From Hippocrates to Hallé. A history of public health from Antiquity to the French Revolution.

Beverly Phillips

School of Humanities, Discipline of French Studies, University of Adelaide, November 2014.

TABLE OF CONTENTS

From Hippocrates to Hallé. A history of public health from Antiquity to the French Revolution.

I would like to express my gratitude to my supervisors, Professor John West-Sooby and Dr Robert Dare, for their direction over the long period of this thesis. I would particularly like to thank Professor West-Sooby for directing me towards *Airs, Waters and Places* and for his useful comments and engagement in the process of research and completion.

Beverly Phillips

November, 2014.

Abstract

This thesis follows the course of public health from the time of Hippocrates (c 460 BCE – c 370 BCE) to Jean Noël Hallé (1754-1822) who was appointed to the first Chair of Public Hygiene in Paris in 1794. It puts forward suggestions as to what led to the creation of this position and why Hallé was a suitable man to occupy it.

Using Hippocrates' On Airs, Waters and Places as a starting point, it outlines the changes in attitudes and practices in public health with particular reference to the influence of scientific knowledge.

The thesis also describes the change from public health being the responsibility of the individual to a more collective approach.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

I also give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library Search and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

Beverly Phillips

November, 2014.

Preface

The idea for this thesis arose from a book given to me by my late father-in-law who was an historian and knew that I was interested in the period of the Enlightenment in France. The book given to me by my father-in-law was *The Foul and the Fragrant* by Alain Corbin.[1] It was originally published in France in 1982 as *Le Miasme et la jonquille*. In his introduction, Corbin mentions being inspired to write his book while he was reading the memoirs of Jean Noël Hallé, the first incumbent of the chair of public hygiene established in Paris in 1794. My further research indicated that not only was Hallé the first holder of this chair, but also that it appeared to be the first chair of its kind in Europe and probably elsewhere.

There are scientists of that period – before, during and just after the French Revolution – who are much better known than Hallé, so I thought it would be interesting to know something about this man, about what public hygiene encompassed at that time and how he came to the position of holding the first chair. The Revolution which occurred in 1789, the momentous events of that period, must have had some influence, some impact on the evolution of medical education for it to encompass public hygiene.

As it happened, I was able to find two major sources to give a comprehensive account of Hallé's family, their antecedents and their achievements. One was produced by the curé of the village where the Hallé family had lived for some generations and were one of the principal families of the area. In the early 1900s he

[1] Corbin, A., *The Foul and the Fragrant*, London, Picador, 1994.

wrote a comprehensive genealogy of the family, based on documents in their holding which have now been destroyed over the course of two world wars. The village, Châtres, in northern France saw action in both wars.[2] The other major source of information about the family was the book *Une dynastie, les Hallé* written in 1995 by French art historian, Nicole Willk-Brocard.[3] In this work, Willk-Brocard documents the achievements of three generations of the Hallé men who were well known artists during the seventeenth and eighteenth centuries in Paris. From these and other sources it was possible to get a good overview of the life and times of Jean Noël Hallé.

Research into the history of public health led me to Hippocrates' work *On Airs, Waters and Place*s,[4] which is generally considered to be the earliest surviving epidemiological text. Since this text presents a causal relationship between environmental factors and disease, it seemed to be a concrete starting point for a study of the history of public hygiene in Europe. In this work, the three areas of Airs, Waters and Places were each discussed and recommendations made by Hippocrates for the best way to maintain health. These three areas make a convenient division of factors important in public health in its entirety, which led me to use them, each as separate chapters, for an account of their history. I followed the scientific research into Airs and Waters over the centuries up until the establishment of new scientific institutions that arose in Paris after the end of the Terror in 1794. This meant that it was possible to have a reasonable knowledge of what Hallé was likely to have known in these two areas and how he would have used this knowledge.

