Lessons Drawn From The History Of Heating:
A French Perspective

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This time, I will try to show that in France's history of heating there is knowledge that may help us today with issues in energy consumption. As an architect, I am accustomed to paying attention to home comfort and saving energy; my research on the history of heating complemented these professional concerns, so I will present key phenomenon's regarding the past that I came across and collected[1].

I will first show that often, innovations were done for other purposes than comfort. Secondly, there was, in France, an ambiguous relationship to innovations. The French can be good inventors, but the proliferation of their discoveries has been long and difficult. I wish to flesh out the cultural and social aspects of the notion of comfort in France. Lastly, I will show that the democratization of thermal comfort, beginning in the eighteenth century, was only completed during the second part of the twentieth century. We may ask the question - will energy saving take as long?

Innovation and Comfort

I have noticed that regularly, during different historical periods, innovations were primarily crafted for production purposes and only thereafter considered for comfort purposes. I will give a few examples of that phenomenon in various historical contexts. During the Roman Empire, Caius Sergius Orata (140-91 B. C.) who is considered the inventor of hypocaustus (an underground system of heating with smoke), was originally growing fish and oysters in

[1] Emmanuelle Gallo (2006) *Modernité technique et valeur d'usage : le chauffage des bâtiments d'habitations en France*, Dissertation, Institut d'art, Université de Paris I, 487 p. + 370 p.

pools which were heated from underneath the ground (around 80 B. C.)[2]. Afterwards, this system was applied to heat public and private baths and subsequently used to heat private spaces in important villas, more often in Northern territories (now in Germany, France, Belgium). The architect Vitruvius described a hypocaustus in the Ten Books on Architecture[3].

In medieval Europe, monasteries were places of architectural and technical innovation, but chimneys in a monastery were rare and located in the warming room. Kitchen chimneys were novel and developed in a very remarkable way in monasteries around Europe. At this time, the purpose was to cook enough food for a large community of monks, nuns and the numerous people working for them. One of the most interesting monastery chimneys in France is located in the Fontevrault Abbey along the Loire valley (twelve century) and the literature on the history of heating quotes other specimens located in different Europeans countries[4].

During the modern period, there was another productive field where new heating methods were experienced long before it was applied in living spaces: this is the case of greenhouses. From the early seventeenth century, there were several types of systems: indirect smoke heating underneath vaults or in hollow walls. At the end of the eighteenth century and early nineteenth century there was also steam heating or hot water heating systems to heat greenhouses. John Claudius Loudon (1783-1843) quoted several examples of this in his study

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[2] Pline L'ancien, *Histoire naturelle*, book IX, 168, (translation Saint-Denis E., Les belles lettres, Paris, 1955, p. 91). There are also references on Orata inVarron, Cicerone and Valère-Maxime.
There is a very interesting study on hypocausts in North Europe:
Jean-Marie Degbomont (1984) *le chauffage par hypocauste dans l'habitat privé de la place Saint-Lambert de Liège à l'Aula Palatina de Trêves*, Service d'Archéologie Préhistorique et Centre Interdisciplinaire de Recherches Archéologiques de l'Université de Liège, 240 p.

[3] Marcus V. Pollio Vitruvius, *Les dix livres d'architecture* (Balland, Paris, 1979, p. 171-173).

[4] Kitchens of Fontevrault and Marmoutiers abbeys in:
Raymond Oursel (1964) *Univers roman*, Office du Livre, Paris, p. 19
Eugène Viollet-le-Duc (1853) *Encyclopédie médiévale*, Paris, p. 384-396.
Abbot's kitchen in Glastonbury (fifteenth century), Wolsey's kitchen in Hampton Court in:
Shuffrey L. A. (1912) *The English Fireplace*, B. T. Batsford, London, p. 53.
Kitchen of the Cistercian abbey in Chorin (thirteenth century) in:
Alfred FABER (1957) *Entwicklungsstufen der Häuslichen Heizung*, R. Oldenbourg, München, p. 265.

of hothouses[5]. The French *Diderot and d'Alembert Encyclopedie* proposed different heating disposal systems in 1776.[6] The conservation of exotics plants and the production of vegetables or fruit came before domestic comfort. Sometimes, in winter, wine froze in glasses inside the Versailles castle, heated by chimneys, while pineapples shrubs were properly heated in the castle's greenhouses…

