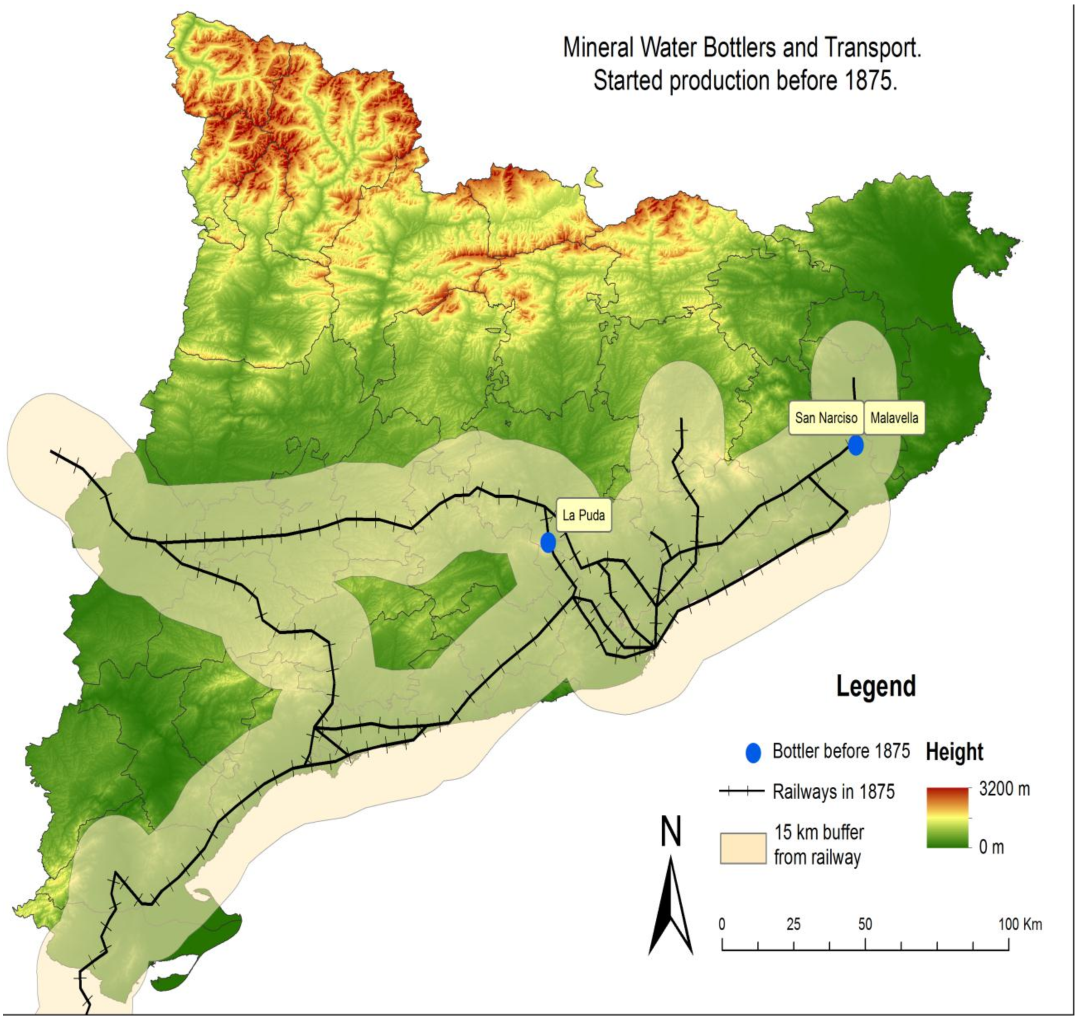


Figure 6.10. Mineral bottling plants and railways before 1875.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Railway data adapted from: (Font i Garolera, Majoral i Moliné et al. 1993)

As the railway network expanded, new bottling companies appeared across the Catalan geography. Between 1875 and 1899 ten companies started producing and shipping mineral water to consumption centres. Most of those companies were linked to spa towns, but a few were companies created ad hoc, like Rubinat. As it can be observed in figure 6.11, only one company, the Font Picant from Sant Hilari Sacalm was not located within 15kms of a railway, while most of them were in towns which had a railway. The case of Sant Hilari can be explained because a regular diligence service linked the town and the Hostalric train station (Torrent i Fàbregas 1981), meaning that even if it increased the cost of the water, it made business possible..

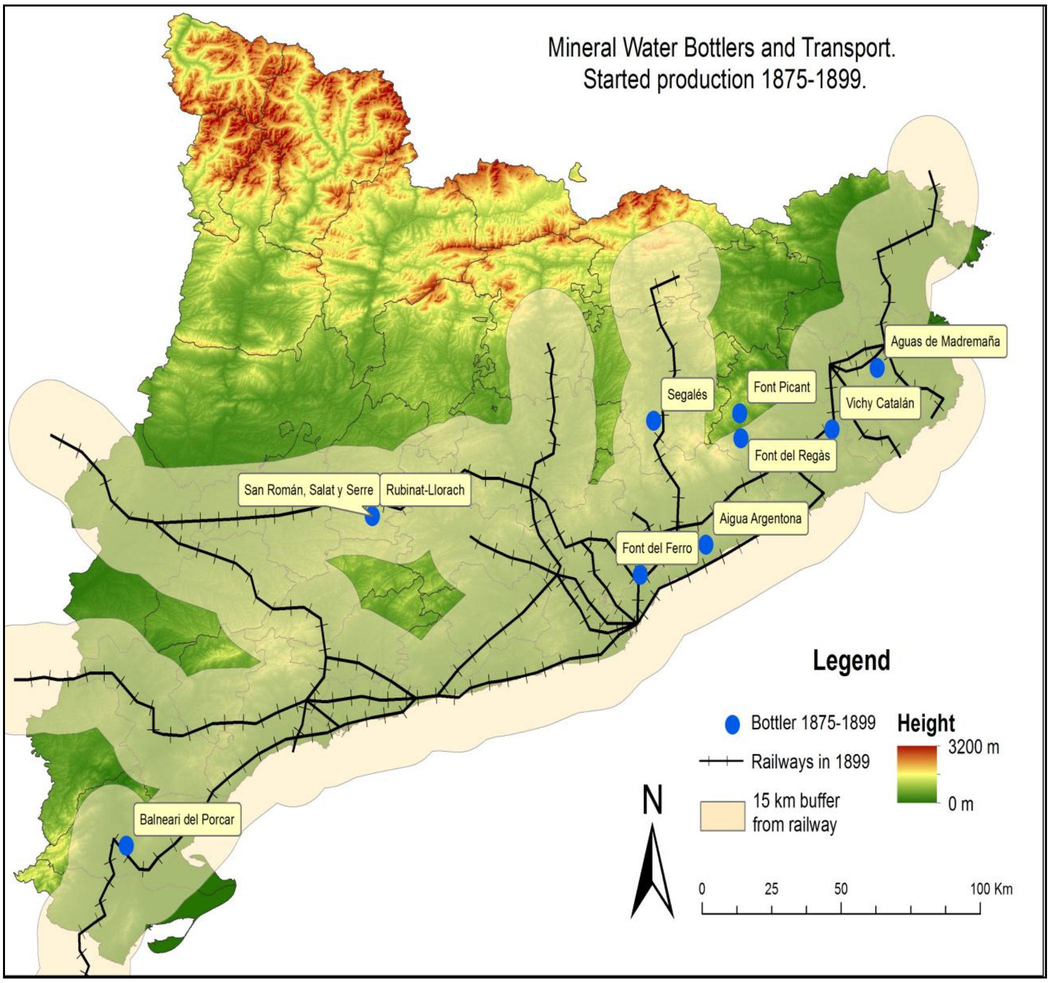


Figure 6.11. Mineral bottling plants and railways between 1875 and 1899.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Railway data adapted from: (Font i Garolera, Majoral i Moliné et al. 1993)

The following decade fifteen water bottling companies started their trade and again most of them chose to locate their plants as near to a railway as possible. It was during this decade, 1900-1909, when mineral water became sold as table water and started being consumed not only by ill people but by everybody as a means of avoiding foul water. It was at this time when mineral water became a commodity and many entrepreneurs tried to obtain a share of the market, so even if many spas started selling their water, a lot of new enterprises were created. The result was that some brands like Agua Fargas, Agua Radial, Miralles and Vila-Roja were located by –or even in- main cities, while others chose their location near railways. Again, only one company, Fonter was located more than 15kms away from a city or a railway station (Figure 6.12). It is also noticeable that thanks to the expansion of the railway system, water from as far away as Vilajuïga could be easily shipped to Girona and Barcelona.

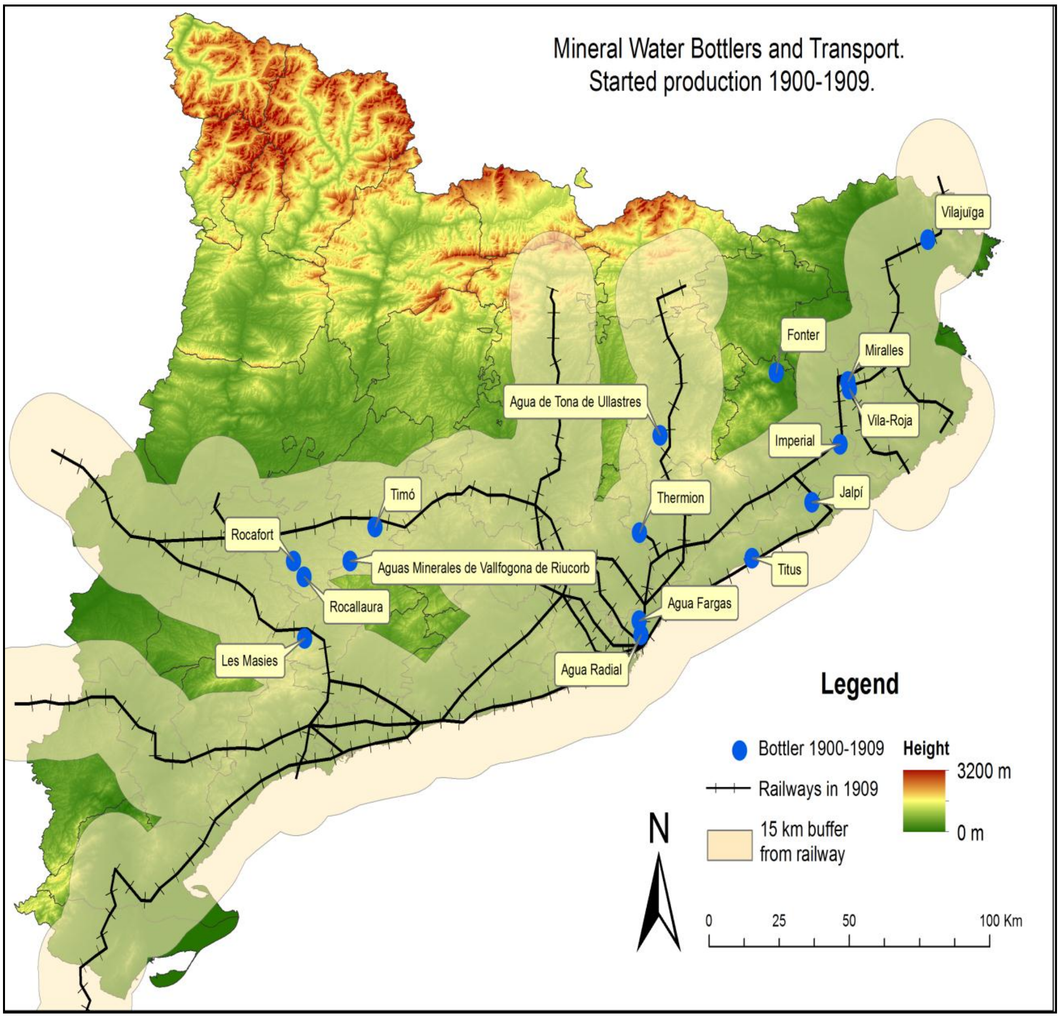


Figure 6.12. Mineral bottling plants and railways between 1900 and 1909.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Railway data adapted from: (Font i Garolera, Majoral i Moliné et al. 1993)

The decade between 1910 and 1919 was when Barcelona suffered one of its most important typhoid fever outbreaks, so mineral water became more than a commodity, it became a necessity. The consequence was that demand for clean water soared and many entrepreneurs saw an opportunity to make easy money. This explains why out of the thirteen new companies of the period, five of them were located within Barcelona's city limits (Figure 6.13). It was during this period when one of the best examples of how the railway influenced the mineral water business occurred. Ribes de Freser had had a bathhouse for decades, but it had not yet sold its water far away from it. However, almost as soon as the railway arrived to the spa –it even had an exclusive station- they started selling their water in Barcelona (La Vanguardia 2012j).

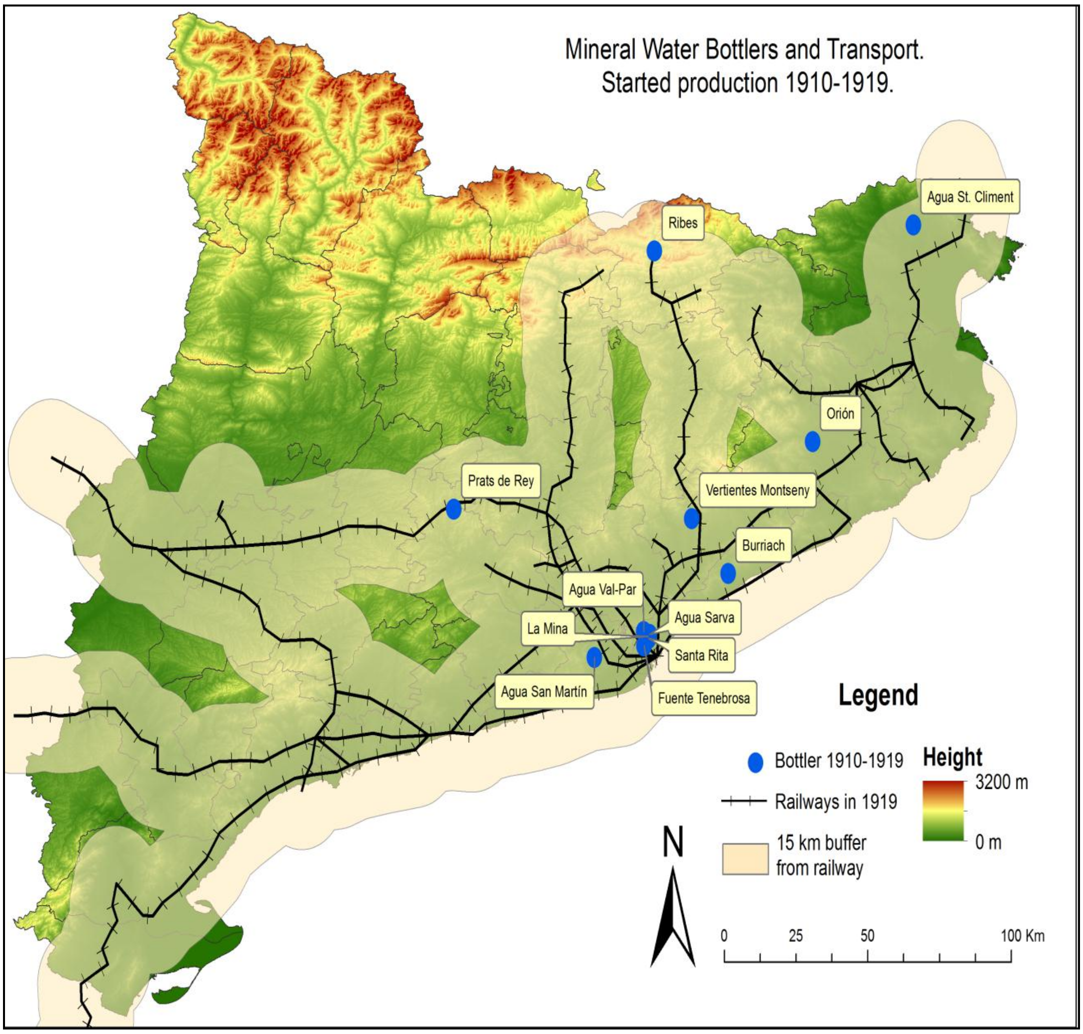


Figure 6.13. Mineral bottling plants and railways between 1910 and 1919.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Railway data adapted from: (Font i Garolera, Majoral i Moliné et al. 1993)

Finally, the last decade encompassed in this study shows the same pattern, with all the newly created mineral water companies located near railways and some of them situated very close to the BMA (figure 6.14).

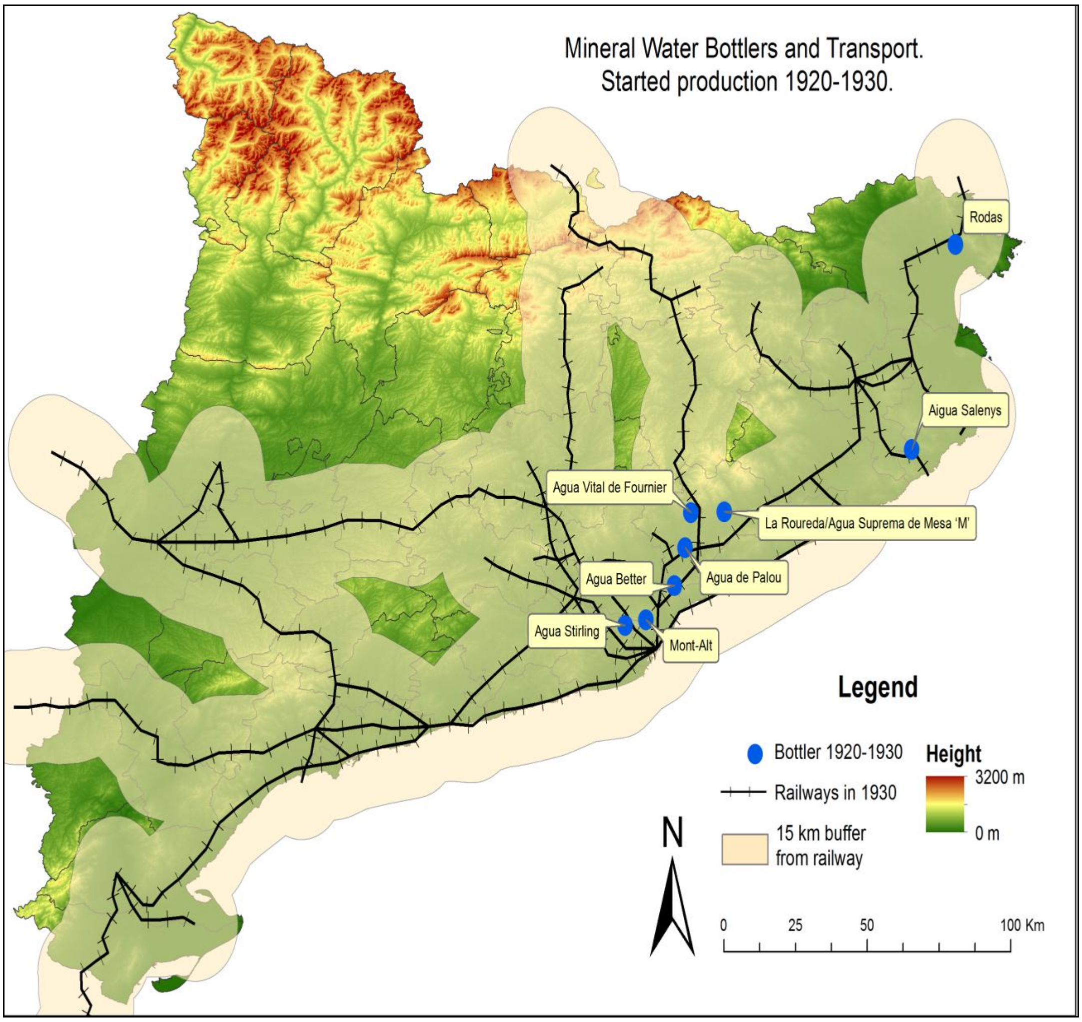


Figure 6.14. Mineral bottling plants and railways between 1920 and 1930.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Railway data adapted from: (Font i Garolera, Majoral i Moliné et al. 1993)

As this series of maps have shown, the expansion of the bottled mineral water business in Catalonia would have not been possible without the invention and popularisation of the railway. The new method of transport allowed a cheap transportation of bottles of water into cities and the return of the empty casks back to the bottling plant, allowing the first companies to sell the water from bathhouses in cities. This first commerce permitted the popularisation of bottled water in cities, so when epidemics stroke, people knew that the product existed and chose it as a means of drinking safe water. Even if it is impossible to know, if spas had not been able to transport cheaper mineral water to cities before the turn of the 20th century thanks to the railway, it is unlikely that mineral water would have been so popular during epidemics.