"Places" is a more complex issue than Airs and Waters. Hippocrates used the condition of both Airs and Waters in a particular geographical location to comment on

---

[2] Estournet, O., *La Famille des Hallé*, Paris, 1905.
[3] Willk-Brocard, N., *Une dynastie: les Hallé*, Paris, Arthena, 1995. There is virtually no information about the women of the family other than the dates of birth, marriage and death.
[4] Hippocrates, *On Airs Waters and Places*, Translated by Francis Adams, Whitefish, Montana, Kessinger Publishing, 2004.

the suitability of that location as a healthy place to live. He also asserted that certain characteristics, physical and mental, were the result of inhabiting certain places. While it may be true that particular climates predispose their inhabitants to particular characteristics and illnesses, the scientific research that was conducted in this area over the centuries did not yield definitive results such as those that came from the research into Airs and Waters. In fact, an enormous amount of meteorological data was recorded in France (and other countries) in the eighteenth century, but it was not possible to draw any correlations between the weather and disease, other than the fact that some diseases occurred more often in some seasons than others. Place, in terms of work, only began to come into focus in the seventeenth century, as evidence of particular problems associated with particular trades was drawn together.

There are other aspects inherent in the notion of place than the composition and influence of its airs and waters. The physical interaction of people inhabiting a geographical location will influence the way in which their society conducts itself. The propinquity of groups with particular interests will facilitate the transmission of ideas and increase the rate at which changes are made and accepted. This is why I feel that Paris, as a place, was important in the eighteenth century for scientific research and advancement. Paris was the geographical location of a population of sufficient size to be able to maintain a number of influential establishments in various areas of research. The interaction of several of these institutions was important in the development of public hygiene as a separate area of concern. The advance towards the development of public hygiene as an important area of concern in its own right was well underway in the 1770s. The Revolution initially had the effect of stopping this, and all other scientific research, because of the abolition of the major institutional and intellectual establishments it associated with the old regime. At the end of the Terror, when it seemed that reason prevailed once more, the rapid acceptance of previous recommendations led to the arrival of public hygiene as a subject in its own right. Paris was the place in which Hallé lived and worked and he knew many of the scientists influential in the areas which underpin the area of public hygiene.

Hallé's place in society had its own importance, as it allowed him to be accepted without consideration into the milieu of educated scientists. Although he was not born into aristocratic society, his family's position in the haute bourgeoisie enabled him to move with ease in the circles of the intellectual elite of the time. His lack of political affiliation and his philanthropy allowed him to continue his work during the Revolution without difficulty. His courage in defending Antoine Lavoisier was a part of his character in that he formed judgements based on his own deductions rather than on what was opportune. Defence of Lavoisier was not a circumspect action during the period of the Terror and he was warned about attracting the attention of the Revolutionary Tribunal. This, however, did not deter him.

Examining the history of public health over the centuries gave me a good indication of how matters of hygiene moved from being an individual responsibility to a more collective one. From Ancient Greek times, the individual was able to consider the advice of physicians and to use this advice to maintain health. This notion of individual responsibility is still with us today, but there is now the added aspect of state intervention in the form of the provision of clean water and unpolluted air, in particular, in order to prevent disease. Quarantine was a major development for disease control and in its administration we can see the beginnings of a collective approach. This first appeared in the major states of northern Italy in the fifteenth and sixteenth centuries, well in advance of the rest of Europe.[5] Hallé's beliefs on the subject are shown in a letter to journal in which he states that health should be considered at the levels of both the individual and society.[6]

I have aimed to show that the advance of science, which owed a great deal to Lavoisier, and the politics of the time in France led to the creation of the first chair of public hygiene. I have also aimed to show something of Hallé's antecedents, education and beliefs that help us to understand why he made a very suitable candidate to hold that chair.

---

[5] Cipolla. C., *Faith, Reason and the Plague in Seventeenth Century Tuscany*, W. W. Norton & Company,`New York, London, 1979, p. 11-14.

[6] Hallé, J.N., "Exposition du plan d'un traité complet", *La Médecine éclairée par les sciences physiques, ou Journal des découvertes relatives aux différentes parties de l'art de guérir*, Paris, 1792, pp. 225-235.