At the end of the eighteenth century and the early nineteenth century, we had several experiences in heating spaces using new means: steam and hot water pipes and stoves in different European countries. In industrial Great Britain, in the late years of the nineteenth century, steam heating systems appeared in cotton mills[7]. The purpose was certainly not the convenience of workers but to ease the production. The threads were less weak with heat, and breakage was rare.[8] In France, during the same period, hot water central heating was firstly developed by Jean-Simon Bonnemain (1743-1830)[9]. In 1777, this clever man built a system for hatching eggs and rearing chickens artificially. The purpose was clearly to produce chickens throughout the year, and that is what he did until the French revolution[10]. To build this device, the inventor had to set up a heat regulator consisting of a bimetallic strip going through the hearth of an iron stove. Latter, Bonnemain decided to apply his heat regulation system for other purposes: heating systems for greenhouses and bathtubs, kitchen stove, an apparatuses for melting suet, stills, laundering devices, a system to crystallise beetroot,

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[5] John Claudius Loudon (1817) *Remarks on the construction of Hothouses*, the Architectural library, London, p. 52. & p. 92.

[6] Diderot & d'Alembert (1776) *l'Encyclopédie*, vol. 19, p. 626, vol. 33, pl. 2., vol. 22, pl. 2 & 3.

[7] Some of this systems located in mills were described in:
Robertson Buchanan (1815) *A Treatise on the economy of fuel, and management of heat, especially as it relates to heating and drying by means of steam...*, Brash and Reid, Glasgow, 363 p.

[8] *Until the machinery acquires a certain degree of warmth, the spinners find it nearly impossible to keep their work in order; and this is most felt on Monday mornings, when every thing has become more cold and adhesive, through being a longer time at rest* in:
Thomas Tredgold (1824) *Principles of warming and ventilating public buildings, dwelling-houses, manufactories, hospitals, hot-houses, conservatories, &c...*, Josiah Taylor, London, p. 173-175.

[9] Emmanuelle Gallo (2006) *Jean Simon Bonnemain (1743-1830) and the Origins of Hot Water Central Heating, (*2nd International Congress on Construction History, Queens' College, Cambridge, UK, 29th March-2nd April 2006), Construction History Society, vol. 1, p. 1045-1060.

[10] Bonnemain is recorded as a poultry producer in the 'ancient regime' tax register (Archives Nationales série Z1)

another for retting hemp and other devices for different chemical uses.[11] Domestic heating applications were significantly delayed. The scientific community recognized the domestic use of Bonnemain's heating system after 1829, though there was only one case that could be confirmed between 1791 and 1816, in a farm in Monceau (now inside Paris)[12].

More recently, Gail Cooper, in her book *Air-conditioning America*, quoted one of the pioneers Stuart Cramer who tried to reach, during the first decade of the twentieth century, *the most favourable conditions to manufacturing* by introducing those systems in the American South textile industry buildings[13]. Controlling the humidity of air helped ease the different processes to make cotton or wool fabrics. A wider industrial development of air conditioning in America started in production buildings before being applied to offices, theatres, and houses.

We could see through those different cases that comfort, and especially home comfort, never came first. Now, however, this has become a more important issue in developed countries, but is comfort really as important as it's economic and industrial impact on our society?

French Attitude Toward Innovations

One of the other phenomenon's I had the opportunity to notice was the difficult rapport that innovations have had in France. The country has had good inventors, but the spread of their discoveries has often been long and difficult. Thus, Denis Papin (1647-1714) began studying steam engines in 1707 in France and he went in England to develop his inventions further. Philippe Lebon (1767-1804) experimented with gas production first in France but his networks developed quicker in England. The Marquis de Chabannes (1770-1835), one of the French pioneers of central heating, started his development in England where he was a refugee, but he never tried to introduce his heating innovations when he came back in France[14]. Great Britain certainly had a more developed industry than in France; there were

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[11] Jean Simon Bonnemain, *Mémoire sur le régulateur du feu*, sealed envelope n° 222, enclosure to the Académie des Sciences's report, 14 August 1782, Paris, 24 p., 6 pl. Jean-Simon Bonnemain (1784)*Objet d'économie - Régulateur du feu*, Le Noir – Clousier, Paris, 1 p.