The transport of water in trains took water from the source and shipped it to pharmacies and water depots spread across the city. The water could be transported already bottled or in large containers which once arrived to their destinations were used to fill individual bottles. Those brands which were bottled at the source where regarded as of being of higher quality because since glass is an inorganic material it does not react with water (Figure 6.15). Brands which chose to sell bulk water and were bottled at the selling place usually used wooden barrels, something which was criticised because since wood is an organic material it could pollute the water[76] (Figure 6.15).

de madera y privaría la fabricación de aguas artificiales. **Aqui en Barcelona, por el contrario,** se venden miles de botellas llenadas de los barriles que **no permiten una buena limpieza interior como el cristal.** Además, las botellas **se limpian con agua de la población.** En este caso, los beneficios del Agua Minero-Medicinal **son nulos.** Basta un solo ejemplo: Tenemos entendido que de todas las aguas de Caldas de Malavella, **la única que se llena en el Manantial es la del Vichy Catalán.** Todas las demás **no pueden tener nunca las condiciones debidas en bien de la salud pública.**

Figure 6.15. Extract from an advertisement of Titus water.
Source: (La Vanguardia 2011f)

Once the water was drunk by the consumer, the cask was sent back to the bottling plant where it was cleaned and refilled and the process started again. The cleaning process was risky at times, because strong chemical products were used and if bottles were not properly rinsed, they could intoxicate consumers, something that still sometimes happens (Sánchez 2011). In any case, the transport of bottles, either empty or full, was an usual sight in train stations located near factories, where the loading and unloading of crates full of bottles was common (Figure 6.16).

[76] See chapter 2.2

Figure 6.16. Caldes de Montbui train station with mineral water bottles waiting to be loaded in the train.
Source: (Salmerón i Bosch 1991)

The importance of railways for the bottled mineral water business is not exclusive of Catalonia, the relationship between both was common across Spain and Europe. In the Spanish case, in 1929 a list of mineral water bottler companies which were considered as being of public utility was published in the Official State Gazette[77] (Palacios 1929). The listed mineral water bottlers were those which were considered to have better properties and the best facilities, therefore being considered of being of public utility. If figure 6.17 is observed it can be seen that all public utility bottling plants were at a reasonable distance from –if not by- a railway. The only exceptions were the waters of Verín-Sousas and Cabreiroá, which had no Spanish railway nearby, but a Portuguese railway line had its terminus station relatively nearby, which meant that a direct link with the harbour town of Oporto. The relationship between water bottlers and railways was so strong that some bottlers shared their names with their respective rail stations, as they had a common location. Some examples of this toponymical coincidence are Borines, Vilajuïga, Valdelamusa or Fuencaliente (Forcano Catalán 1931).

[77] Boletín Oficial del Estado (BOE)

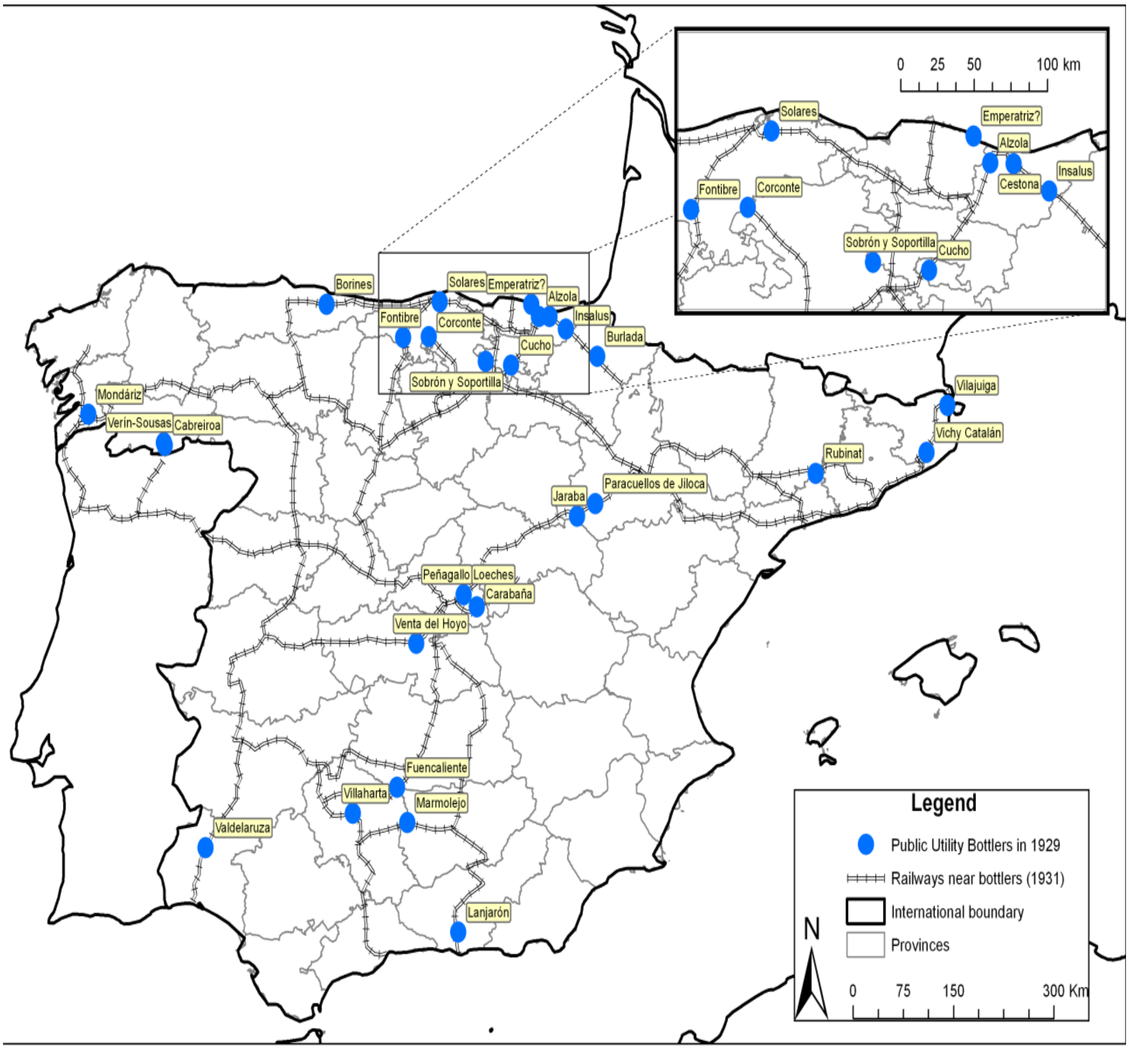


Figure 6.17. Spanish mineral water bottlers recognised as being of public utility in 1929 and railways.

Note: Only those railways relevant to mineral water bottlers are respresented.

Source: Author's work. Water bottlers data: (Palacios 1929). Railway data adapted from: (Forcano Catalán 1931)

In the rest of Europe a strong relationship between railways and the main mineral water bottlers also existed. Relevant historical brands like Vittel, San Pellegrino, Buxton or Evian all have train stations and sometimes their distribution warehouses are located right by the station (Figure 6.18). In fact, when a traditional mineral water bottling town which had a relevant role in the development of the industry is visited, the existence of a train station can usually be expected. However, the preponderance of newer means of transport has implied that sometimes train lines which linked those towns with the rest of the country have ceased their activity. Examples of this can be found in the aforementioned "Aigües de Ribes" train station (Pallí i Buxó, Roqué i Pau et al. 2002) or in Volvic (FNAUT 2008).

Figure 6.18. Railways and stations in mineral water bottling towns.
Clockwise from top: Fournier water factory and railway in la Garriga (Catalonia), Buxton´s station with bottling plant at the background (England), San Pellegrino's train station (Italy) and Vittel´s train stop (France).
Source: Author's work

6.3.2 Roads

Trains were not the only means of transport used to transport water. As it has already been shown, even if most bottlers were very close to a train station, others were within the vicinity or at a short distance. This meant that they had to transport the water to the train station somehow, so a network of modern roads was needed to allow the successful distribution of their water.

A few mineral water bottlers appeared before railways started, so they had to ship their produce using alternatives to the railway. A good example of this is the first found bottler of mineral water in Catalonia, the Puda of Montserrat, which is considered to have started production around the year 1844 (Saurí, Matas 1849). However, the train line which served the factory was not built until fifteen years later (Font i Garolera, Majoral i Moliné et al. 1993), so during that interim it had to distribute its water using an alternative transport. It is known that the Puda water was sold at several locations of the Barcelona province, but it was especially distributed in the city of Barcelona, where it had its headquarters (Saurí, Matas 1849). Considering that the the Puda bathhouse was some 40kms away from Barcelona, the water could not be transported on foot, so other means of transport had to be used. Historical records show that a daily service of diligences covered the distance between Barcelona, but with the advent of the railway their service became less crucial (J.A.S, M. Ll 1863). It can therefore be inferred that the first commercial transport of bottled mineral water in Catalonia was done using diligences and carts, a freight that was changed to trains when they became available. However, those bottlers which had the nearest train station at a certain distance had to continue using diligences to cover the distance between the spa and the station. The Puda bathhouse, for example, was located at around four kilometres from the nearest train station, Olesa de Montserrat, so they had to keep a carriage service to link the bottling facilities and the spa linked with the station (Figure 6.19).

Figure 6.19. La Puda diligence service.
Source: (Unknown author 2011b)

Other mineral water bottlers were located at a significant distance of the nearest railway station, so they had to continue heavily relying in the use of diligences and carriages to distribute their bottled water to the consumption centres. They would usually send their produce to the nearest rail station rather than directly to the city, so they did finally take advantage of the newer transportation system, even if not directly. A good example of an enterprise which had to use this dual transport system is water from Sant Hilari, as they were located some 25kms away from the nearest train station, located in Hostalric. The train arrived to Hostalric in the year 1860 (Font i Garolera, Majoral i Moliné et al. 1993), and by the year 1879 the water from the Font Picant source was being sold (Baeza Rodríguez-Caro, López Geta et al. 2001). They would send the water using a diligence which took three hours to cover the distance from the bathhouse to the train station (Martí Sanchís 1904).

As transportation methods improved, bottling companies adopted them to increase their productivity and lower their distribution costs. It is therefore not surprising that lorries and buses –also known as omnibuses or automnibuses- soon became a popular way of transporting water and people to and from bottling plants and spas. Many spas purchased motorised vehicles to transport their customers and transport goods to their closest train station. La Puda bathhouse was not an exception and it improved its diligence service by using a motor vehicle for its customers and goods transportation (Figure 6.20).

Figure 6.20. La Puda motorised vehicle service.
Source: (Unknown author 2011a). Picture signed by L. Roisin.

Apart from the current method of road transport for each time, either animal pulled or run by an explosion engine, communications between bottled springs and consumption centres required an adequate road network to guarantee a fast, secure and convenient transport of goods and people. The construction of the Catalan road network started before the railway arrived to the country and evolved faster than the rail system, as by the year 1935 most of Catalonia had access to a road (Font i Garolera 1993). The expansion of the road network, similarly to the expansion of the railway, was seen as an opportunity by entrepreneurs looking to start a business in the bottled water sector. As figure 6.21 shows, before 1850 the only two bottlers that existed were located very close to the main road network. Even if La Puda was at a certain distance from the Barcelona-Lleida road, the connecting road was being built in the year 1850, so shortly after they had direct access to it (Font i Garolera 1993).

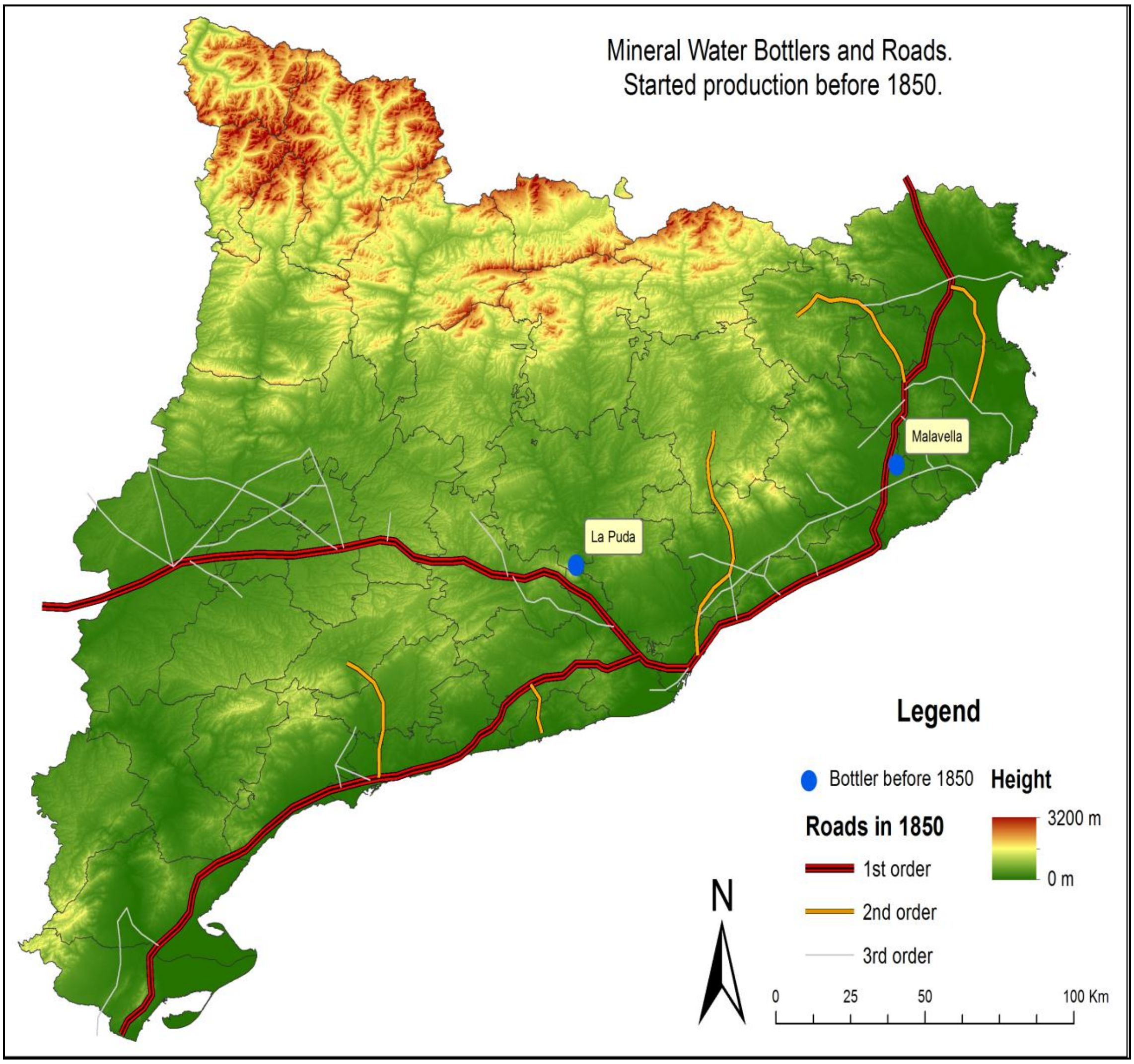


Figure 6.21. Mineral bottling plants and roads before 1850.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Roads data adapted from: (Font i Garolera 1993)

Between the years 1851 and 1880 four bottlers started their production, and all of them apart from the Font Picant source in Sant Hilari Sacalm were linked to the road network (Figure 6.22). However, just like the Puda case, the road to Sant Hilari was being built during 1880, so it arrived to the town shortly after (Font i Garolera 1993).

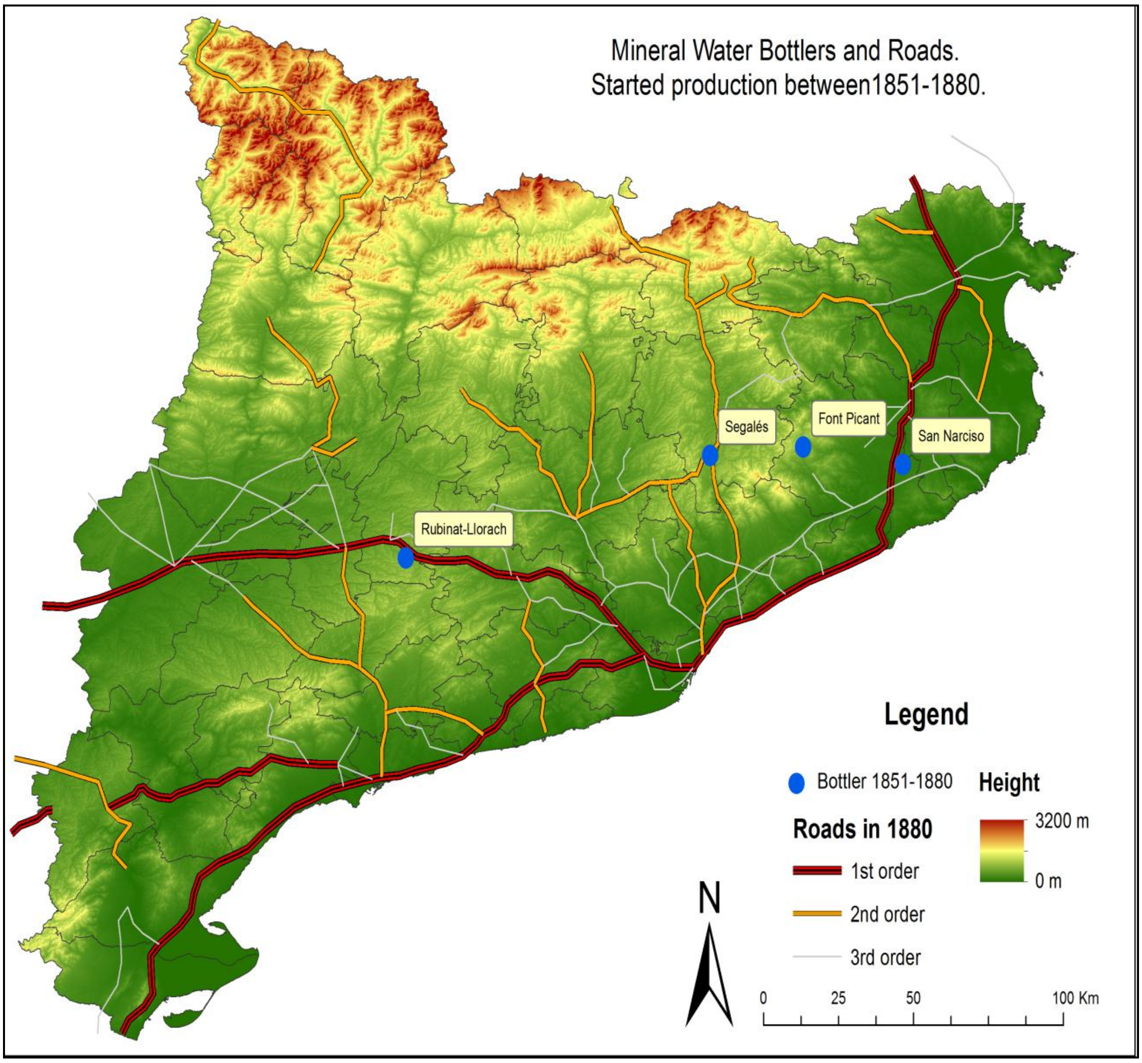


Figure 6.22. Mineral bottling plants and roads between 1851 and 1880.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Roads data adapted from: (Font i Garolera 1993)

By 1910 the road network was already quite dense across the lowlands and it had connected the main Pyrenean valleys with the rest of Catalonia. During the period 1881-1910 many new bottlers started their businesses in the country, and all of them were linked to one of the main roads of the network, connecting them to consumption centres and rail stations located nearby (Figure 6.23).