INTRODUCTION

> The protection and promotion of the health and welfare of its citizens is considered to be one of the most important functions of the modern state. This function is the embodiment of a public policy based on political, economic, social and ethical considerations. But whence this concern for the health of the group? And how does it relate to the individual citizen? [7]

The present-day concept of public health is taken to mean the health of a society collectively. In that sense, public health in France only came of age as an integrated discipline towards the end of the eighteenth century. One of the drivers of this was the modernisation of hospitals and of medical teaching. [8] It was set in motion before the Revolution and briefly interrupted by the phase of the Revolution known as the Terror, which lasted from September 1793 until July 1794. It was then set in train again at the end of 1794.

From the time of Hippocrates (ca 460BC – ca 370BC) until well into the eighteenth century, public health was taken to mean the health of the individual and was often referred to as hygiene. The ability of the individual to influence external factors such as air and water quality was limited so it was more important to be able to recognise a healthy atmosphere and avoid those which were harmful. The earliest known attempt to give direction in the determination of a healthy environment is to be found in Hippocrates' work, *On Airs, Waters and Places*. This text presented a causal relationship between environmental factors and disease and was the basic epidemiological text for public health for over 2000 years. It provided the guidelines for individuals and small groups to choose the best site for habitation to maintain their

---

[7] Rosen, G., *A History of Public Health*, The Johns Hopkins University Press, Baltimore and London, 1993, p. lxxxix.

[8] Ackerknecht, E.H., "La Médecine à Paris entre 1800 et 1850", in *Les Conférences du Palais de la Découverte*, Série D, no 58, 1958.

health.[9] There was no centralised organisation or control. It was the responsibility of the individuals concerned to use the knowledge available to make informed choices.

Individual responsibility remained the cornerstone of public health across the centuries. While fashions changed in the approach to maintaining health, the underlying philosophy of personal accountability remained constant from Greek and Roman times through to the self-help literature of the eighteenth century. Each individual must use the information provided by experts to maintain health. Deviating from this path was at one's own risk.[10]

The fairly rapid transformation in emphasis from private responsibility alone to the inclusion of some degree of collective responsibility for public health, in the middle of the eighteenth century, was recognised by contemporaries and has also been acknowledged by historians of the period.[11] This transformation received official recognition at the end of 1794 when a new school of medicine was established in Paris and one of the twelve chairs was devoted specifically to public hygiene. This was the first chair in public hygiene in the world, and its first holder was Jean Nöel Hallé (1754-1822).

What were the factors which initiated and sustained this transformation at this particular time, and who was this man who was the first to hold a chair in public hygiene? In other words, why Hallé and why then?

To begin to answer these questions, it is instructive to start with Hippocrates' work, *On Airs, Waters and Places*, and follow its passage through the ages. This and other works of Hippocrates were an integral part of medical teaching, particularly in the

[9] Hippocrates, *On Airs, Waters and Places*, translated by Francis Adams, Whitefish, Montana, Kessinger Publishing, 2004.

[10] Green, R.M., *Galen's Hygiene (De Sanitate Tuenda)*, Springfield, Illinois, Charles C Thomas Publisher, 1951. Tissot, S.A., *Avis au peuple sur sa santé*, Paris, Didot le Jeune, 1763.

[11] Hannaway, C., "From Private Hygiene to Public Health: A Transformation in Western Medicine in the Eighteenth and Nineteenth Centuries", in Ogawa (ed), *Public Health*, Tokyo, Saikon Publishing Company, 1981, p. 112.

second millennium. Hippocrates (ca 460 BC – ca 370 BC) is considered to be the father of Western medicine. He is credited with the idea that disease is a natural phenomenon and not the result of supernatural intervention. The Hippocratic Corpus is a collection of about seventy works, which are thought to have been written by his students and followers, the most famous document being that of the Hippocratic oath. This is still used in modified form today.