[12] Rapport de séance 11 mars 1829, *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, vol. 30, p. 355.

[13] Gail Cooper (1998) *Air-conditioning America, Engineers and the Controled Environment, 1900-1960*, John Hopkins University Press, Baltimore, p. 17-23.

[14] The marquis de Chabannes published two books on heating and ventilation systems in England. They were not published in French, they were even not available in English in the numerous libraries in which I had done researches.

also the great economic difficulties due to political instability after the French revolution, as well as the lack of liquidities available for investment that were partly responsible for the situation. But, there was also a real caution, even fear, toward novelties. Another example from the latter part of the nineteenth century was that some towns transferred train stations, and steam power, out of their territories, even if it was not convenient. At present, those choices are still noticeable in the rail network. In the same spirit, laws and regulations were useful to reassure the population and are also a good sign of social anxiety. From 1810, a series of regulations came out, applying to boilers and steam power, their set-up and their location of space.[15]

The French Social and Cultural Reluctance towards Heating

From the thirteenth century, the traditional way of heating in France was the chimney leaned against masonry walls, apart from Alsace where stoves were used as in the nearby Alemannic area. Between the thirteenth century and the eighteenth century, the shapes of chimneys change step by step. The size of the hearth was reduced, the shapes, positions and sizes of smoke air ducts changed, but the general disposal and inefficiency stayed rather constant.

Some French soldiers and scientists travelling in other countries (North and East) discovered stoves and their thermal efficiency. Reactions were interesting: they were impressed by the heat, but found stoves unsightly and bulky. For the Marquis de Montalembert, French people were so much accustomed to symmetry and the pleasure of balance in interior decoration, that inserting such an incongruous object was unheard of![16] As those French travellers were not used to heated spaces they found the atmosphere too hot, their clothes were also probably inadequate. In 1758, King Louis XV asked for a ceramic stove in his sleeping room, which was king Louis XIV's bedroom, the architect in charge of the castle, Ange-Jacques Gabriel (1698-1782) disapproved this change for heritage and aesthetics reasons[17]. Afterwards, the king waited three years before having a second chimney, facing the other…

Jean-Baptiste Marie Frédéric Chabannes, marquis de (1815) *Explanations of a new method for warming and purifying the air in private houses and public buildings*, Schulze & Dean, London, 25 p.
Jean-Baptiste Marie Frédéric Chabannes, marquis de (1818) *On conducting air by forced ventilation, and regulating the temperature in dwellings*, Schulze and Dean, London, 79 p.
[15] Archives de la Préfecture de Police de Paris, décret du 18 mars 1824 (DB 141).
[16] Marc-René De Momtalembert, marquis de (1766) *Cheminée poêle ou poêle françois*, l'Imprimerie Royale, Paris, 20 p.
[17] Pierre Verlet (1985) *Le château de Versailles*, Fayard, Paris, p 313.

From the end of the eighteenth century to 1830, only a few French pioneers developed different types of central heating systems using hot air (with Désarnod), hot water (with Bonnemain and le marquis de Chabannes) and steam (with the stock exchange building)[18]. This experimental stage was followed by the development of those new systems mostly in public buildings (prisons, hospitals, schools, theatres, courts). But during the entire nineteenth century, the domestic use of central heating was generally delayed. Although most people, even engineers and architects, praised the opened chimney, it was a less efficient way of heating. The pleasant view of a fire and the efficient ventilation by the flue duct were usually pointed out. In the context of a continuous lack of wood, the use of coal or coke also came out in France and increased during the nineteenth century. Stoves and central heating allowed for an alternative - coal, which is not the case when it comes to traditional chimneys. But, this assessment did not stop the chimneys proselytes. In the house, even if stoves were also recommended, heating producers suggested hiding them or using them only in private and secondary rooms. Some procedures also suggested decorating them.

In spite of this cautious attitude, few architects involved themselves in the promotions of new means of heating: François Cointeraux (1740-1830), Joseph-François Désarnod, Hamon (for the first part of the nineteenth century) and Emile Trélat (1821-1907), Vallin, Vaudremer (1829-1914), Augustin Rey (1864-1934) (for the second part of the nineteenth century).[19]

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[18] This topic is largely developed in my dissertation.