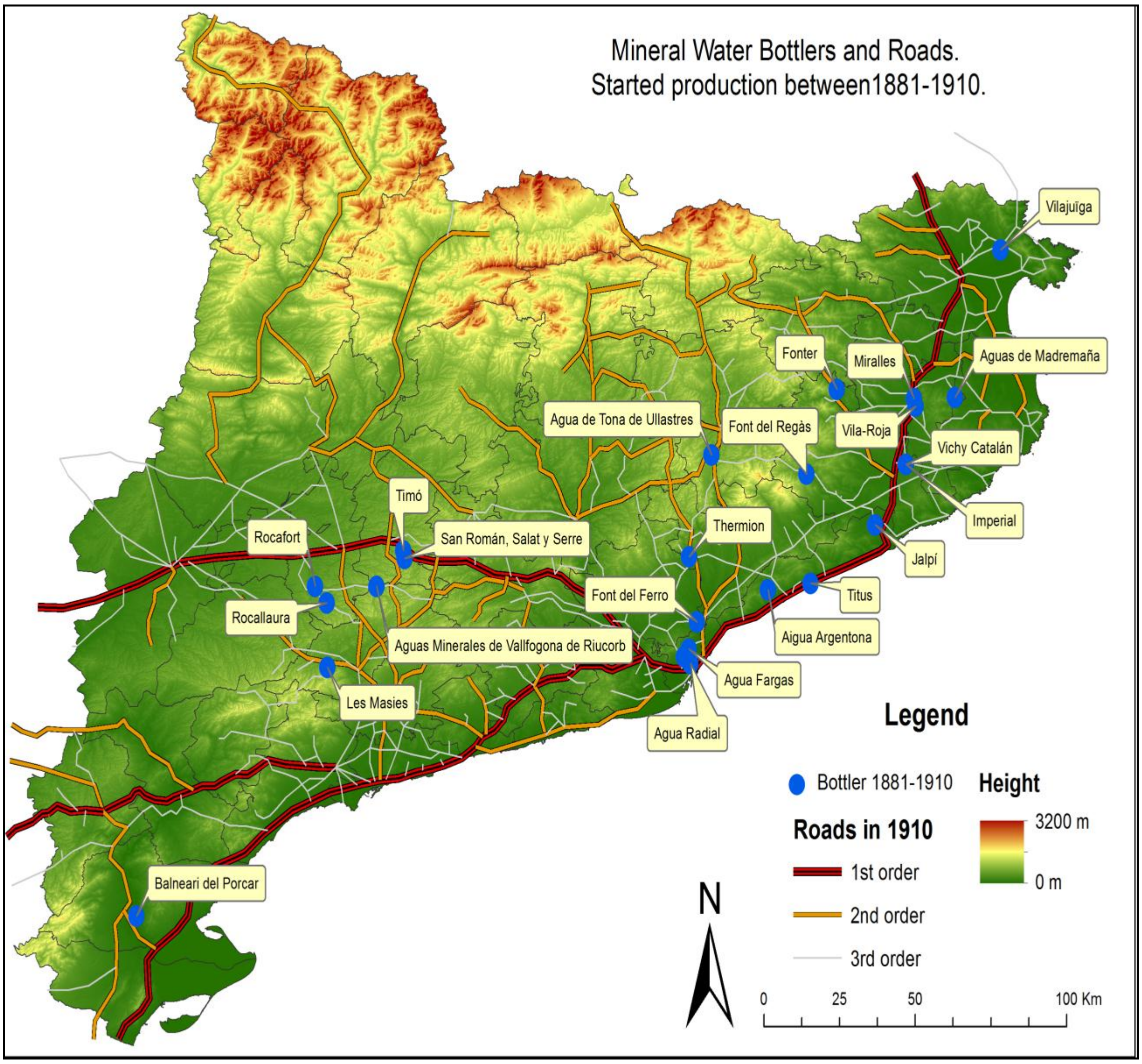


Figure 6.23. Mineral bottling plants and roads between 1881 and 1910.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Roads data adapted from: (Font i Garolera 1993)

It was during the period 1911-1935 that the road network became a dense web connecting most population centres between them. Again, all those bottlers which chose to start their production during this period were located by a road (Figure 6.24), guaranteeing their connection with consumers. It is worth noting that only Ribes water was located within the Pyrenees, as it was the only valley which had a direct railway link to Barcelona.

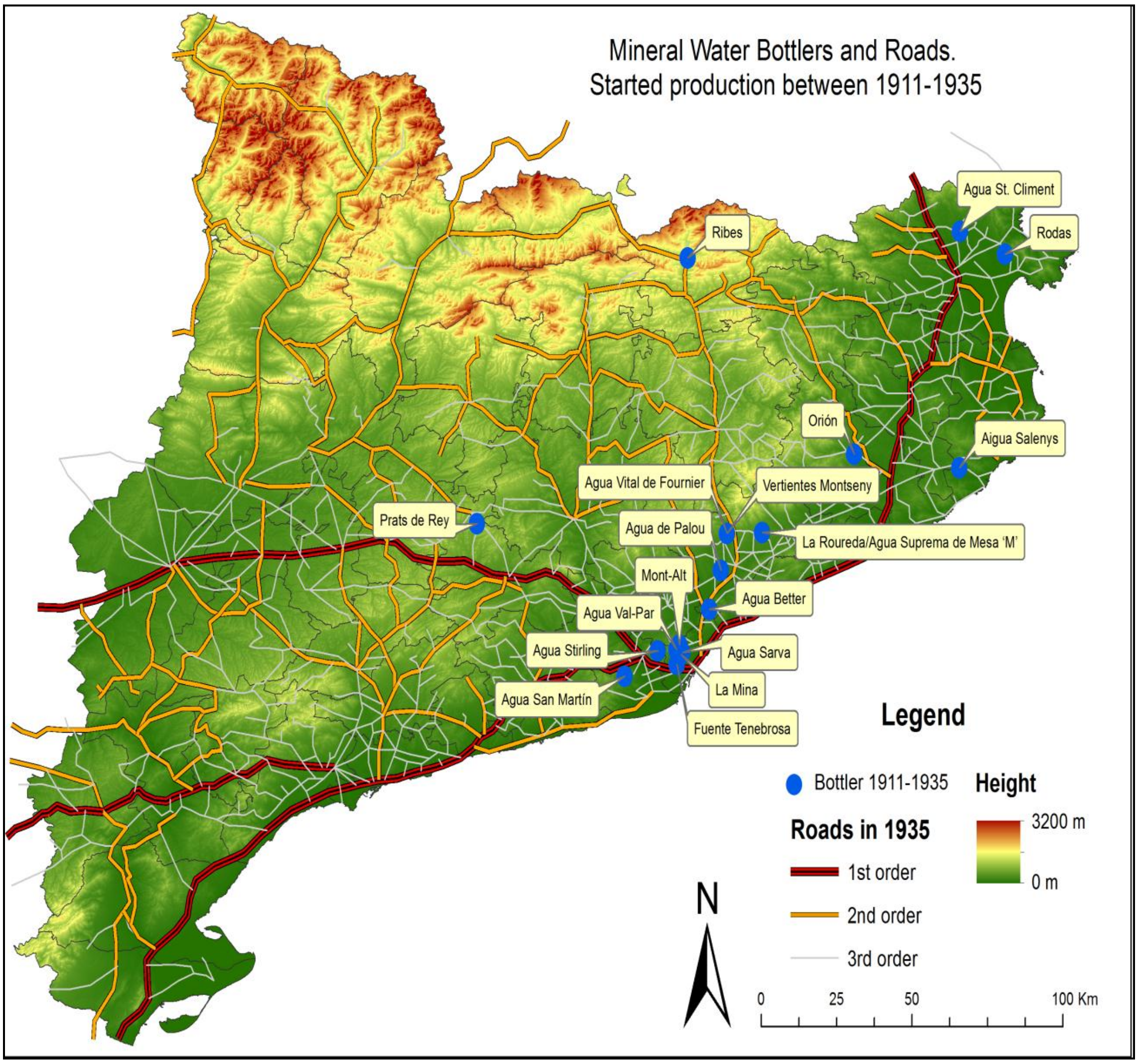


Figure 6.24. Mineral bottling plants and roads between 1911 and 1935.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Roads data adapted from: (Font i Garolera 1993)

As the map series just presented shows, water bottling companies were always linked to the expansion of the road network. Areas which were not connected to the network did have sources which could be used to bottle water, but the cost of transporting the goods would have been too high to make the business profitable, so only those sources well linked to population centres –either directly or connected with the train- were chosen. However, the transport of water was not limited to the freight between the production centre and populated places, an urban transport also existed. When mineral water arrived to cities it was sold either in pharmacies, drugstores, water depots or from door to door (La Vanguardia 2009j); (La Vanguardia 2009f, La Vanguardia 2009e). It was therefore necessary to transport water bottles from the train or bus station to the distribution centres, something which was done using carts, wagons (Figure 6.25) and eventually lorries.

Figure 6.25. Jalpí water distribution centre in Barcelona.
Source: Picture taken at the exhibit “La revolució de l'aigua a Barcelona. De la ciutat preindustrial a la metròpoli moderna, 1867-1967”

6.3.3 Connectivity

From the series of maps displayed in the preceding sections, it can be inferred that the road and rail networks played a relevant role in the development of the mineral water industry in Catalonia. Without the necessary means of transportation, the consumption of mineral water would have been limited to bathhouses, as it had been for centuries. The introduction of modern and efficient means of transport, like the train, had a preponderant part in transforming mineral water into a commodity which could easily be purchased in cities across the country. At the same time, the construction of a new road network which linked previously isolated springs with the rest of the nation together with the newly built railway, helped to increase the interconnectivity between areas which had been beforehand difficult to reach.

Historical records show that a combination of different means of transport, namely railways and diligences or lorries, was commonly used by bottlers. For example, the spa and bottling town of Vallfogona de Riucorb did not have direct access to the nearest train station –Tàrrega- as it was some 20kms away. However, a bus service was established and did four daily trips between the spa and Tàrrega's train station (La Vanguardia 2012i). The bus' timetable was adjusted so it linked the bathhouse with the train that linked Tàrrega with Barcelona. This combination of transports meant that bottled water and costumers could go from the bathhouse to Barcelona in less than six hours or to Lleida in a bit more than three hours (La Vanguardia 2012i). In addition to the bus service, private cars were also used to link the spa town with the train station (La Vanguardia 2012i).

The case of Vallfogona de Riucorb was not unique, as other mineral water sellers which were not directly connected with the rail network used a combination of means of transport to distribute their products. In the Aragonese spa town of Panticosa they shipped their water across Spain, from Cádiz to Barcelona (Balneario de Panticosa 192?). Even if Panticosa was located in a remote valley of the Pyrenees, they were able to send their water to cities so far away thanks to a combination of road and rail transport. The price of the water consisted of two tariffs, a fixed fare which included the price of the product and the transport of the shipment to Sabiñanigo's train station via lorry –one peseta per litre in the 1920s- and a variable price depending on the rail fare from Sabiñanigo to the final destination (Balneario de Panticosa 192?).

This intermodality ensured that even if a mineral water bottling plant was far away from a railway it could ship its water to consumers. However, remote springs which were too isolated could not sell their water because of increased transport costs which would have meant bottles becoming too expensive. To elucidate which areas lacked the necessary access to transportation networks, a series of connectivity maps have been created. In order to create the maps, a series of conditionings have been introduced. Rail transport was the fastest and cheapest of the time (Harvie 1998), so a greater importance has been given to railways. Roads are considered depending on the quality they had -1st, 2nd or 3rd order-, so they have been weighted accordingly. All these factors combined provide a connectivity map, where areas highly connected to the network are represented with warm colours, while areas which had more limited connexions are symbolised with cold colours. Those regions with no rail or road connections to the main network are not characterised with any colour, just with a background DEM (Digital Elevation Model) to illustrate the orography of those areas.

With the accessibility of mineral water plants to the network represented as a connectivity map, it becomes clear that all bottling industries were located in areas which were conveniently connected to the main transportation network of the country. In figure 6.26 it can be seen that all those bottlers which started their production before 1880 had at least some connection to Barcelona. Out of five companies, four are located within the main transportation links, while one, Sant Hilari, even if not as conveniently, did have a connection to the network.

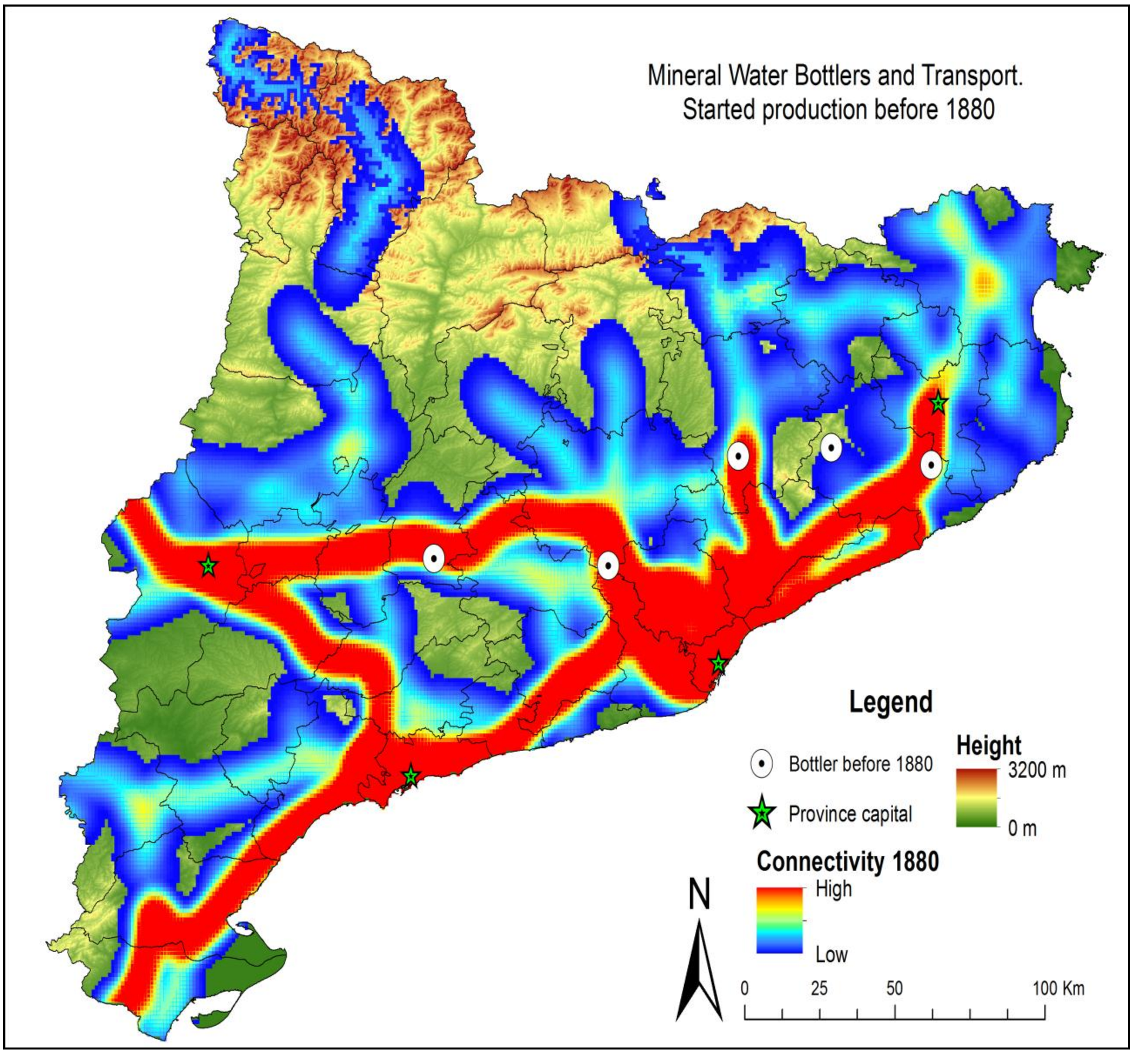


Figure 6.26. Mineral bottling plants connectivity in 1880.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Roads data from: (Font i Garolera 1993) Railway data: (Font i Garolera, Majoral i Moliné et al. 1993)

If those companies which started their production between 1881 and 1910 are analysed, it is found that they are mostly located within highly connected areas. Those from sources which were not located on the main communication links did at least have some connections with the network (Figure 6.27); a fact which ensured that their transportation costs could cope with the costumer's price expectations. It should be noted that as the transportation network became denser, less areas were isolated, and areas which had low connectivity scores improved their accessibility.