The transmission of Hippocrates' works owes a great deal to their promotion by Galen (129 -199/217 AD). Galen is a pivotal figure in the history of Western medicine. He was born in Pergamum into a well-to-do family. His father had him well educated and he studied at the Sanctuary of Asclepius, a famous centre of healing in Pergamum. As it was a period of relative peace and order, he was also able to study in Smyrna, Corinth and finally in Alexandria. He started his medical practice in Pergamum as physician to the school of gladiators, and several years later he went to Rome where he became physician to Marcus Aurelius and later to his son Commodus.[12] The remainder of his life was spent mostly in Rome, interspersed with sojourns elsewhere, mainly in Pergamum. He was also the author of a very large body of work, much of which survived him and is still studied, although not for its medical advice.

Galen believed Hippocrates to have been the greatest medical authority of all, although there are those who consider that Galen not only used the works of the Hippocratic Corpus as evidence to justify what he, himself, wished to do, but also attributed to his hero some theories and practices that Hippocrates was unlikely to have shared.[13] Be that as it may, Galen's commentaries on eighteen treatises of the

[12] Temkin, O., *Galenism. The Rise and Decline of a Medical Philosophy*, Ithaca; London, Routledge, 1973, pp. 2-5.
[13] Nutton, V., *Ancient Medicine*, London, New York, Routledge, 2004, pp. 226, 218.

Hippocratic Corpus aimed to make clear to the intelligent reader just what Hippocrates had meant, and mostly he achieved his aim.

He believed that true study began with the close reading of the works of the ancients. They were not to be followed slavishly, as in some cases they had not expressed themselves clearly, had omitted some things altogether and had been misinterpreted by their successors. He used the simile of Roman roads to compare the therapeutic method of the ancients with his own. The ancients had cut the roads, but they had left them in a far from perfect state. It was left to those who followed to complete the surface. In other words, the framework had been put in place but the detail needed for completion was determined later on. [14]

Hippocrates' work was thus not to be replaced, only improved upon, and this is what Galen set out to do with his commentaries on the Hippocratic works. In this way, he asserted his superiority over his contemporaries. Indeed, he believed the desire for superiority to be natural, as when he speaks of the man 'whose purpose it is to know something better than the multitude'. He never hesitated to put himself forward as such a man.[15]

Galen's work, *Hygiene*, which he claimed was based on Hippocrates' work, shows very clearly the emphasis on the responsibility of the individual to maintain health by following the advice of the physician. Indeed the first chapter of this book is entitled "The Art of Preserving Health".[16]

The separation of the Roman Empire into east and west saw Galenism assigned to the east, particularly in the Greek centres of learning in Alexandria and Constantinople. It spread from there to Syria and later to the countries of Islam. By about AD 350, his acceptance as the leading medical authority was established in

[14] Temkin, *Galenism*, p. 58.
[15] Temkin, *Galenism*, p. 34.
[16] Green, R.M., *Galen's Hygiene*, pp. 6-41.

Alexandria. By about 500-600 AD, Galenism had become a medical philosophy, 'a set of more or less cogently connected principles, doctrines and concepts used in thinking about man's body in health and disease, and shaping the physician's attitude to his profession and to human life'.[17]

At that time, Galen's works were better known in the Muslim East than in the West. In the Latin West, Galenism was strengthened after 1000 AD as a result of Arabic influence and began its five centuries of dominance in the world of medicine. In the twelfth century, the rise of Galenism in such celebrated medical schools as Salerno, Montpellier, Toledo and Pisa, went together with the widely enlarged knowledge of Aristotelian metaphysics and natural science. After 1200, when medicine became incorporated into the structure of the universities, there arose a legalised profession of academic physicians, formed from among men of higher education. Galen's teachings were important influences in their training. His works dealt with the art of medicine and with the diagnosis, prevention, prognostication and treatment of disease.