[19] François Cointeraux (1792) *Le chauffage économique ou leçon élémentaires avec lesquelles chacun pourra chauffer à peu de frais l'intérieur de sa maison ou de son appartement*, Vezard et Le Normant, Paris, 28 p.
François Cointeraux (1810) *Le chauffage économique nouvellement imaginé par Cointeraux*, Paris, 28 p.
Joseph-François Désarnod (1788), *Mémoire sur les foyers économiques et salubres de M. le Docteur Franklin et du Sr. Desarnod*, Desenne et Gattey, Lyon, 58 p., 15 pl.
Hamon P. (1829) *Art de chauffer, ou Traité des moyens de mettre à profit la chaleur qui émane des appareils de chauffage*, Mahler et compagnie, Paris, 293 p.
Emile Trélat, Henri Peligot (1864) *Examen comparatif des deux systèmes de chauffage et de ventilation établis à l'hôpital de Lariboisière*, Dupont, Paris, 48 p.
Emile Trélat, Charles Somasco (1889) *Le chauffage et l'aération des habitations*, Bibliothèque des Annales économiques, Paris, 11 p.
Marius Vallin (1869) *Chauffage et ventilation par les calorifères à chaud*, Dépollier et Cie, Annecy, 16 p.
Augustin Rey, Chauffage d'immeubles administratifs urbains situés dans un même rayon au moyen d'une usine centrale, *La Technique Sanitaire et Municipale*, Paris, sept-oct 1907, p. 260-272.

Central heating was usually promoted by persons such as the engineer Eugène Péclet (1793-1857), the general Arthur Morin (1795-1880), Louis Ser (1829-1888), Léon et René Duvoir, Philippe et Jules Grouvelle, Eugène Geneste and Charles Herscher.[20] But some engineers were cautious, as well, especially about domestic heating: Paul Planat wrote about the wide diffusion of domestic central heating in America, but believed it was not appropriate for French apartments.[21]

To reassure people about modern heating, Roman Antiquity and their hypocaustus systems were used as a cultural reference, as well as the traditional Chinese Kan. Unfortunately,

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Augustin Rey, Le problème du chauffage collectif des habitations populaires, *Revue de l'art de l'ingénieur et de l'hygiénisme municipal*, Paris, oct-nov 1908, p. 248.

[20] Jean-Claude-Eugène Peclet (1828), *Traité de la chaleur et de ses applications aux arts et aux manufactures*, 2 vols., Mahler, Paris. Other revisited editions: 1830, 1832, 1838, 1843, 1847, 1860, 1878.
Jean-Claude-Eugène Peclet (1853) *Nouveaux documents relatifs au chauffage et à la ventilation des établissements publics*, Hachette, Paris, 176 p.
Arthur Jules Morin, Général (1860) *Rapport de la commission sur le chauffage et la ventilation du Palais de Justice*, Mourgues, Paris, 81 p.
Arthur Jules Morin, Général, Chauffage et ventilation des amphithéâtres du Conservatoire des Arts et Métiers, *Annales du Conservatoire des arts et métiers*, Paris, 1864-1865, p. 21-33 et p. 523-531, pl. 21.
Arthur Jules Morin, Général (1868) *Salubrité des habitations, Manuel pratique du chauffage et de la ventilation*, Hachette, Paris, 148 p. (2nd edition 1874, 383 p.)
Arthur Jules Morin, Général (1866) *Notes sur les appareils de chauffage*, Bourdier, Paris, 31 p.
René Duvoir, Chauffage par eau chaude, *Revue Générale de l'Architecture et des Travaux Publics*, 1847-1848, n° 7, col. 509-515. pl. 13, pl. 44, pl. 45.
Léon Duvoir-Leblanc (1846) *Réponse de MM. Léon Duvoir-Leblanc et Cie, aux objections de MM. René Duvoir et Cie*, Surcy, Paris, 44 p.
Léon Duvoir-Leblanc (1856) *Notes en réponse à une thèse de M. Grassi sur les procédés de chauffage et de ventilation employés à l'hôpital de Lariboisière*, Dupont, Paris, 44 p.
Philippe Grouvelle (1845) *Chauffage et ventilation de la Nouvelle Force à Paris par Philippe Grouvelle*, Fournier, Paris, 36 p.
Philippe Grouvelle (1855) *Rapports et notes sur les travaux de Ph. Grouvelle, ingénieur civil…*, impr. de Munzel frères, Sceaux, 47 p.
Jules Grouvelle, Emile Cornuault, Appareils et procédés de chauffage, *Exposition universelle internationale de 1889*, rapport du jury international, Groupe 3, Classe 27, p. 727-758.
Charles Herscher, *Etablissements Geneste, Herscher et Cie. Applications du génie sanitaire Ventilation, chauffage, assainissement, désinfection. Matériel d'assainissement*, Dupond, Paris, 1889, 82 p.
Louis Ser (1888-1890) *Traité de physique industrielle, production et utilisation de la chaleur*, 2 vols., Masson, Paris.