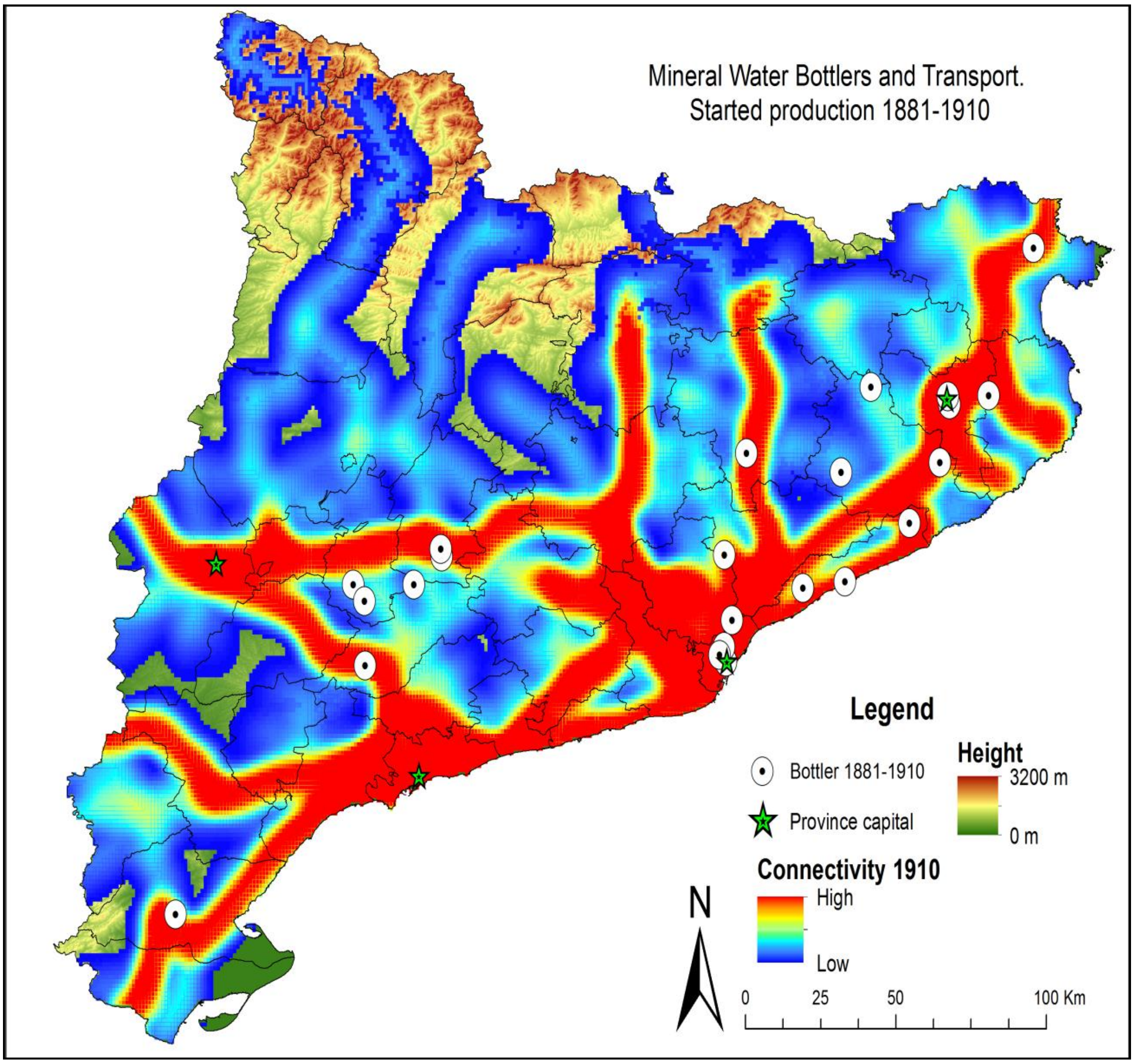


Figure 6.27. Mineral bottling plants connectivity in 1910.

Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Roads data from: (Font i Garolera 1993) Railway data: (Font i Garolera, Majoral i Moliné et al. 1993)

Finally, those sources which hosted a water bottler for the first time between 1911 and 1935 also follow the already explained pattern. Most bottlers were located in high connectivity areas, and those which were not had at least some access to them (Figure 6.28). Again, the case of Ribes' water is especially significant, as it did not start selling its water outside the spa until it area achieved a high connectivity.

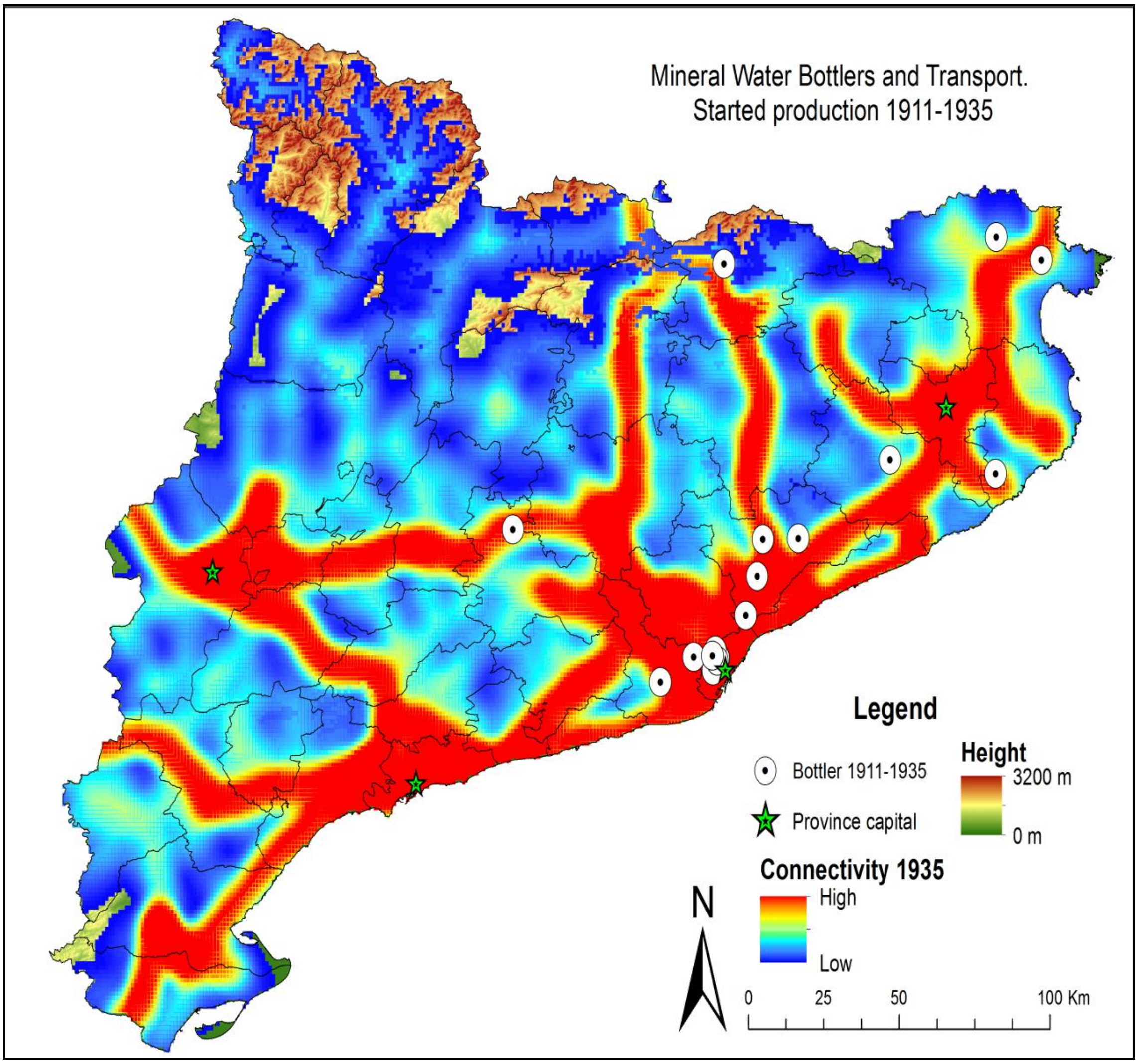


Figure 6.28. Mineral bottling plants and roads before 1935.
Source: Author's work from (Baeza Rodríguez-Caro, López Geta et al. 2001, Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985, Montserrat y Archs 1889, La Vanguardia 2011g, ABC Periódico Digital 2011, Ferrer i Santaló, Gay 2003, Mitjà i Sarvisé, Associació Balneària et al. 1999, Latorre i Piedrafita 1998a, Pladevall i Font 1989, Bouza Vila, Cifuentes et al. 2002, Bouza Vila, Cifuentes et al. 2002). Roads data from: (Font i Garolera 1993) Railway data: (Font i Garolera, Majoral i Moliné et al. 1993)

Transporting bottled mineral water from its production places to cities was possible thanks to the improvement of transportation systems. Without the invention and diffusion of the railway it would have been very difficult for many sources to have their water bottled and sold. However, the improvement of the road network and the invention of the explosion engine were also crucial, as without their existence only those springs located right by a railway station would have been able to successfully sell their water. The improvement of the transportation means can therefore be considered a key factor in the transformation of mineral water from a product consumed *ad hoc* to a commodity potentially consumed anywhere.

Furthermore, two trends regarding mineral water bottlers can be inferred from what it has been explained up to this point. On one hand those spas which were located either within a certain distance to population centres or with adequate transportation links were able to start their bottling plants if an entrepreneur –who could be a doctor, the spa owner or an outsider-, chose to invest in it. On the other hand, new mineral water brands chose to locate their new businesses as close to population centres or transportations systems as possible. This meant that, even if mineral water is by definition not flexible location-wise, production centres were highly interrelated to consumption places either by proximity or transportation ease, two key factors during the starting stages of the mineral water bottling business.

6.4 Catalonia and beyond

The freight of bottled mineral water was not limited to the internal Catalan market, as water from abroad was sold in Catalonia and Catalan water was sold abroad. The international freight of water was not something uncommon, but due to the increase in transportation costs only those brands which had higher consideration, both Catalan or foreign, were able to sell their produce abroad.

6.4.1 Bottled mineral water importation

The importation of foreign mineral water to Catalonia –either from neighbouring areas or from further away- during the study period was not uncommon. Since the starting stages of the bottled mineral water market, mentions of imported waters being sold in Catalonia can be found. In 1853, a list of relevant foreign bathhouses and the characteristics of their waters was included in a book about the mineral waters of Spain (María Rubio 1853), but it is unclear if water from those spas could be purchased in Catalonia at the time. However, it is relevant because it meant that springs from across Europe were well known in Spain during those dates.

Relevant members of society like nobility, writers or politicians would sometimes go to spa towns to spend the summer healing, socialising or relaxing. In some occasions, they would go to foreign spas and news would spread about where they went, popularising the names of the cited spa towns. The description of their experiences of in those locations influenced society and gave those bathhouses an aura of quality. For example, Catalan writer Joan Maragall went to the French spa of Cauterets and wrote different articles about his experience there (Maragall Noble 1997). In another occasion newspapers explained that the two most preeminent politicians of the time, Cánovas del Castillo and Sagasta, spent the summer in Carlsbad -Czech Republic- and Eaux-Bonnes –France- respectively (La Vanguardia 2011a). Soon enough, names like Vichy, Baden-Baden, Spa, Carlsbad or Luchon, amongst others, became familiar to the public and eventually became a model of what excellent waters should be like (La Vanguardia 2011c). In addition to them, several non-Catalan spas from Spain like Verín, Solares, Insalus or Cabreirioá were also highly regarded in Catalonia, and were considered to be a benchmark in water quality and refinement (La Vanguardia 2011g).

It was therefore not surprising that when a Catalan spa or mineral water seller wanted to promote the quality of their waters, they used brands from abroad as a yardstick to boast the properties of their waters. For example, in a publication of Vallfogona de Riucorb's bathhouse, the water of the establishment was described as more mineralised than those from Cestona or Carlsbad (Unknown author 1925). Also, the owners of the Balneri del

Porcar in Tortosa described their waters as being of excellent quality because they had more carbonic acid than the waters from Carlsbad, more minerals than Royal spring -France- and were as good as those from Loeche –Switzerland- (La Vanguardia 2011d). The continuous comparison with waters from abroad meant that mineral water consumers were highly aware of the existence and qualities of foreign waters, so it is not surprising that a demand for those waters existed.

Only very relevant foreign brands which were well known and had an international reputation had the necessary economic muscle and local demand to ship water to Catalonia. Not surprisingly, those waters which were located closer to the border were more likely to start exporting their bottles to Catalonia, but waters from further away also reached the Catalan market. Barcelona and Madrid even had water depots which were specialised in importing and selling international waters, so even if not mainstream, a certain market for foreign waters existed in Catalonia (Marty 2009). Documentation from the water depot in Madrid shows that it offered 22 different mineral water brands from nine different countries in 1866 (Table 6.4). Even if figures for Barcelona's water depot have not been found, it is likely to have offered a similarly broad offer of international waters, if not more thanks to the port. The increasing regularity with which mineral water was imported to Spain led to the publication of an official recommendation in the Official State Gazette (BOE/Gaceta de Madrid) in 1870. The government suggested border authorities to only open those bottles of mineral water of foreign origin which were unequivocally foul, but to leave all others untouched (Figuerola 1870).

Table 6.4. Countries of origin of international waters sold in Madrid's water depot.

Country[78]	Number of brands
France	12
Bohemia	3
Switzerland	1
Savoy	1
Saxony	1
Bavaria	1
Corsica	1
Duchy of Nassau	1
Belgium	1

Source: Author's work from (Moreno 1866:5-6)

[78] Some countries do not exist anymore or have changed their name

The price of foreign waters, however, was as much as two times more expensive than Spanish water, even if national waters had been transported from provinces far away (Moreno 1866). This could be due to higher transportation costs, but also because of a customs duty. Since mineral waters were considered a pharmaceutical product (Moreno 1866), laws regarding the importation of drugs also applied to them and in 1869, a law was passed which stated that foreign medicaments could be introduced in the country, but they had to pay customs duty when crossing the border (Gisbert 1869). Even if imported waters had to pay a levy and were therefore more expensive, they were highly successful and in 1890 the Pharmacists Association of Barcelona criticized it (Villacorta Baños 1990). They argued that the reason why foreign waters were successful was not because of a higher product quality, but due to better advertising and promotion thanks to their greater economic and industrial resources (Villacorta Baños 1990).

Even with the complaints of the pharmaceutical guilds, foreign mineral water kept arriving to Catalonia. According to port reports, between the years 1881 and 1913 at least 18,188 crates full of mineral water distributed in 176 shipments arrived to the port of Barcelona (La Vanguardia 2012a). It is unknown exactly how much water each case contained, but the sheer quantity of imports to Barcelona's port is quite significant and shows the vigor imported mineral water commerce had at the time. The chronological distribution of the product's importation thru the port of Barcelona shows a higher concentration of cargo between the years 1895 and 1906 –around the time when bottled water became commercialised as table water- (Figure 6.29), with a maximum of 2,786 crates in 1899. The peak in volume occurred in the year 1890 can be explained because an extraordinary shipment of 800 crates which arrived in December of that year (La Vanguardia 2012a).

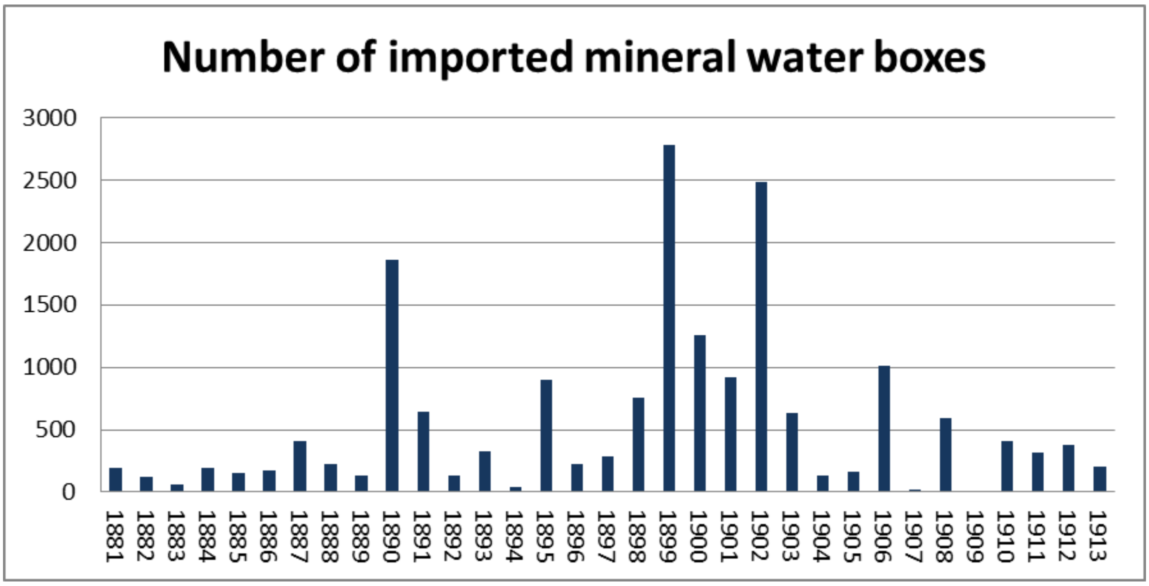


Figure 6.29. Number of imported mineral water boxes to the port of Barcelona (1881-1913).
Source: Author's work from (La Vanguardia 2012a)

The ports of origin of the ships which transported mineral water to Barcelona were mainly located in Europe, mostly in the French Mediterranean coast (La Vanguardia 2012a). The majority of the water came from Sète (France), a coastal town with a railway connection and the place of origin of the canal du Midi and the canal du Rhône a Sète (Ormsby 1931). It was therefore a very well connected city which could receive mineral water from several French regions. Marseille, also well connected with other French departments, was also a common port of origin to ship bottled water to Barcelona (La Vanguardia 2012a). Sporadically, water from other ports like Hamburg, Liverpool, Anvers, Bilbao, Fiume[79] or Trieste also arrived to the Catalan capital (La Vanguardia 2012a). The water was imported by at least 25 different traders, and amongst them some of the most important mineral water depots, like the Freixa depot, could be found.

Information about French exports towards Spain can also help to depict the importance foreign waters had in Catalonia. As it has been explained, the great majority of bottled water shipments to Barcelona were from Sète and Marseille, so due to proximity reasons and for being a powerful market, French water had a great influence in Catalonia. The importance of French mineral water in Catalonia was proven by with the choice of two of the main Catalan sources to use the word Vichy in their names, a typical case of cultural

[79] Nowadays known as Rijeka (Croatia)

diffusion, like the Champagne-Cava conflict. Vichy Catalán and Vichy Caldense were two brands based in Caldes de Malavella which named their product after the French city of Vichy, one of the most important spa centres in France (Altman 2000). Both brands had complex and lengthy legal issues with the French Governement, the owner of French Vichy waters, which argued that the name Vichy could not be used by foreign companies (Sáiz González 1996). However, Vichy Catalán was able to keep its name while Vichy Caldense was forced to change its name to Agua Xala first and Agua Imperial later as it was not authorised to use the name Vichy (Ajuntament de Caldes de Malavella 2010). French water was therefore well known and a synonym of quality, which added to the geographical proximity to Catalonia, made it an important supplier of imported mineral water.

In the year 1904 France exported 7,829 quintals[80] of mineral water to Spain (Marty 2009). This quantity is much smaller than the 26,267[81] quintals shipped to Belgium or the 24,006[82] quintals sent to England (Marty 2009), but is proves that a certain amount of water was exported to Spain, as the reports from the port of Barcelona showed. By 1914, the amount of imported French water to Spain had not changed much -8,210 quintals[83]-, but overall French mineral water exports had almost doubled (Marty 2009). It was precisely during those years that the Catalan mineral water industry boasted and consumption increased, but it seems that the excess of demand was not covered by French water, but by local brands. Therefore, it can be inferred that while the consumption of French waters had a stable consumer base, when mineral water became a commodity new consumers chose cheaper local mineral waters rather than choosing luxurious foreign brands.