A few centuries later, one of the major texts used by the medical faculties in their curriculum was an anthology by the name of *Articella* which was repeatedly reprinted in the 15th and 16th centuries. One of the most important parts of this anthology was Galen's book, *Ars medica*, which enjoyed an extraordinary popularity and was widely known, as attested to by various contemporaneous references, including Dante's encounter with him in limbo, in the *Divine Comedy*. The introduction to *Ars Medica* divided medicine into two parts, theoretical and practical, the theoretical consisting of the study of things natural (i.e. basic science), non-natural (hygiene), and contra-natural (pathology).

---

[17] Temkin, *Galenism*, p. 93.

According to Galen, there are seven natural things: elements, temperaments, humours, the parts of the body, faculties, functions and spirits. In this system, there are four elements, nine temperaments, four humours, and they all had further subdivisions. It was as if complete categorisation would lead to complete understanding. The categorisation was continued in the non-naturals, which were influences that were not inborn and generally encompassed air, food, exercise, sleep, evacuation of wastes and perturbations of the mind and emotions. The classification of the six non-naturals constituted one of the most enduring contributions of Galenism to medical thought and, until the early nineteenth century, hygiene was taught more or less under these six headings. This categorisation is notably present in Hallé's work of that period.[18]

The strength of Galenism reposed in no small measure in its having provided these medical categories for relating the individual to health and disease. Their scientific reinterpretation might have been desirable but their abandonment was not. It is this possibility of adding knowledge that gave Galenism its flexibility and adaptability and was a major factor in the longevity of its influence. Brockliss and Jones, in particular, refer a number of times to the ability of Galenic theory to absorb new theories or advances. [19] For instance, the doctrine of the temperaments was reinterpreted to provide a medically useful classification of man and a somatic theory of human behaviour that were preserved into the nineteenth century.[20] One of Hallé's areas of interest was that of the relationship between temperament and health, and his interpretation may be seen in the entry "Temperamens" in the *Encyclopédie ou Dictionnaire raisonné des Sciences, des Arts et des Métiers*.

---

[18] Hallé, J.N. et Nysten, "Hygiène", *Dictionnaire des Sciences Médicales*, Paris, 1818.
[19] Brockliss, L., and Jones, C.L., *The Medical World of Early Modern France*, Oxford, Clarendon Press, 1997.
[20] Temkin, *Galenism*, p. 181.

In Galen's opinion, bodily health was strongly related to an upright life and moral practice; hence the physician should intervene in the overall supervision of man.

> The soul is corrupted by undesirable habits as regards food and drink, in exercise, in what we see and hear, in the unsuitable practice of any art. Whoever wishes to exercise the art of hygiene correctly should be an expert in all these things; he should not be of the belief that the formation of the soul is the only responsibility of the philosopher; the latter concerns him because of something greater, that being the health of the body, so that we do not slip towards a state of illness.[21]

Living healthily was to become a moral obligation, to such an extent that a man of healthy constitution could be considered blameworthy if he failed to reach old age without illnesses and without pain. Basically, intemperance or ignorance, or both together, were to be held responsible for the sufferings caused by gout, intestinal pains, arthritis or ulcers of the bladder. All of Galen's medical practice was influenced by this moralising element. In many of his clinical case histories, which were destined to be read by medical colleagues, he took great pains to point out the patient's moral failings or the lack of temperance in his life.

Galenism was more than a medical doctrine; it was a way of understanding human life, a philosophy. One of the main tenets of this philosophy was that of personal responsibility and control. Personal responsibility and control were ideals that were out of reach for the majority of the population, who could only do their best in often difficult situations. The ideals of access to essentials such as clean air and water in their place of living were rarely achieved in cities or in poor rural areas. Good health was not a choice for many.

However, by late mediaeval and early modern times in France, it was possible to see the beginnings of organised control of public health. Most of this was in the

---

[21] Garciá-Ballester, *Galen and Galenism*, Aldershot, UK, Ashgate Publishing, 2002, p. 11.

form of individual charitable organisations, but by the time of Louis XIV, his minister, Colbert, established the office known as the Contrôleur Général des Finances, which included in its purview, health and relief of the poor. This was administered by the corps of royal intendants in the provinces.[22] Late in the reign of Louis XIV, the government began shipping boxes of remedies to the countryside when an intendant reported an epidemic. It also dispatched medical personnel to the most severely affected regions.[23]

Nevertheless, public health, as a discipline, was still ill defined, and measures to combat disease came under the rubric of 'police'. Municipal ordinances controlled essential services such as water supply and the disposal of sewage and refuse, but there was no coordinated system of public health and rural areas were mostly deprived of any services at all.