[21] Paul Planat (1880) *Cours de construction civile - Chauffage et ventilation des lieux habités*, Ducher et Cie, Paris, 490 p.

sometimes terrible events gave modern heating bad press: in 1858, a hot water system burst in the Saint-Sulpice church, killing two persons and seriously injuring five others.[22]

For centuries, France had a society ruled by nobility, and their values stayed longer than the real monarchy. Aristocrats were supposed to control their bodies and they put social representation first. They used many servants and were supposed to spend money to show their distinction. So servants regularly burned wood in chimneys, as they wanted an impressive fireplace, even if the room was impossible to heat. The composition of space and the decor, using symmetry, had nothing to do with comfort but with aristocratic lifestyle. The bourgeoisie was more interested in comfort and saving wood, but as the nobility was still considered to represent upper class even after the French Revolution, aristocratic interiors and lifestyle were remained positive references for a long. People were tempted to copy, at a reduced scale, the big aristocratic chimney with the mirror and golden frames in their mid-sized lounges.

I put forward the hypothesis that as modern heating was coming from the productive area (with boilers and steam) and was used firstly in hospitals and prisons since they were considered as relegation spaces, the upper and middle classes may have been reluctant to use the new heating system in their homes. The Church was also often regarded the use of (or the recourse to) comfort as immoral attitude, even diabolic [23]. Heating is also considered as dangerous by the army: it weakened men, consuming their good nature[24]. During the nineteenth century, the same kinds of view are shared by public boarding schools; pupils must be resilient because the country needed soldiers[25]. In 1885, an American doctor E. E. Marcy wrote:

When in Europe two years ago, I examined with considerable care, the house heating apparatuses in England, France and Germany, and I am quite certain that there is nothing in any one of these countries, which can be compared with your apparatus, in effectiveness and

[22] Explosion d'un calorifère de l'église de Saint-Sulpice, *l'Illustration*, Paris, 16 janvier 1858.
[23] Fanny Beaupré, Roger-Henri Guerrand (1997) *Le confident des dames, Le bidet du XVII^e au XX^e siècle : histoire d'une intimité*, La Découverte, Paris, p. 113-114.
[24] Arthur Jules Morin, Général (1864-1865) Expériences sur une cheminée en usage dans les casernes et dans les hôpitaux d'Angleterre, *Annales du Conservatoire des arts et métiers*, Paris, p. 192-193.
[25] One interesting point is that when finally central heating was really democratic, in France a professional army replaced the national conscript.

all other qualities. It would be a philanthropic and probably profitable enterprise to introduce your excellent Steam Heaters in these countries.[26]

The pragmatic and democratic America, submitted to a rigorous climate, reacted in a more efficient way.

On the other hand, French utopians socialists of the nineteenth century, were in favour of well-being for everybody and they planed new comfortable and heated buildings connected by heated arcades: Charles Fourier (1772-1837), Victor Considérant (1808-1893), Jean Reynaud (1806-1910)[27].

Some wealthy owners chose a compromised solution, between comfort and traditions, in their houses. For example, in the residence and studio of the sculptor Victor Vilain, in Paris in 1868, air ducts, from a hot air stove located in the basement burning coal, heated the entire house. But, at the same time the lounge and the sleeping rooms kept their chimneys[28].