Apart from water from France (La Vanguardia 2010c), Germany (La Vanguardia 2010a), the Czech Republic (Palacios 1929) or even Argentina (La Vanguardia 2008) Spanish water could also be purchased in Catalonia. Water from the most important spas was dispatched in some mineral water depots. For example, in the 1920s water from

[80] French quintals. 383,237kgs
[81] French quintals. 1,285,796kgs
[82] French quintals. 1,175,118kgs
[83] French quintals. 401,888kgs

Panticosa could be purchased in two different mineral water depots in Barcelona (Balneario de Panticosa 192?).

Non Catalan waters therefore, had a vital role in the expansion of the local mineral water market and found a niche to sell their products. Their aura of quality and their industrial excellence inspired local entrepreneurs who would later on start their own bottling businesses trying to compare themselves to the most preeminent European bottlers. Consumers also became aware of the existence of great spas located across Europe which provided famous waters and names like Vichy, Carlsbad or Apollinaris immediately evoked water quality. However, even if a market for those foreign waters existed, not everybody could purchase them due to their higher cost, so when mineral water became a commodity the majority of consumers chose to purchase cheaper local brands instead. Nevertheless, those local brands kept comparing themselves with those foreign labels in order to prove their quality, so the influence of the external market always existed.

6.4.2 Bottled mineral water exportation

The Catalan mineral water industry, even if less powerful than their European counterparts, was able to export its product to Spain and other European countries. During the very initial stages of the mineral water business, Spanish brands were only able to export water to nearby towns or provinces (María Rubio 1853).

As table 6.5 shows, in 1853 the only Spanish water which was exported abroad was Busot water. It was shipped to Gibraltar and London, most probably because of the spring's proximity to Alacant's port. Also, water from Panticosa arrived to Madrid. All other Spanish mineral water sellers only sold testimonial quantities to nearby towns. In the Catalan case, only references to three spa towns which had exporting capabilities are made, Sant Hilari -it is unclear if any water left the town at all-, Caldes de Montbui -the water was sold as bathing water, not as a drink- and La Puda de Montserrat, which mainly exported water to Barcelona. The latter was therefore the only spa that sold bottled water as a business, but it shipped its water mainly to Barcelona and other metropolitan towns, no international or even interregional sales existed at the time.

Even if in 1853 only one brand of Spanish water was selling its product abroad, experts of the time considered that the value of Spanish mineral water was underrated by foreign countries. Pedro María argued that the reason why Spanish waters were not sold outside spa towns was because associated spas did not have the facilities to comfortably host visitors. If bathhouse facilities improved their levels of comfort, he explicated, their associated mineral waters would surely be sold everywhere in a successful manner (María Rubio 1853). Effectively, as spas gained fame and transportation networks improved, Catalan mineral water could progressively be purchased outside the country. For example, by 1866 water from La Puda de Montserrat and from Sant Hilari[84] was sold in Madrid, over 600kms away (Moreno 1866).

[84] It is unclear which source produced the water sold in Madrid and how or in which quantities it reached the city. Therefore it has been decided to keep the first found reference date as 1879 for the Font Picant source.

Table 6.5. Bathhouses which sold water outside the building (1853)

Bath house	Province	Quantity	Destination	Notes
Alhama de Aragón	Saragossa	"Some water"		
Arenosillo	Cordova			Only during summer time
Busot	Alacant	"Quite a lot"	Alacant, Alcoi, Torrevella, Gibraltar and London	Bottled
Caldes de Montbui	Barcelona	12960@ in 1839 (≈209,084l)	Barcelona and "other towns located further away"	Used to bath. Queen Elisabeth II of Spain once bathed in Barcelona using this water.
Carratraca o Ardales	Malaga	"Large quantities"	Málaga and surroundings	
Cestona o Guesalaga	Gipuzkoa		"Different places"	
Chiclana	Cadis		Within the town and the shire	
Grábalos	Logroño		8-10 Leagues (≈45-60Kms)	This distance includes the cities of Logroño, Calahorra or Arnedo
La Puda	Barcelona	15526 bottles in 1848	Barcelona and Catalonia	
Lanjarón	Granada	"Large quantities"		
Marmolejo	Jaen			
Molar	Madrid		Madrid (city)	
Panticosa	Huesca	3600-4680 bottles	Huesca province, Saragossa, Madrid	In bottles and sometimes earthenware
Paracuellos de Giloca	Saragossa			
Puertollano	Ciudad Real	"Large quantities"	"Long distances"	Bottled
Quinto	Saragossa	1208@ in 1849 (≈19,489l)	"Neighbouring villages"	
Sacedón	Guadalajara	"Not much"		Bottled
Sant Hilari	Girona			It is unclear if any bottles were exported outside of the village
Villavieja de Nules	Castelló	"Large quantities"	Valencia	
Zaldivar o Zaldua	Biscay		"The three Basque provinces"	

Source: Author's work from (María Rubio 1853)

However, the first internationally successful mineral water did not have its origin in a bathhouse, but in an undiscovered spring. As it has been already explained previously in chapter 3, water from Rubinat was discovered in 1876 by doctor Llorach when a farmer showed him that his herd suffered from diarrhoea when they roamed around the spring (Puig, Mora et al. 2008). It was therefore not mineral water as we know it today, but medicinal-mineral water, i.e water not used to hydrate but water used to heal an illness, in this case constipation. The success of Rubinat-Llorach was unprecedented of any other Catalan water bottler, and its water was soon sold across the globe. The bottles were filled and sealed at the source, transported to Cervera –which had a railway stop-, sent to Barcelona and from there they were shipped from the port to faraway harbours (Ustrell 2012). The international success of the company meant that apart from having offices in Barcelona they had an international office in Paris from which worldwide shipments could be arranged (Puig, Mora et al. 2008). Amongst other places, Rubinat-Llorach water was sold in Europe (Puig, Mora et al. 2008), the United States (Ustrell 2012) or South America (Marty 2009).

Rubinat's international success showed other businesses that Catalan waters could be effectively sold abroad, so several bottled water companies followed through and started exporting their water outside of Catalonia. In the year 1914, right when Catalan mineral water had become a commodity and the industry was blossoming, all Spanish bottling plants together, including those based in Catalonia, exported around 14,000 quintals[85]. If the exports are compared to the imports of the same year -8,210 quintals[86]- the figure may look impressive, as Spain's bottled water commercial balance was positive, but quantities are dwarfed when compared to those of neighbouring countries. Figure 6.30 shows the volume of mineral water exported by several European countries between the years 1912 and 1914. As it can be observed, Spain's mineral water exports were marginal when compared to those in Italy, France or Germany. The volume of the Catalan water market was therefore even smaller, so its weight within the European mineral water trade was anecdotic.

[85] French quintals. 685,314kgs.
[86] French quintals. 410,098kgs.

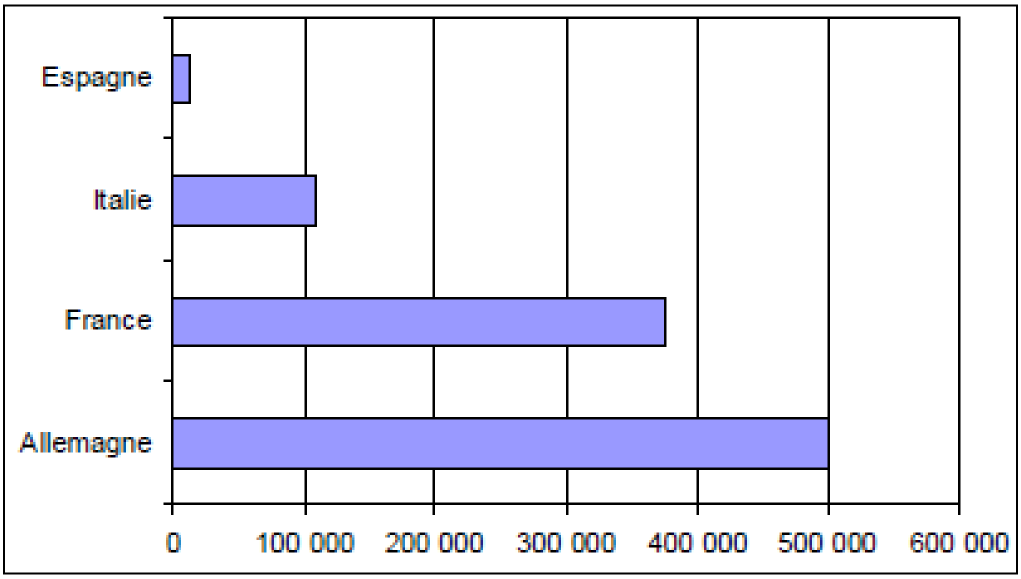


Figure 6.30. Mineral water exports in French quintals (1912-1914)
Source: (Marty 2009:72)

Even if Catalan mineral waters did not have a preponderant role in Europe, several companies did export their bottles abroad. There is evidence of at least five companies which did export mineral water outside of Spain during the crest of the Catalan mineral water hype (Table 6.6). Between 1916 and 1923 all those companies did send their water to foreign markets according to the records available in the Commerce Chamber of Barcelona yearbooks. All those companies, even if based across Catalonia had their export headquarters located in Barcelona. This can be explained because, apart from being Catalonia's largest conurbation, it was its main transportation hub. Water could be sent to the capital by train and by using the port ship the crates full of bottles to any other place in the world. It is also interesting to note that the only companies which exported during those years were all well established and important. A fact that highlights the significance of these five brands within the Catalan mineral water market is that, contrary to the general trend, three of them have been able to keep in business since those years. This shows that only those well established and recognised mineral water bottling enterprises were able to sustain exportation in the long run.

Table 6.6. Catalan mineral water companies which exported mineral water (1916-1923)

Company	HQ location	Province	1916	1918	1920	1923
Agua Imperial S.A.	Barcelona	Barcelona	Yes	Yes	Yes	Yes
Agua Jalpí	Barcelona	Barcelona	Yes	Yes	Yes	Yes
Agua Radial	Barcelona	Barcelona	Yes	Yes	Yes	Yes
Agua Villajuiga	Barcelona	Barcelona	Yes	Yes	Yes	Yes
Vichy Catalán S.A.	Barcelona	Barcelona	Yes	Yes	Yes	Yes

Source: Author's work from (Cambra Oficial de Comerç, Indústria i Navegació de Barcelona 1916; 1985)

The exportation of Catalan mineral water, even if limited when compared to the powerful French or German industries, did exist and helped spread the qualities of those springs and spas that commercialised the water. Even in the dusk of the first mineral water hype, right before the advent of the Second Spanish Republic and the Spanish Civil War, water was being sold across Europe. For example, in the year 1929 the Spanish government reached an agreement with Czechoslovakia by which both countries could sell each other's mineral waters without any constrains (Palacios 1929). The exportation of Catalan mineral water abroad was not the main goal of the industry and not all companies took part on it, but it was a way by which certain companies diversified their clientele and improved their manufacturing capabilities to compete with the much more powerful European industry. By expanding abroad, companies increased their chance of survival, and when the market started slowing down they were more likely to stay afloat.

7. Conclusions

7.1 The downfall of bottled water

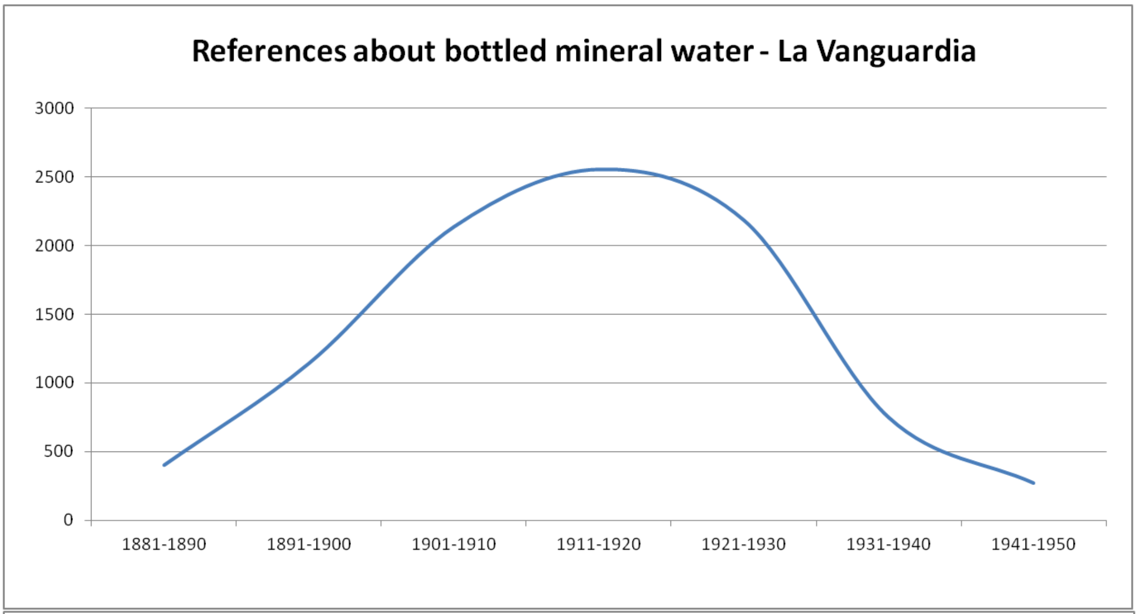
Up to this point, the thesis has explained how mineral bottled water came to be and how it became a success, but it has not elucidated at any point how mineral water lost its popularity. Even if the main purpose of this piece of work has been to explain the starting stages of the mineral water market, it is necessary to explain, even if briefly, how and why mineral water started an interim during which sales and production dropped.

Historical records show that right after the first golden age of bottled mineral water, new companies creation and presence in the media became scarcer. Between 1930 and 1955 only one water bottling company has been found to have started its production. In comparison, in the 25 years which preceded 1930, 29 new companies have been documented. This dissymmetry can also be observed if the press of the time is analysed. If one the oldest newspapers in Catalonia, La Vanguardia, is looked at, a clear pattern can be seen (Figure 7.1). The keywords “mineral water”, “bottled water”, “mineral-medicinal water”, “medicinal water” and “table water”[87] were searched in the newspaper’s archive and the number of yearly occurrences were recorded and then grouped by decades. The result shows an almost perfect bell shaped curve. Between 1881 and 1900 news, advertisements and views about topics related with mineral bottled water grew constantly, reaching its pinnacle between 1901 and 1930, the time when mineral water became a commodity as explained in chapter 3. On the other hand, between 1931 and 1950 the number of references related with mineral water suddenly dropped, reaching the same levels from 1881. This decrease is even more dramatic if the number of pages the newspaper had its taken into account, since during the end of the period the newspaper was significantly longer than at the beginning (La Vanguardia 2011g).

An almost identical pattern can be observed if one of the oldest Spanish national newspapers is taken into account, the ABC from Madrid (figure 7.1). In this case, the pattern is even more symmetrical, with a period of growth and a period of decline. The peak of references related to bottled mineral water is reached between 1923 and 1932, a

[87] The actual keywords in Spanish are: "agua mineral", "agua envasada", "agua embotellada", "agua mineromedicinal", "agua medicinal" and "agua de mesa"

bit later in time than in the La Vanguardia case. Again, by the 1950s the level of mentions had dropped to levels founds during the first available period.



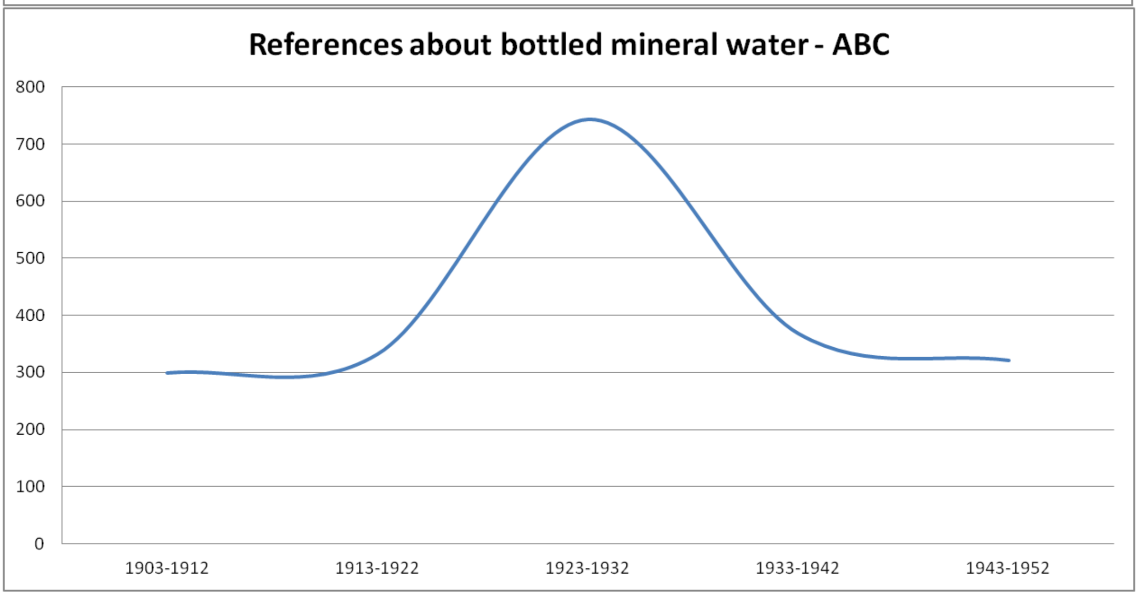


Figure 7.1. Number of references regarding bottled mineral water found in La Vanguardia (top) and ABC (bottom) newspapers.
Source: Author's work from (La Vanguardia 2011g, ABC Periódico Digital 2011)

It is therefore clear that during the years that followed the end of the study period mineral water lost its commodity condition and became progressively less important for consumers and media. One of the explanations of why mineral water lost its popularity can be explained to the turbulent times which followed 1931. That year saw the end of the Spanish monarchy and the advent the Second Spanish Republic, an instable period which had three different governments in just six years (Jackson 2009). In the year 1936 the Spanish Civil War started and was followed by three years of fratricide battles which heavily involved Catalonia (Jackson 2009). During the war, many bathhouses were militarised and used as hospitals for the troops, a fact that meant that bottling production had to be stopped as some spa facilities were badly damaged (Piernas 2009). As a result, manufacture of mineral water decreased and, even if it existed, it was very difficult to distribute bottled water through a country divided by war.

The post-war period was characterised by an economical autarchy which meant that most people had problems to obtain nourishment, so a food rationing system was introduced (Gago González 2007). Therefore, the consumer base able to purchase a product like bottled mineral water dramatically decreased, as obtaining bread, potatoes or lentils was difficult enough.

Under these privative and harsh conditions, mineral water factories which had managed to survive the war had difficulties importing production goods and industrial production decreased (Artola, San Sebastián 2000). However, in the year 1941 some surprising mineral water advertisements appeared in the magazine “Y”. They advertised mineral water and spa treatments as a means of losing weight and avoid becoming obese. This apparent anachronism, in a time when a large proportion of the population was starving, could be explained as propaganda used by the new regime to give a sense of opulence, which we nowadays know it was false (Lafuente, Gabilondo 2006).