Rosen saw the Age of Enlightenment (1750-1830) as pivotal to the evolution of public health.[24] The French philosophers rejected tradition and authority as the source of knowledge. They believed in the pre-eminence of reason and science. 'The charity and benevolence of the old days were useless medicines', asserted the Duc de Rochefoucauld-Liancourt.[25] Diderot (1713-1784), main editor of the *Encyclopédie ou Dictionnaire raisonné des Sciences, des Arts et des Métiers*, proclaimed that health and happiness were synonymous. His *Encyclopédie* had medical contributions from thirty or so authors, according to Brockliss and Jones.[26] These contributions and the ideas of other *philosophes* led to greater consideration being given to prophylaxis and

---

[22] An intendant was an administrative official in the Ancien Régime and served as the king's agent in the Provinces.

[23] Ramsay, M., "Public Health in France" in D. Porter (ed.), *The History of Public Health and the Modern State*, Amsterdam-Atlanta GA, Editions Rodopi BV, 1994, p. 47.

[24] Rosen, *A History of Public Health*, p. xxiv.

[25] La Rochefoucauld-Liancourt, *Rapport du comité de Mendicité*, 1790.

[26] Brockliss, L., and Jones, C.L., *The Medical World of Early Modern France*, p. 415.

hygiene, to the health of women and children, to the blind and the deaf, as separate entities, and to the humane treatment of the insane.

There was now an expectation that scientific discoveries would lead to improvements in treatment. Linnaeus asserted that the symptoms produced by a particular disease are so constant that the physician can identify and classify disease in exactly the same way as a botanist classifies plants. Indeed, a number of systematic nosological treatises were produced in the second half of the eighteenth century.

The idea of personal responsibility and control of health was spread through a wider audience with the contemporaneous shift from Latin to French in publications in all the arts and sciences – including medical science, which saw books and pamphlets aimed at the educated public. One of the best known and most reprinted was the *Avis au peuple sur sa santé*, by Samuel Tissot (1728-1797), a Swiss Protestant from Geneva. This book was translated into a dozen other languages and reprinted many times. Its particular goal was to provide information of a medical nature to those who had no recourse to immediate aid, for example those in rural areas. It was extremely comprehensive, covering everything from various maladies and their treatment to the composition of various drugs and what they should cost. It included sections on how to detect charlatans, how to treat injuries and wounds, and how to revive the drowned.

Tissot's complete works were published in five volumes in 1810, with Hallé contributing a brief overview of Tissot's life, a preface and notes to volumes 1 and 2. Volume 3 contains a note from the publisher that M. Hallé was too busy at the time to provide notes for the other volumes (volumes 3-5) but that he would do so later. The second edition of the complete works was published in 1820 but is said to be exactly the same as the first, according to the catalogue of the Bibliothèque Nationale de

France, so it seems that Hallé never supplied notes for those volumes. Nevertheless, it is evident that Hallé was very familiar with Tissot's work and agreed with it in general, although he felt that modifications could be made in some areas, as he indicated in his notes.

It is highly probable that Hallé would also have been familiar with the work of Bernardino Ramazzini (1633-1714), who wrote on the subject of diseases related to particular occupations. Ramazzini wrote of the hazards to the health of inhaling dusts and powders, of the effects of various chemicals, and of repetitive actions and of other disease causing factors to be met by workers in 52 different occupations.[27] He believed that physicians should add to the list of questions that Hippocrates recommended they ask their patients with 'What is your occupation?' His work was seminal in the establishment of occupational health as a domain of importance, particularly with regard to public health. Ramazzini's work was translated into French by Hallé's colleague and contemporary, Antoine Fourcroy (1755-1809), for the Royal Society of Medicine, of which they were both members.