False Novelties

The other particulars that I have noticed through the centuries were false novelties. Often, products are sold as inventions and novelties, but they are very far from new. The more noticeable example is the case of the "new system" of air circulation behind a metallic double back in the hearth, which can be found in fireplaces today, are dated back to 1624 and cited by Louis Savot in *l'Architecture Françoise* (1579-1640).[29] A lot of models of chimney and stoves used this disposal system during the eighteenth and nineteenth century. So reusing the double back in recent chimney is really not a novelty. In the same way, heat pumps and solar energy are frequently represented as very recent, but both systems were already described in

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[26] Baker, Smith & Co, *Warming compete and ventilating by steam and water*, Baker, Smith & Co, Chicago, 1885, p. 45.

[27] Charles Fourier (1829) *Le nouveau monde industriel et sociétaire*, Flammarion, Paris, 1973, p. 170.
Victor Considérant (1840) *Description du phalanstère & considérations sociales sur l'architectonique*, Guy Duriez, Paris, p. 69, p. 71, p. 91.
Jean Reynaud (1834) *Terre et Ciel*, p. 73-74.

[28] Anatole Amouru (1868) Habitation d'artiste, *Revue Générale de l'Architecture et des Travaux Publics*, n° 26, pl. 35-36.

[29] Louis Savot (1624) *L'architecture françoise des bastiments particuliers*, Sébastien Cramoisy, Paris, p. 154.

professional magazines like, *Œuvres et maîtres d'œuvres*, in 1947.[30] Of course, developing a principle is easier than creating an industrial product and distributing it, but we must be watchful towards what is supposed to be innovative.

Democratization of Thermal Comfort in France

Facing all those persistent tendencies during the past centuries, there is a real evolution in the growth of democratisation of thermal comfort. During the eighteenth century, people wanted more comfort in general, less smoke coming out of the chimneys, and they also tried to save on fuel coming from wood or coal. In order to fulfil these demands, the German model stove was often enhanced - the hearth of the chimney was improved through different methods, smaller fire-places and radiant angles were the contribution of Nicolas Gauger (1680-1730) and other modifications were seen in Benjamin Franklin's (1710-1790) chimney-stoves or open stoves[31]. Before the eighteenth century, townhouses had only a few chimneys, some times just one. After this period, there was almost one chimney or stove for each room, and this significantly increased the consumption of fuel. At the same time, the master of the house was not the only one to access warmth; the servants began to be interested as well. Iron stoves, considered unsightly were often located in the hall, the foyer, and the workshop, whereas, earthenware stoves were sometimes installed in dining room. As I said previously, central heating went through an experimental stage during the first part of the nineteenth century, when different firms competed with different devices. With the creation of new engineers schools and the writing and editing of huge heating and ventilation treatises, the field became more scientific. The different heat carrying flues: air, hot water or steam were used, with the special development, in France, of the hot water system named "thermosiphon". In particular, hot air heated theatres, and steam was requested for very large buildings like hospitals or large prisons. Around 1880, knowledge was more settled, and the heating firms proposed systems fitting to the program. Standardized radiators, whose patents came from the USA, have replaced the different kinds of old heat exchangers, as standardized furnaces become also more common. After 1880, gas and electric networks developed in

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[30] Desplanches M. A., Le chauffage thermodynamique - Chauffage-ventilation–conditionnement, *Œuvres et maîtres d'œuvres*, Paris, déc. 1947-janv. 1948, n° 9, p. 45-46.
L'utilisation de la chaleur solaire dans la maison moderne - Chauffage-ventilation–conditionnement, *Œuvres et maîtres d'œuvres*, Paris, déc. 1947-janv. 1948, n° 9, p. 84.

[31] Nicolas Gauger (1713) *La mécanique du feu*, Estienne et Jombert, Paris, 266 p.
Benjamin Franklin (1744) *Pennsylvanian fire-place*, Philadelphia, 1744, 40 p.

France. But even if only a few new appliances dedicated to heating were available, the high cost of both networks slowed the use for heating significantly, until 1930. Then small radiators appeared for small space or as an additional heating technique. Heating systems burning oil became the modern way of heating even if oil refineries were rather rare in France. We found this energy in several modern buildings in towns or in the countryside, with better energy efficiency and a reduced workforce.