However, war and post-war, even if they helped, are not enough to explain the spectacular drop in mineral water consumption and production; other factors were responsible for the loss of the market. According to the theory proposed in this thesis, in order to have a thriving mineral water business, four factors are necessary:

- An adequate container
- An efficient transportation method
- A cultural/social predisposition
- Lack of salubrious water

Up until a few years before the war, all the necessary conditions for the commoditisation of bottled water had been valid. However, due to the change of two of those conditionings, the adequate environment for a thriving mineral water business stopped and the market rapidly grinded to a halt.

The first factor which transformed and therefore hindered the demand for bottled mineral water was the improvement of water sanitation techniques. As it has been explained in chapter 3, several innovations in the field of water management greatly improved the mains' water quality in Catalonia. Perhaps the most determinant one was the popularisation of the use of chlorine to kill potential pathogens present in the water. The high effectiveness chlorine has as a water disinfectant guaranteed that tap water treated this way could be consumed by citizens with confidence. This meant that those drinking mineral water as an alternative to mains water could stop buying bottled water and instead consume the much cheaper public water, so a proportion of demand was lost (Back, Landa et al. 1995).

The second factor which influenced the downturn of bottled mineral water was that the cultural and social disposition towards it decreased dramatically thanks to the rise of modern medical treatment techniques and the consequent decline of hydrotherapy. The discovery and popularisation of penicillin, discovered by Alexander Fleming in 1928 (Wermuth), together with other medical advances supposed a severe blow to the hydrotherapeutic sector, which included spas and mineral water. Since, thanks to advances in medicine, people could heal their illnesses in an effective way from home, without the need of spending weeks at a bathhouse, the decline of spa towns became common across Europe (van Tubergen, van der Linden 2002, Widmann 1999).

The decline of bathhouses had a knock-on effect on the bottling water business, as many spas had bottling plants. The loss of popularity of spas and water treatment techniques meant that the social and cultural tradition which had blossomed for over 100 years came to an end. With the change of paradigm, movements like hygienism or hydrotherapy lost their popularity, meaning that the cultural tradition derived from them –which included the development of bottled water-, started a time recession.

Even if the other two conditionings, an efficient transport and an adequate container, were not altered by the use of chlorine and the improvement of modern medicine, the change of circumstances was enough to end the success that had characterised the initial stages of the bottled mineral water business. The industry in Catalonia remained in a latent stage with only a handful of companies producing bottled water until circumstances changed again between the 1970s and the 1980s, but that is another story which does not fit within the scope of this thesis.

7.2 Limitations of the research

Even if the best effort has been put into the research that has led to the elaboration of this thesis, some difficulties have been impossible to overcome and have to be taken into account when considering the final result.

Firstly, a one hundred per cent complete list of all Catalan mineral water bottlers throughout history has been unattainable. All books, archives, articles or almanacs which included references of mineral water brands have been found to be extremely limited and atomised. Therefore, a lot of effort has been put into creating a detailed inventory of Catalan mineral water bottlers. The utilised sources of information have usually been fragmented, which has forced using a varied array of materials, from advertisements in the press, to mentions in books or private collections. At times the information found relative to a brand was just a name, occasionally only the spring was mentioned, sometimes more information was given, but each time a thorough process of research has been carried out to obtain as much information about each manufacturer as possible. This has meant that the most complete list of Catalan mineral water bottlers that exists has been created *ad hoc* for this thesis, but it also means that there surely are some brands missing. Although all preponderant springs and most highly local or efimeral brands have been inventoried, it is likely that some bottlers which were unknown to most of the public have been skipped and not included in the list. It is impossible to know how many –if any- missing brands have been ignored in this thesis, but what it can be said, is that this study holds the most detailed list available to researchers at the present time. A side limitation, linked to the lack of information about some of the brands, has been that in many cases a firm production start date for them has been impossible to find. To overcome this limitation, when a brand's start date was unknown, it has been traced as far back in time as possible. When the track of the brand disappeared, the first found date was established. This means that some dates may or may not be exact, but the best available year has been used.

Secondly, an explanation regarding the relationship between aquifers and mineral water bottlers has not been found. As explained in chapter 5.2.3, there is an apparent relationship between mineral water bottlers and areas where aquifer types change, as most bottlers have been located on those frontier regions. Even after asking to several renowned hydrologists and consulting relevant literature, no clear explanation about why this relationship exists has been found. It would be necessary to do a more specific research to find an explanation about it and see if this relationship is just casual or if it follows a causal reason.

Finally, the most important limitation this thesis presents is the lack of a monographic study of a specific brand. Only a handful of brands were suitable to be included in a monographic study since it was considered they had to fulfill three requirements:

- Have started their mineral water bottling business before 1930
- Be currently active
- Distribute its water throughout Catalonia

The reason why an in-depth study of one of the three brands that complied with all requirements has not been included in this thesis is because it has been impossible to access the archives of those businesses even if many tries were made. After contacting with them, different reasons were argued by the companies to not allow access to their sources of information. For example, they argued that the companies' archives had been lost, they had been moved to another country or they directly said that they did not want a researcher investigating their paperwork, even if only historical documentation was involved. As a result, it has been impossible to carry direct research in any of the pre-established candidates and the monographic study had to be cancelled.

7.3 Future lines of research

The initial goal of this thesis was to explain the history, evolution and current situation of the Catalan bottled mineral water market and with all the found information to elaborate a prognosis of the trade. However, due to the lack of previous studies, it was considered that it would be more relevant to focus the study in the history of the market and leave other considerations for future research.

The study of bottled mineral water, not only in Catalonia, is in its initial stages. It is hoped that this thesis will be a starting point for new research topics about the world of mineral water from historical, cultural, geographical, environmental or economical perspectives. Thanks to the special characteristics bottled mineral water has, multidisciplinary studies can be carried out to impulse a higher level of understanding of the role bottled water plays in several aspects of economy and society.

Amongst the new research topics which could take this thesis as a starting point, the following can be highlighted:

- Application of the proposed theory to other European countries
- Bottled water today: Producers and Consumers
- Bottled water vs. Tap water
- Multinational corporations and bottled water
- Bottled water and nationalism
- Bottled water consumption and underground nitrate pollution
- Bottled water and environment
- Waste generation related to plastic bottles
- Overexploitation of aquifers
- Bottled water and rural economies
- Media and bottled water
- Bottled water vs. Wine vs. Soft drinks
- Sustainability of the mineral water bottling business
- Study of mineral water advertisements
- Nature and mineral water marketing

- Health benefits/problems of consuming exclusively mineral water
- Tourism and mineral water
- Cultural landscapes of mineral water

The future research potential which could stem from this thesis is therefore important and broad, covering not only geography, but also many other fields of knowledge. Either the thesis' author or other researchers should continue the path opened by this piece of work, as the study of mineral water bottlers and all the facts that surround it still remains largely unexplained.

7.4 Implications of research

A theory about why did the mineral water industry start and finish when it did was formulated at the beginning of the research, and the entire thesis has been orientated to prove or disprove it. The final conclusion has been that the formulated theory has shown to be valid in the Catalan case. It was not until all four factors - an adequate container, an efficient transportation method, a cultural/social predisposition and lack of salubrious water- occurred coetaneously that the trade became successful. During the years that went from approximately the 1850s to the 1930s all four conditions were valid in Catalonia, so mineral water was a commodity consumed by the general public. However, at the point in time when some of those requisites changed, mineral water in Catalonia lost its popularity. It would be interesting to see if the same theory can be applied to other European countries, but that will have to be done in future research.

In consequence, it can be argued that bottled water was a product of its time, and the proposed theory can be applied to other products of the period. Some of them, like sodas or bottled beer survived the test of time and have become commodities which can be purchased virtually anywhere. Other products originated during the same time like lithium water or siphons have seen their market shrink dramatically. Bottled water has followed an intermediate path, it was highly successful during the period explained in this thesis, but it suffered a big crisis when conditions explained in the theory changed. However, when those circumstances changed again, bottled water was capable of becoming a commodity once again.

Due to a lack of previous research, this thesis can be considered to be innovative and original research. However, several contributions should be especially highlighted as they represent a breakthrough in the discipline. The most important one is that for the first time a detailed list of those mineral water brands which started before the year 1930 has been created (Annex 2). Existing lists found in relevant literature were very limited and partial, with only a handful of brands shown. The proposed list includes 89 Catalan mineral water bottlers of which 52 have been confirmed that started production before 1930, an extraordinary number for such a small territory. This list has the potential of being used by researchers looking at the same research topic, so it is a relevant starting point.

Apart from all found brands which had been lost in the mist of time, each chapter presents original research and new discoveries regarding bottled water. The role of the container or the importance of the social predisposition as catalysts of the success of the new trade has been formulated for the first time. In this thesis, the geological conditionings to bottled water, even if well studied by geologists, have focused in what does a source need to become successful, discovering in the meanwhile the important role radioactivity had for a couple of decades or that successful sources are located in instable tectonic areas. Also, the role of the medical profession and epidemics in the increase of demand of bottled water has been explained, finding that a change of use and denomination, from medicinal water to table water, spurred the popularity of mineral water and boosted its production and consumption. Finally, the importance of transport as a vector of productive dissemination has been found, linking the expansion of production centres with the proliferation of new railways and roads.

Thanks to the intensive use of GIS throughout the dissertation, a series of original maps have been produced, some of them of interest to bottled water researchers, while others may be found relevant by other disciplines. Some significant examples are maps regarding the relationship between religious buildings and springs, early connectivity maps, earthquake maps or historical maps.

Overall, this thesis can be considered as the stepping stone in the study of mineral water in Catalonia, as it explains how a new trade came to be and how it became redundant. The proposed theory should be tested in other countries to see if it can be applied internationally. At least in the Catalan case it helps to elucidate how, when and why bottled mineral water started and ended during its first period of success, something which had never been explained before.

7.5 Final conclusion

The lack of scientific research about the initial stages of the mineral water business in Catalonia is somewhat surprising as the country is currently the largest manufacturer in Spain and it is one of the biggest producers in Europe, both in the absolute and relative terms. Some of the most preeminent springs and brands have their origin in Catalonia, but almost no geographers, historians or economists have researched how all this productive network came to be. A study regarding the origins of the trade in Catalonia was therefore imperative.

The history of bottled mineral water in Catalonia is not a simple one as it is not linear. Even if a few earlier examples can be found, it could be said that the trade began around the 1850s, reached its peak during the 1910s and lost its momentum in the 1930s. During most of the 20th century, bottled water lost its commodity condition and became a product used scarcely, so only a few manufacturers were able to continue their business. However, between the 1970s and 1980s, a certain revival was experienced, with an increasing success which has lasted until the present decade. Nonetheless, it has yet to be seen if the economic downturn will affect the thriving industry once more. Since the history of bottled mineral water in Catalonia had yet to be explained, it was considered that the best place to start was at the beginning, so this is why this thesis covers the first “golden period” of the trade, from its initial stages to the downfall of the business in the 1930s. The rest of the story up until nowadays remains to be explicated.

Several conditionings were necessary in order to make the new business viable. Without an appropriate container, water could not be effectively transported. Without an adequate transport network the distribution of mineral water would have been too expensive and unreliable to make a profitable business. Without an untrustworthy water distribution system demand for alternative ways of keeping hydrated would have not been necessary. Without a social predisposition towards the benefits of mineral water other liquids would have prevailed. It was therefore necessary that all those factors occurred at the same time to make the mineral water business successful and to have a demand large enough to sustain the offer. As it has been proven, when two of those factors changed, the sector almost succumbed.

The thesis has explained how each of these conditioning evolved towards a point where they were relevant to bottled water production. Even with all the limitations originated by the lack of previous studies, this piece of work has been capable to prove that the sale of mineral water inside a bottle was not a spurious act, it happened because a series of factors occurred at the same time. Until that point, the sale of mineral water to populated places was condemned to be a marginal activity without any prospects to expand. It was not until all four factors concurred in time that the business was able to grow and became a relevant sector of the Catalan economy, with advertisements in the press of the time and social repercussion.

Due to the special characteristics of mineral water –it is ineluctably linked to a spring-, its spatial distribution is different from other types of industry, which have the liberty of to locating themselves depending on the circumstances. This aspect of the industry means that its analysis has to take geography into account, as economical and historical factors alone will not draw the bigger picture. The use of modern cartographic methods has allowed finding new relationships between the location of mineral water bottling plants and other factors, like geology, transport, population or bathhouses. These relationships have helped to tune the explanation provided by the proposed model, while highlighting previously unknown relationships.

To conclude, the study of bottled mineral water is still in its starting stages. Even if this thesis is an important step forward to understanding the field, more work is required to fully appreciate the implications the business had and has in Catalonia. Hopefully, future work will explain more aspects about the bottled mineral water market both, in Catalonia and outside.

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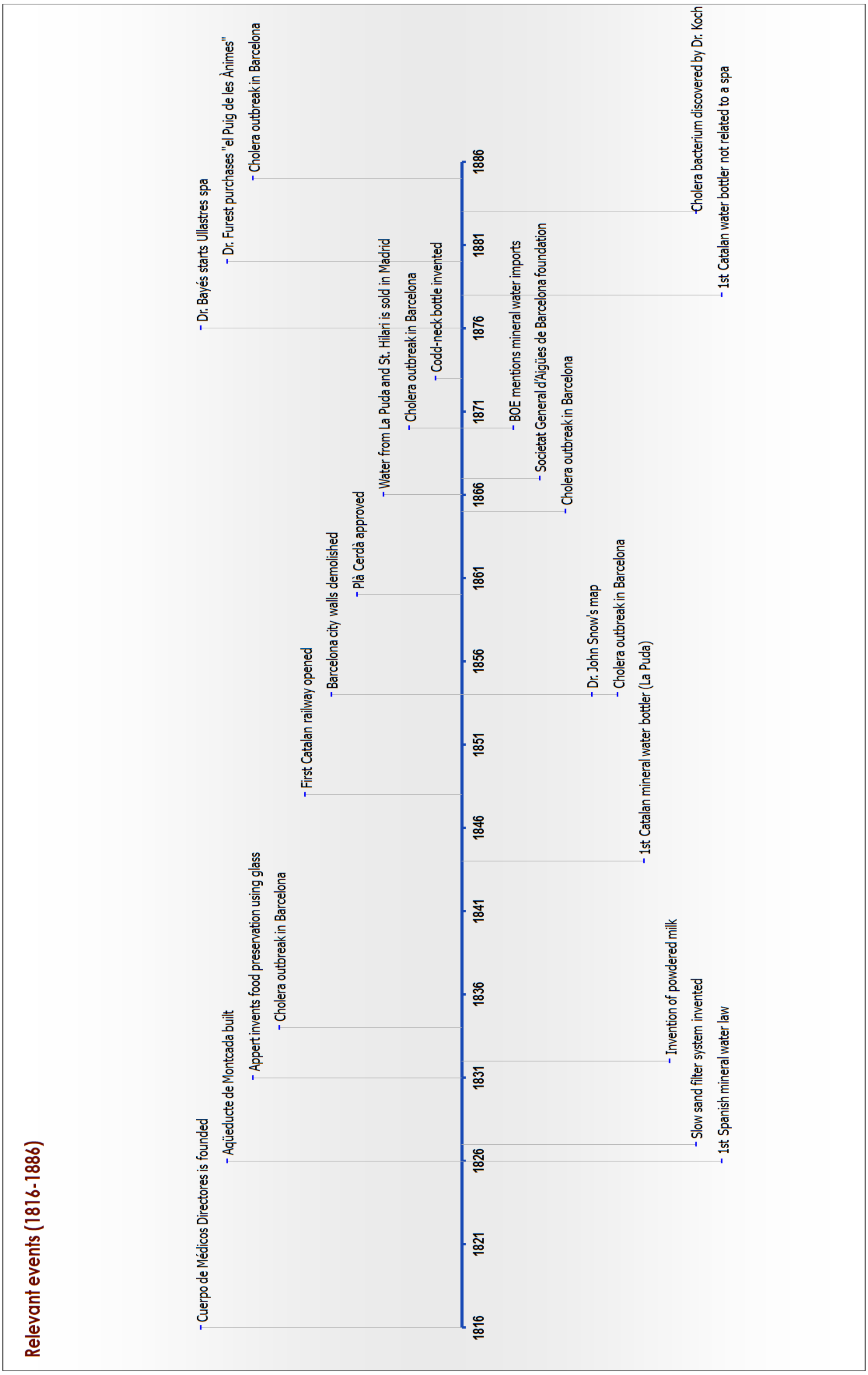
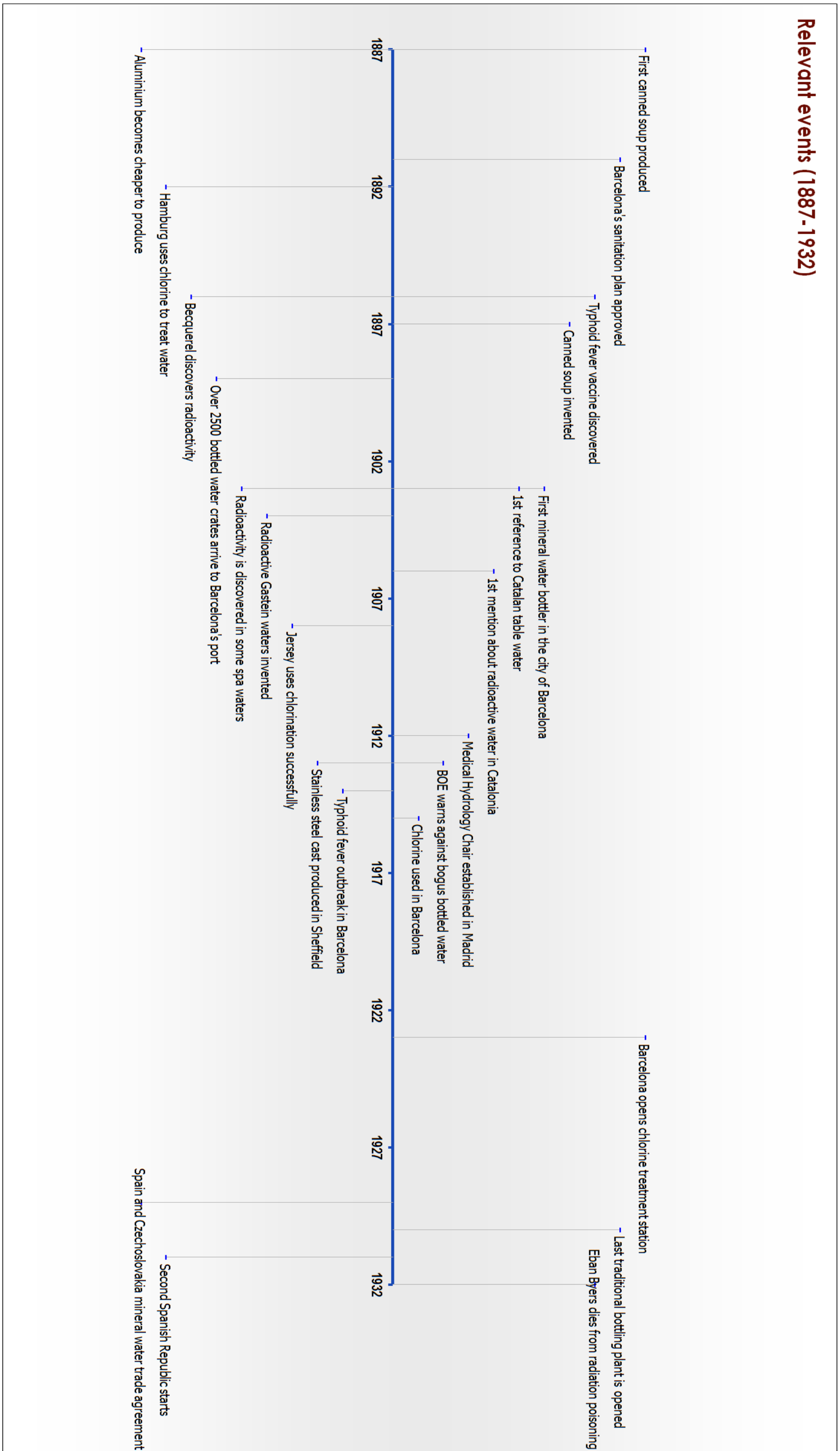
Appendices