These two important works by Tissot and Ramazzini are indicators of the trends in public health. Tissot's work gives the possibility of more control to more individuals, while Ramazzini's work points the way to a collective approach to the health of groups of workers. These two strands can be seen in Hallé's letter to Fourcroy in October 1792.[28] In this letter, Hallé proposed that it was necessary to divide the study of hygiene into three parts. The first part would encompass the knowledge of the healthy man in his relationships and in his differences, that is to say, in society and as an individual. The second part would encompass the knowledge of

[27] Ramazzini, B., *De Morbis Artificum Diatriba*, Modena, 1700.
[28] Hallé, J.N., "Exposition du plan d'un traité complet", *La Médecine éclairée par les sciences physiques, ou Journal des découvertes relatives aux différentes parties de l'art de guérir*, Paris, 1792, pp. 225-235.

the things that man uses and enjoys, improperly (sic) called non-naturals, and of their influence on our constitution and our organs. The third part would encompass the rules which determine the measure in which one must restrict the usage of the things called non-naturals in order to maintain the health of man, be it in society collectively, or be it as an individual. He saw these three parts as the subject, the matter and the rules of hygiene.

Hallé thought it particularly important to make the distinction between public and private hygiene, according to whether one was considering man collectively or individually. He believed that, in the field of public hygiene, the doctor philosopher should become the counsel and the soul of the legislator. Hallé's interest in the teaching of public hygiene was a part of his humanitarian concerns. He was also known for his treatment of those in need and was said to have never turned anyone away. He refused payment from those in difficulty and was a visitor to prisons where, again, he treated those in need. His medical interests also reflected his humanitarian instincts, as illustrated by his publications on the promotion of vaccination, as well as on the maintenance of sanitation and on the treatment of scabies.

The older members of his family, particularly his father, were noted for their philanthropy and their examples are very likely to have been a strong influence on the direction of his life. Jean Noël Hallé was the scion of a family of artists, being the son, grandson and great grandson of painters. The best known and probably the most artistically talented of the family was his father, Noël Hallé (1711-1781). The family genealogy and history have been well documented by Octave Estournet,[29] who was the *curé* of the village of Châtres (Seine et Marne) where was situated the family property. They had preserved records over the generations and Estournet was able to

[29] Estournet, O., *La Famille des Hallé*, Paris, 1905.

construct a family tree as well as write a biography of the family. He found many documents in the family archives recording baptisms, marriages and wills, and refers to them many times in his biography. It is fortunate that he did so, as most of these useful documents disappeared from public archives during the course of two world wars. He published this work in 1905 and it was drawn upon heavily by Nicole Wilk-Brocard in her work, *Une dynastie: les Hallé*.[30]

Estournet tells us that the Hallé family had lived in Rouen since 1356 but not a lot is known about them until Geoffroy Hallé, who became principal of the Collège des Bons-Enfants in Rouen in the 1570s. At this time there are records of other family members who were haberdashers, silversmiths and decorators. Geoffroy's grandson, Daniel (1614-1675), was the first of the three Hallés to make their mark as an artist. He was apprenticed to a sculptor-artist against his father's wishes and later moved to Paris, where he lived in the Rue de Buci and was married at Saint-Sulpice. This church saw the marriages, baptisms and burials of many of the Hallé family over the next 150 years. Daniel and his wife had fifteen children, twelve of whom died very young and were baptised and buried in Saint-Sulpice. Of the three survivors, one was Claude-Guy (1652-1736). Claude-Guy studied at the Academy where he won some prizes and then went to Italy to study in 1678. It is not known exactly when he returned, but in 1681 he presented his work to the Academy back in Paris. At the age of 45, at last financially secure, he married a very young woman who had a dowry of ten thousand pounds. They were married in the church of Saint-Sulpice on 9 December 1697 and eight children were born of this union. Unfortunately, in 1712 his wife died, a few months after the birth of their eighth child (Noël), leaving him with their four surviving children. For a number of years he led a quiet and rather solitary