Despite a better technical set up of heating systems during the nineteenth century, the diffusion of domestic applications was not democratic. In 1934, the French Bureau Veritas, published a small book giving advice on heating blocks of rented apartments.[32] They classified the flats as: A - luxurious, B – high, modern convenience, C - intermediate, D - low rent. The temperatures recommended for the bedroom, lounge area, dining room were: A 20° C, B 18° C, C 16° C respectively; for the bathroom: A 20° C, C/D 18° C; for the kitchen*:* A/B/C 15° C; for the bedroom, kitchen and shared room D 15° C. This book showed a picture of the social and economic standards of thermal comfort that was acceptable between the two World Wars.

In 1946, Jean Fourastié, a specialist in the history of consumption, wrote: '*..apart from the nicest district of Paris and Lyon, central heating and hot water producing systems were extremely rare.*'[33] National statistics do not disprove the previous comment. Surprisingly, rates were not available on heating means until 1954, even if it was already possible to know the numbers of toilets inside lodgings, or apartments with running water. In 1954, the average lodging with central heating reached 10%.[34] But this rate was distributed very differently in France. In the country, the average reached 3%, small towns 12% and Paris and its suburbs had 26%. In this last area, averages were also diverse between districts, the third arrondissement (an old and central district) only had 12%, and in the sixteenth arrondissement (a recent, peripheral and wealthy district) the average rose to 60%. The rich suburbs of the West of Paris had 50 %of lodgings with central heating. Ten years after World War II, central heating was still rare in France and a sign of a special wealth.

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[32] Bureau Veritas (1934) *Installation du chauffage central dans les immeubles de rapport*, Véritas, Paris, 62 p.
[33] Jean Fourastié (1979) *Les trente glorieuses*, Fayard, Paris, p. 137.
[34] INSEE (1957) *Etudes et conjunctures*, PUF, Paris, p. 1233.

In 1968, 28%of lodgings that had central heating were still occupied primarily by socially and financially privileged persons (25-49 years old, with families)[35]. In 1988, the average price for central heating reached 57.4% and in urban zones it rose to 62% and 88.8%. From this year, there was far more statistical information available and the different means of heating were detailed: centralized or not, individual or collective; as well as the type of fuels: domestic oil, butane gas (cylinders or tanks), coal, wool or energy networks, gas, electricity, and district heating (steam or hot water). This reinforcement of interest must be in relation with the first oil crisis in 1973, and the different efforts of regulation and insulation that was undertaken at that time. In 1993, the national average reached 79.8% with 70 to 90.1% in urban zones.[36] In 1997, the national average rose to 88.55%. [37] A more recent study provided a national average of 90.56%.[38] The way information was collected left out individual electric heating, so the averages available are not totally accurate, from my point of view.[39]

The nationalisation of energy in France after the World War II had really positive effects on the democratisation of the growth of thermal comfort. But after the crisis of 1973 when the State chose nuclear power; public networks slowed down alternative energy from district heating to environmental approaches. We must recognise that a real democratisation of thermal comfort in lodgings in France took significant time, not only due to technical reasons but also for cultural and economic ones. I think that there is no clear awareness of this phenomenon, especially among younger generations. For them, warmth at home is as natural as running water, electric light and computer games.

In Conclusion

With the various phenomenon's, it is difficult to find a unique conclusion. But, we could start to be vigilant with false innovations and be aware of our own cautiousness toward novelties. We ought to be attentive to social reluctances towards innovations and try to change them if

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[35] Marchand O. & Feolder C. (1973) *Les conditions de logements des ménages en 1973*, INSEE, p. 65.

[36] Vanderkerckhove L., Desmond N., Birot de la Pommeraye G. (1995) *Habitat et occupation du parc de logements en 1988 et 1992 - Enquête sur le logement* INSEE, p. 66 & p. 203.

[37] Omalek L., Laferrière A., Le Blanc D., Cherrier F., Guyot D. (1998) *Les conditions de logements des ménages - Exploitation de l'enquête sur le logement 1996-1997*, INSEE, p. 87

[38] Lincot Liliane, Reig Christelle (2003) *Les conditions de logements des ménages en 2002 - enquête logement 2002*, INSEE.

[39] EDF (Electricité de France) and GDF (Gaz de France), state-run energy networks since WWII developed their own statistics.

necessary. I hope that pointing out those different observations on the history of heating might help to recognise the actual situation with eyes wide-open. I hope that these comments can help to reduce the time needed to reach a good energy saving level, and to understand why we have done so little during the two last decades.