Appendix 1. Timetable




Relevant events (1887-1932)
First canned soup produced
Aluminium becomes cheaper to produce
Barcelona's sanitation plan approved
Hamburg uses chlorine to treat water
Becquerel discovers radioactivity
Typhoid fever vaccine discovered
Canned soup invented
Over 2500 bottled water crates arrive to Barcelona's port
First mineral water bottler in the city of Barcelona
1st reference to Catalan table water
Radioactivity is discovered in some spa waters
Radioactive Gastein waters invented
1st mention about radioactive water in Catalonia
Jersey uses chlorination successfully
Medical Hydrology Chair established in Madrid
BOE warns against bogus bottled water
Stainless steel cast produced in Sheffield
Typhoid fever outbreak in Barcelona
Chlorine used in Barcelona
Barcelona opens chlorine treatment station
Spain and Czechoslovakia mineral water trade agreement
Last traditional bottling plant is opened
Second Spanish Republic starts
Eban Byers dies from radiation poisoning
1887
1892
1897
1902
1907
1912
1917
1922
1927
1932

Appendix 2. List of Catalan mineral water bottlers

	Brand's Name	Spring's Name	Town	Shire	Province	FFD[88]	EU 2010[89]
1	Agua Better	Font del Ferro	Sant Fost de Campsentelles	Vallès Oriental	Barcelona	1927	
2	Agua de Cabrera	Manantial de Modolell	Cabrera	Maresme	Barcelona	1939	
3	Agua de Cabrils	Manantial de la Sta. Cruz	Cabrils	Maresme	Barcelona	1965	
4	Agua de Palou	Font de Ràdium	Granollers	Vallès Oriental	Barcelona	1923	
5	Agua de Tona de Ullastres	Ullastres	Tona	Osona	Barcelona	1903	
6	Agua del Carol	Manantial de Vallbona	Vallbona d'Anoia	Anoia	Barcelona	1956	
7	Agua del Grébol	?	Vimbodí	Conca de Barberà	Tarragona	1984	
8	Agua Fargas	Font d'en Fargas	Barcelona	Barcelonès	Barcelona	1903	
9	Agua Mans	?	?	?	?	1920	
10	Agua Radial	Casa Queralt	Barcelona	Barcelonès	Barcelona	1909	
11	Agua San Martín	Font del Porró	Torrelles del Llobregat	Baix Llobregat	Barcelona	1915	
12	Agua Sarva	?	Barcelona	Barcelonès	Barcelona	1914	
13	Agua St. Climent	?	Sant Climent Sescebes	Alt Empordà	Girona	1917	
14	Agua Stirling	Font de can Pascol (Pascual)	Barcelona	Barcelonès	Barcelona	1923	
15	Agua Val-Par	Manantial Vall-par	Barcelona	Barcelonès	Barcelona	1913	
16	Agua Vital de Fournier	?	La Garriga	Vallès Oriental	Barcelona	1930	
17	Aguas de Madremaña	Nuestra Señora de los Ángeles	Madremanya	Gironés	Girona	1899	
18	Aguas Minerales de Vallfogona de Riucorb	Fuente Grande y Pequeña	Vallfogona de Riucorb	Conca de Barberà	Tarragona	1905	
19	Aigua Argentona	?	Argentona	Maresme	Barcelona	1898	
20	Aigua Salenys	?	Bell Lloc, Santa Cristina d'Aro	Baix Emporda	Girona	1923	
21	Aiguaneu	Aiguaneu	Espinelves	Osona	Girona	2004	Yes
22	Balneari del Porcar	Nostra Senyora de l'Esperança	Tortosa	Baix Ebre	Tarragona	1883	
23	Brugués	?	?	?	?	1916	
24	Burriach	Manantial Burriach	Argentona	Maresme	Barcelona	1910	
25	Caldes de Boí	Font del Bou	Vall de Boí	Alta Ribagorça	Lleida	1961	Yes
26	Can Tancat	?	?	?	?	?	
27	Cardó	Cardó	Benifallet	Baix Ebre	Tarragona	1974	

88 First Found Date. In some cases it refers to precise the date it has been found the bottler started selling its water, but in others is the first date of which information about the company has been found.
89 Sources which were listed as recognized potential producers of mineral water by the European Union in the year 2010

	Brand's Name	Spring's Name	Town	Shire	Province	FFD[88]	EU 2010[89]
28	Clarà	?	Argentona	Maresme	Barcelona	?	
29	Codolier	Mina San Antonio	?	?	?	?	
30	Font Agudes del Montseny	Font Agudes del Montseny	Arbúcies	Selva	Girona	1966	Yes
31	Font Aiguaviva	Font Aiguaviva	Sta. Margarida i els Monjos	Alt Penedès	Barcelona	?	Yes
32	Font de Sant Llop	Font de Sant Llop	Hortsavinyà	Maresme	Barcelona	?	
33	Font del Camí	Font del Camí	La Secuita	Tarragonès	Tarragona	1995	
34	Font del Ferro	Font del Ferro	Montcada	Vallès Occidental	Barcelona	1885	
35	Font del Pi	Font del Pi	Guissona	Segarra	Lleida	1974	
36	Font del Pic	Manantial Font del Pic	St. Hilari Sacalm	Selva	Girona	1968	
37	Font del Regàs	Font del Regàs	Arbúcies	Selva	Girona	1890	Yes
38	Font del Subirà	Subirà	Osor	Selva	Girona	1998	Yes
39	Font la Collada	?	Santa Oliva	Baix Penedès	Tarragona	?	
40	Font Nova	?	Vilanova i la Geltrú	El Garraf	Barcelona	?	
41	Font Nova del Pla	Font Nova del Pla	Aiguamúrcia	Alt Camp	Tarragona	?	Yes
42	Font Picant	Font Picant	Amer	Selva	Girona	1994	Yes
43	Font Picant	Font Picant	St. Hilari Sacalm	Selva	Girona	1879	
44	Font Vella	Sacalm	St. Hilari Sacalm	Selva	Girona	1966	Yes
45	Fontdaira	Sant Aniol	St. Aniol	La Garrotxa	Girona	?	
46	Fontdalt	Fontdalt	Tivissa	Rivera d'Ebre	Tarragona	?	Yes
47	Fontdor	Fontdor	St. Hilari Sacalm	Selva	Girona	1972	Yes
48	Fonter	Fonter	Amer	Selva	Girona	1903	Yes
49	Fontselva	Fontselva	St. Hilari Sacalm	Selva	Girona	1992	Yes
50	Fuente Estrella	Fuente Estrella	St. Hilari Sacalm	Selva	Girona	2002	Yes
51	Fuente Tenebrosa	Fuente Tenebrosa	Barcelona	Barcelonès	Barcelona	1916	
52	Imperial	Imperial	Caldes de Malavella	Selva	Girona	1902	Yes
53	Jalpí	Jalpí	Tordera	Maresme	Barcelona	1901	
54	La Mina	Manantial la mina	Barcelona	Barcelonès	Barcelona	1917	
55	La Puda	La Puda	Monistrol de Montserrat	Bages	Barcelona	1844	
56	La Roca	?	La Roca del Vallès	Vallès Oriental	Barcelona	?	
57	La Roureda/Agua Suprema de Mesa 'M'	?	Sant Pere de Vilamajor	Vallès Oriental	Barcelona	1929	
58	Les Creus	Les Creus	Maçanet de Cabrenys	Alt Empordà	Girona	1955	Yes
59	Les Masies	Font del Ferro	L'Espluga de Francolí	Conca de Barberà	Tarragona	1907	

	Brand's Name	Spring's Name	Town	Shire	Province	FFD[88]	EU 2010[89]
60	Malavella	Malavella	Caldes de Malavella	Selva	Girona	1845	Yes
61	Miralles	Miralles	Sant Daniel	Gironés	Girona	1904	
62	Mont-Alt	?	Barcelona	Barcelonès	Barcelona	1920	
63	Mont-Missé	?	St. Vicenç de Montalt	Maresme	Barcelona	?	
64	Orión	?	Sta. Coloma de Farnés	Selva	Girona	1916	
65	Pallars	?	Rialp	Pallars Sobirà	Lleida	1968	
66	Pineo	Pineo	Estamariu	Alt Urgell	Lleida	?	Yes
67	Prats de Rey	?	Prats de Rei	Anoia	Barcelona	1912	
68	Ribes	Fontaga	Ribes de Freser	Ripollès	Girona	1917	Yes
69	Rocafort	?	St. Martí de Riucorb	Urgell	Lleida	1909	
70	Rocallaura	Virgen de Tallet	Vallbona de les Monges	Urgell	Lleida	1909	Yes
71	Rodas	Massana	Pau	Alt Empordà	Girona	1929	
72	Rubinat-Llorach	Cardona	Rubinat	Segarra	Lleida	1878	
73	San Narciso	San Narciso	Caldes de Malavella	Selva	Girona	1870	Yes
74	San Román, Salat y Serre	?	Rubinat	Segarra	Lleida	1898	
75	Sant Aniol	Sant Aniol	St. Aniol de Finestres	Garrotxa	Girona	1997	Yes
76	Sant Genís	?	?	?	?	1915	No
77	Sant Hilari	Sant Hilari	St. Hilari Sacalm	Selva	Girona	1997	Yes
78	Santa Rita	Santa Rita	Barcelona	Barcelonès	Barcelona	1910	
79	Segalés	Segalés	Tona	Barcelonès	Barcelona	1878	
80	Thermion	?	Caldes de Montbui	Vallès Oriental	Barcelona	1909	
81	Timó	Timó	Sant Pere dels Arquells	Segarra	Lleida	1900	
82	Titus	Manantial Titus	Caldes d'Estrac	Maresme	Barcelona	1900	
83	Vertientes Montseny	?	La Garriga	Vallès Oriental	Barcelona	1916	
84	Vichy Catalán	Vichy Catalán	Caldes de Malavella	Selva	Girona	1883	Yes
85	Viladrau	Fontalegre La Curanya	Arbúcies	Selva	Girona	1973	Yes
86	Vilajuïga	Vilajuïga	Vilajuïga	Alt Empordà	Girona	1904	Yes
87	Vila-Roja	Fuente de la Pólvora	Vila-Roja	Gironés	Girona	1902	
88	Xaró	?	La Pobla de Claramunt	Anoia	Barcelona	?	
89	Xavi Lluís	?	Santes Creus	Alt Camp	Tarragona	?	

Appendix 3. List of towns where bottled water has been produced

	Town	Number of bottlers	Latitude	Longitude
1	Barcelona	9	41,421	2,165
2	St. Hilari Sacalm	7	41,879	2,511
3	Caldes de Malavella	4	41,839	2,810
4	Arbúcies	3	41,817	2,514
5	Argentona	3	41,556	2,401
6	Amer	2	42,009	2,604
7	La Garriga	2	41,683	2,286
8	Rubinat	2	41,626	1,321
9	St. Aniol de Finestres	2	42,090	2,588
10	Tona	2	41,860	2,232
11	Aiguamúrcia	1	41,330	1,359
12	Bell Lloc, Santa Cristina d'Aro	1	41,831	2,979
13	Benifallet	1	40,975	0,517
14	Cabrera	1	41,526	2,394
15	Cabrils	1	41,526	2,369
16	Caldes de Montbui	1	41,630	2,166
17	Caldes d'Estrac	1	41,570	2,527
18	Ribes de Freser	1	42,306	2,169
19	Espinelves	1	41,868	2,418
20	Estamariu	1	42,374	1,524
21	Granollers	1	41,600	2,268
22	Guissona	1	41,787	1,291
23	Hortsavinyà	1	41,627	2,645
24	La Pobla de Claramunt	1	41,553	1,676
25	La Roca del Vallès	1	41,590	2,326
26	La Secuita	1	41,204	1,281
27	L'Espluga de Francolí	1	41,379	1,091
28	Maçanet de Cabrenys	1	42,386	2,754
29	Madremanya	1	41,991	2,956
30	Monistrol de Montserrat	1	41,610	1,843
31	Montcada	1	41,483	2,189
32	Osor	1	41,947	2,553
33	Pau	1	42,315	3,115
34	Prats de Rey	1	41,705	1,541
35	Rialp	1	42,443	1,135
36	Sant Climent Sescebes	1	42,367	2,980
37	Sant Daniel	1	41,988	2,834
38	Sant Fost de Campsentelles	1	41,511	2,234
39	Sant Pere de Vilamajor	1	41,685	2,391
40	Sant Pere dels Arquells	1	41,643	1,317
41	Santa Oliva	1	41,253	1,550
42	Santes Creus	1	41,347	1,363
43	St. Martí de Riucorb	1	41,563	1,056

	Town	Number of bottlers	Latitude	Longitude
44	St. Vicenç de Montalt	1	41,583	2,510
45	Sta. Coloma de Farnés	1	41,862	2,665
46	Sta. Margarida i els Monjos	1	41,321	1,663
47	Tivissa	1	41,040	0,733
48	Tordera	1	41,702	2,719
49	Torrelles del Llobregat	1	41,360	1,981
50	Tortosa	1	40,816	0,524
51	Vall de Boí	1	42,505	0,804
52	Vallbona d'Anoia	1	41,518	1,707
53	Vallbona de les Monges	1	41,526	1,089
54	Vallfogona de Riucorb	1	41,563	1,237
55	Vilajuïga	1	42,325	3,091
56	Vilanova i la Geltrú	1	41,221	1,726
57	Vila-Roja	1	41,970	2,839
58	Vimbodí	1	41,401	1,049

Appendix 4. Current[90] list of recognised Catalan mineral waters

Trade Description	Name of source	Place of exploitation	Province
Aiguaneu	Aiguaneu	Espilnelves	Girona
Caldes de Bohi	Font del Bou	Barruera	Lleida
Estrella V	Estrella V	Arbúcies	Girona
Font Agudes del Montseny	Font Agudes del Montseny	Arbúcies	Girona
Font Aiguaviva	Font Aiguaviva	Santa Margarida i els Monjos	Barcelona
Font del Regàs	Font del Regàs	Arbúcies	Girona
Font del Subirà	El Subirà	Osor	Girona
Font Nova del Pla	Font Nova del Pla	Aiguamúrcia	Tarragona
Font Picant	Font Picant	Amer	Girona
Font Vella	Font Sacalm	Sant Hilari Sacalm	Girona
Fontdalt	Fontdalt	Tivissa	Tarragona
Fontdor	Fontdor	Sant Hilari Sacalm	Girona
Fonter	Fonter	Amer	Girona
Fuente Estrella	Fuente Estrella	Arbúcies	Girona
Imperial	Imperial	Caldes de Malavella	Girona
Les Creus	Les Creus	Maçanet de Cabrenys	Girona
Malavella	Malavella	Caldes de Malavella	Girona
Pineo	Pineo	Estamariu	Lleida
Ribes	Fontaga	Ribes de Freser	Girona
Rocallaura	Agua de Rocallaura	Vallbona de les Monges	Lleida
San Narciso	San Narciso	Caldes de Malavella	Girona
Sant Aniol	Sant Aniol	Sant Aniol de Finestres	Girona
Sant Hilari	Sant Hilari	Arbúcies	Girona
Vichy Catalán	Vichy Catalán	Caldes de Malavella	Girona
Viladrau	Fontalegre	Viladrau	Girona
Vilajuïga	Vilajuïga	Vilajuïga	Girona

[90] As 21/11/2012 by the European Union (European Union 2012).

Appendix 5. Antique satirical cartoons about water pollution in Barcelona from the Campana de Gràcia and the L'Esquella de la Torratxa magazines

Figure I. Auca regarding the 1885 cholera outbreak (L'Esquella de la Torratxa, 07/11/1885)

Figure II. Auca criticising the role of the Barcelona city council in the typhoid fever outbreak of 1914 (L'Esquella de la Torratxa 6/11/1914)

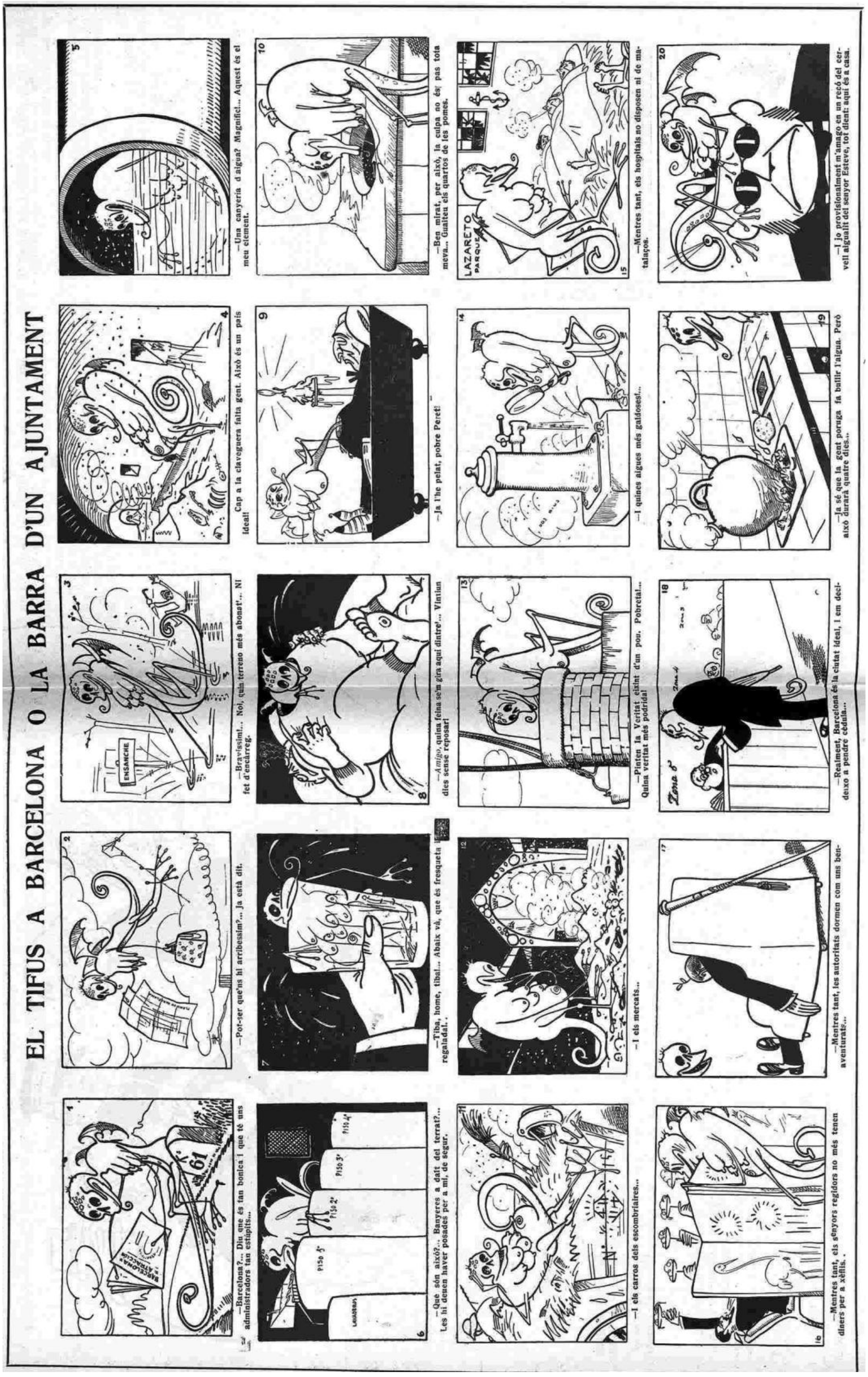


Figure III. L'Esquella de la Torratxa 6/11/1914

"THE PRECAUTION

- What do you want for desert? A grilled peach, a scalded apple or boiled strawberries?"

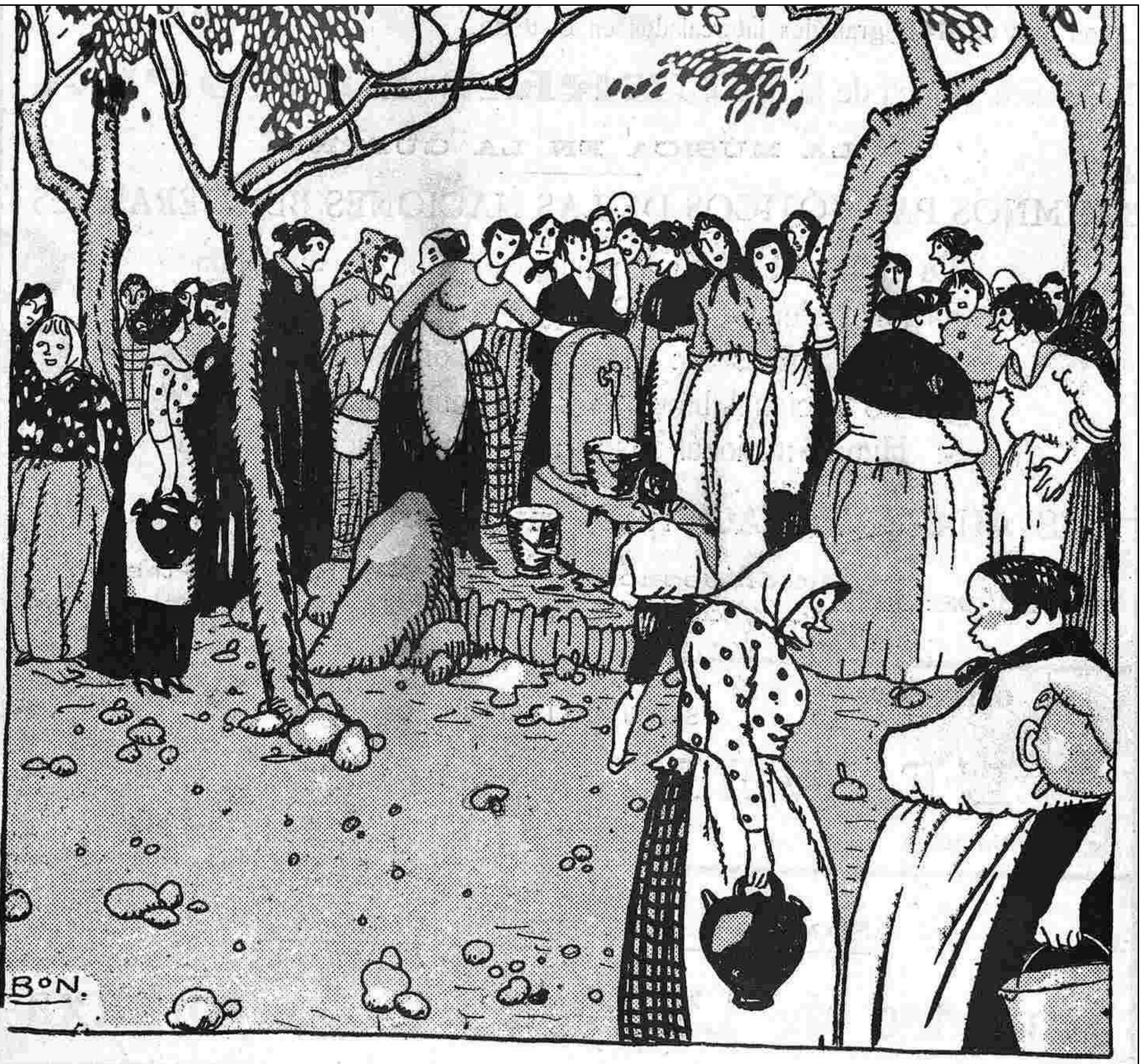
Figure IV. L'Esquella de la Torratxa 6/11/1914

"TAVERN WINE IS BAPTISED WITH BOILED WATER"

"A PREPARED BAR OWNER

To have many clients there is nothing like a good advertisement"

Figure V. L'Esquella de la Torratxa 6/11/1914



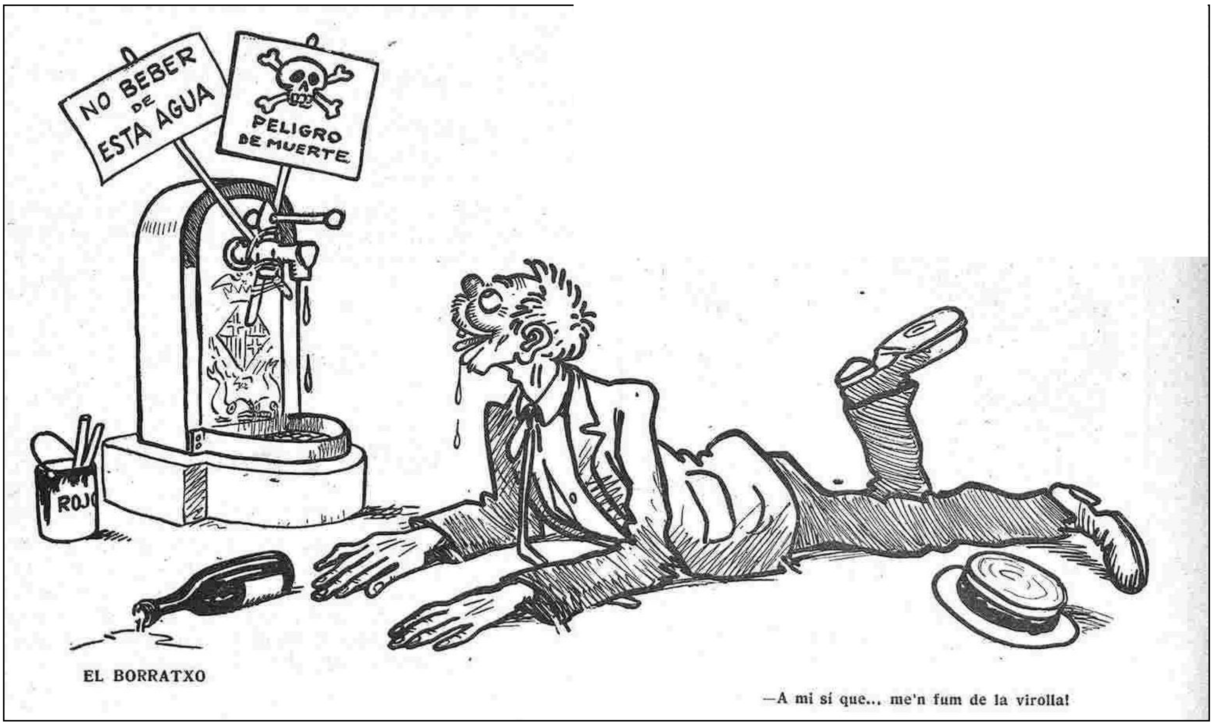
EL FOCO

—Sí, senyora, sí; tota està infectada. No serveix ni per a rentar.
—Ai, ai!... Els regidors bé *s'en renten les mans,* segons diuen.

"THE FOCUS

- Yes, madam, indeed; all of it is infected. It is not even good to clean.
- Oh dear...! Even though councilmen do *wash their hands*, I've heard."

Figure VI. L'Esquella de la Torratxa 6/11/1914



"DO NOT DRINK THIS WATER" "DANGER OF DEATH"

"THE DRUNKEN

- I don't care!"

Figure VII. L'Esquella de la Torratxa 6/11/1914

"THE NEW TURPENTINE

- Believe me Mr. President; send these to the German troops. They can be deadlier than a mortar."

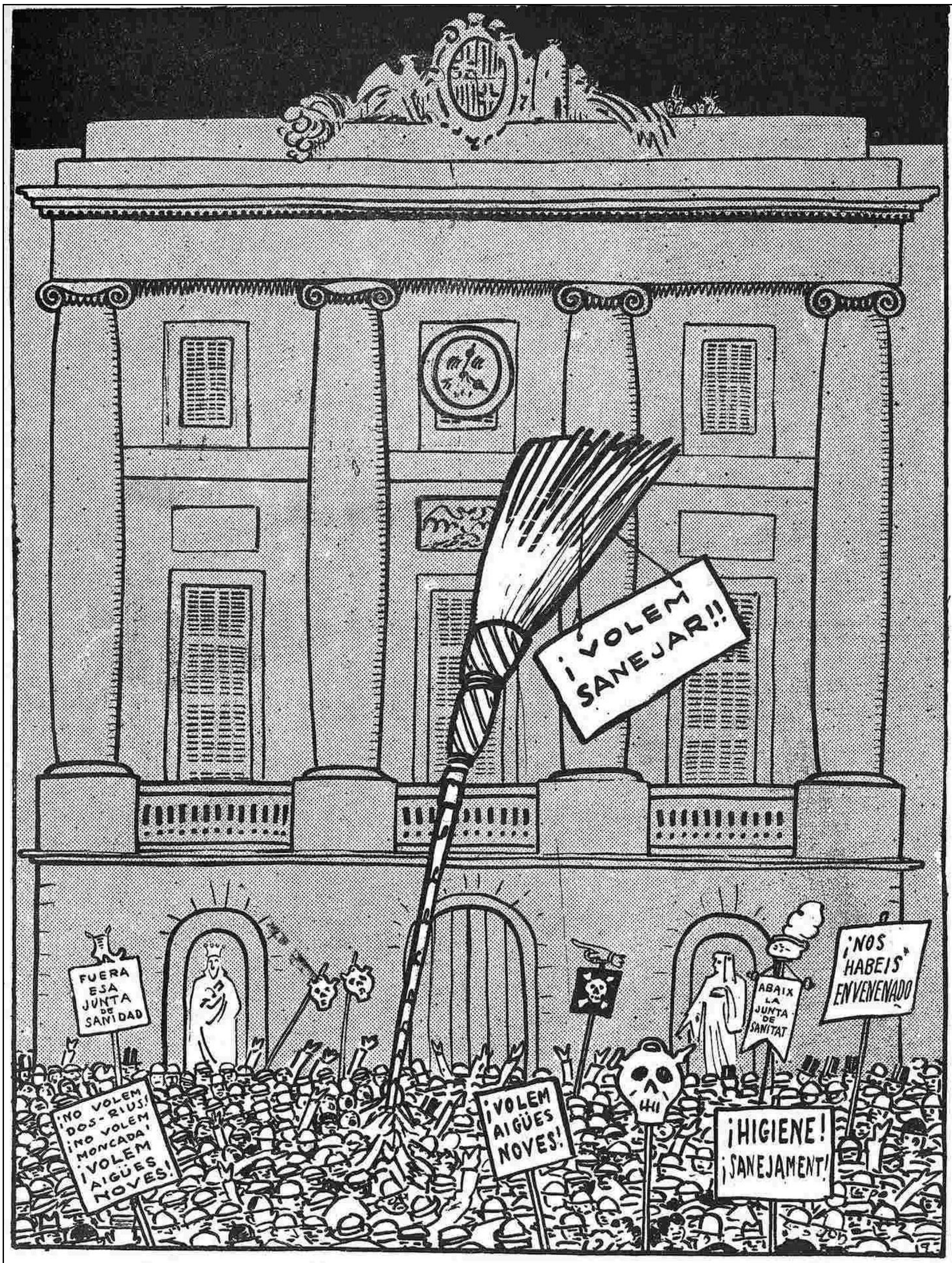
Figure VIII. L'Esquella de la Torratxa 13/11/1914

DRAMES CIUTADANS

Un suicidi barato, o en aquest món avui hi som i demà tampoc

"Leave alone, leave alone!!"
"CITY DRAMAS
A cheap suicide, or we are now in this world and not tomorrow"

Figure IX. L'Esquella de la Torratxa 13/11/1914



Una manifestació que hauria sigut altament simpática, si entre mig dels manifestants no s'hi haguessin vist els eterns pescadòrs d'actes municipals.

"WE WANT SANITATION!" "YOU HAVE POISONED US!" "WE WANT NEW WATERS"

"A demonstration which would have been nice if the searchers of municipal acts had not infiltrated it."

Figure X. L'Esquella de la Torratxa 13/11/1914

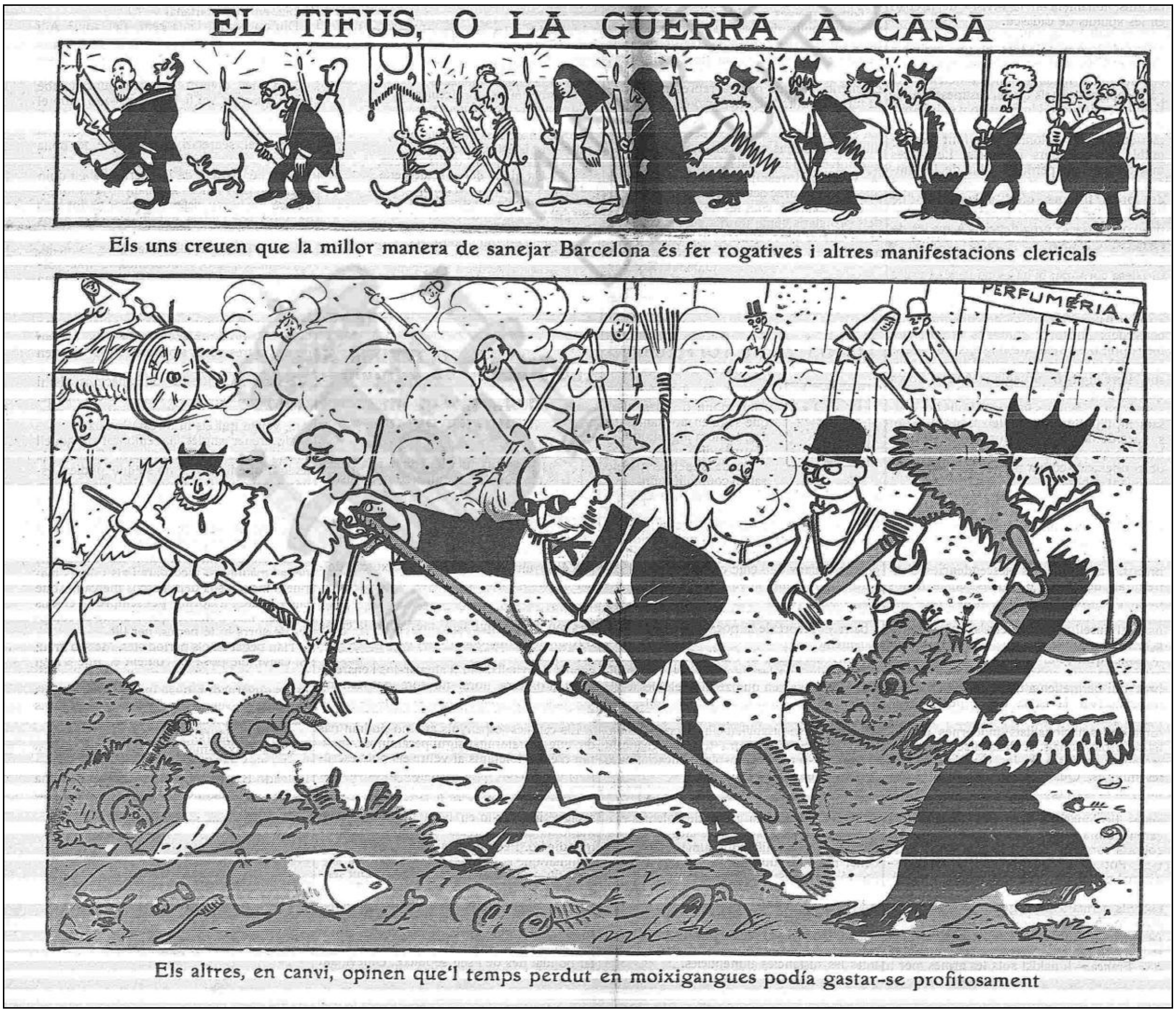
PASSANT LA PASSA

—Hola!... Quants ne té, vostè?
—Som nou de familia i, per ara, no més n'hi hà set que'l tinguin, gracies a Déu.

"PASSING THE OUTBREAK"

- Hi! How many do you have?
- Our family has nine members and, right now, only seven of them have it, thank God.

Figure XI. La Campana de Gràcia 14/11/1914



"TYPOID FEVER O THE WAR AT HOME"

"Some believe that the best way to clean Barcelona is to pray"

"On the other hand, others think that the time wasted could have been used more efficiently"

Figure XII. L'Esquella de la Torratxa 20/11/1914

MATRIMONI PROLÍFIC

El marit. — Noia, em sembla que nosaltres també n'hauriem d'adquirir una d'aquelxes màquines esterilitzadores...

"A PROLIPHIC MARRIAGE"

"The husband: Children, I think we should also need to purchase one of these sterilising machines…"

Figure XIII. L'Esquella de la Torratxa 20/11/1914

LA CONSIGNA DEL SÁNCHEZ

—Per a què serveix vostè?... Que no ho sab que no s'en pot beure d'aquelxa aigua empestifada?

—A mi no me han dicho res d'aixó. A mi solo me han dicho que vichile la font.

"THE SÁNCHEZ SLOGAN

- What are you good for…? Are you aware it is forbidden to drink this foul water?
- I have not been informed about this. They just told me to look after the fountain"

Figure XIV. L'Esquella de la Torratxa 20/11/1914

"DURING THE DESINFECTION"

- I have been well *pergamanated* by them painting the water red…! This is giving a bad example to taverns!

Figure XV. La Campana de Gràcia 21/11/1914

"PASSING THE OUTBREAK"

"The typhic bullfighter: Oh my God, what a thrust…!"

Figure XVI. L'Esquella de la Torratxa 27/11/1914

FUGINT DE L'EPIDEMIA

El barceloní.—Vaja, està vist que'l millor temps per a anar a estiuejar és l'hivern.

"RUNING AWAY FROM THE EPIDEMY"

"The citizen from Barcelona: It looks like the best time to go on a summer retreat is winter."

Figure XVI. L'Esquella de la Torratxa 18/12/1914

"-Where do you go so determined?

-To the Montseny mountains, to drink a lot of water. I am sick of drinking it boiled!"