[30] Wilk-Brocard, Nicole, *Une dynastie: les Hallé*, Paris, Arthena, 1995.

life in caring for his children. In 1729 he agreed to the marriage of his daughter Marie-Anne to Jean Restout, painter to the King and member of the Academy. The groom was the son of Jean Restout and Marie-Madeleine Jouvenet. This marriage allied the Hallé family with a network of other artists. Jean Restout was a well-known artist who had trained both with his father (Jean Restout) and with his maternal uncle, Jean Baptiste Jouvenet, who was and still is probably the best known of them all. Anthony Blunt, in a book review, says that Jouvenet's work 'has been grossly underestimated for more than a century',[31] although he was highly regarded during his life and for a century afterwards. Blunt considers that Jouvenet was pivotal in developing a truly French baroque.

Claude-Guy continued to work with a "touche encore vigoureuse et ferme' at the age of 82 and he attended meetings at the Academy until a month before his death in November 1736. He too was interred in Saint-Sulpice.

Not much is known about the education received by the young Noël (1711-1781) but the high level of his classical knowledge is attested to by his library, by his nomination to the Académie littéraire des Arcades in Rome, and by the tenor of his numerous letters in administrative matters.[32] After the marriage of his sister to Jean Restout, the young Noël, at the age of eighteen, became the student of his brother-in-law. Some years later, in 1736, after several attempts, he won first prize for a painting at the Academy. This was two months before his father's death and it afforded Claude-Guy great pleasure to witness his son's success and to see the family tradition continue.

Noël left Paris for Rome in 1737 to study at the French Academy there. Towards the end of his stay, he became a member of the Académie littéraire des

---

[31] Blunt, Anthony, review of *Jean Jouvenet et la peinture d'histoire à Paris* by Antoine Schipper, in *Burlington Magazine*, vol. 119, no. 890, May, 1977, p. 357.
[32] Wilk-Brocard, Nicole, *Une dynastie*, p. 107.

Arcades. This prestigious society was founded in the seventeenth century by poets from the court of Queen Christina of Sweden and counted among its members Corelli, Scarlatti, Goethe and Grimod de la Reynière. This honour was rarely awarded to students and indicates that Noël Hallé had not only achieved a high level of classical and literary education but was accepted by the Roman aristocracy. He prolonged his stay in Rome beyond the normal three years, remaining there until 1744.

On his return to Paris, he found plenty of work in carrying out drawings for engravings and illustrations. He had rapid success in his work and he also enjoyed material comfort from several generous inheritances. He carried on the family tradition of marrying young women when, at the age of forty, he married the eighteen-year-old Françoise-Geneviève Lorry. Her late father had been a respected lawyer both in the Faculty of Law of the University of Paris and in parliament, while her mother was the niece of the painter Charles de la Fosse and cousin to Nicolas de Largillierre, also a well-known painter.[33] The witnesses to the marriage contract were Françoise-Geneviève's mother and her two brothers. One brother, Paul-Charles, was a lawyer in the Faculty of Law as his late father had been, and the other brother, Anne-Charles, was a *docteur-régent* of the Faculty of Medicine and *Censeur royal des livres*. This advantageous alliance linked the world of beaux-arts to that of science and literature. As a bonus, Françoise-Geneviève was very pretty and became the model in many of her husband's paintings and drawings, including one of her and the young Jean Noël.

Between 1761 and 1775, the career of Noël Hallé blossomed and he received many prestigious assignments from the Church, the City of Paris and the Gobelins factory. He also enjoyed great popularity amongst the students at the Academy and

[33] Wilk-Brocard, Nicole., *Une dynastie*, p. 122.

was well known for the academic and financial assistance he gave them. In 1775, he was appointed interim director of the Academy of France in Rome. The previous director, having been there for a long time, had let everything fall into disarray and morale was low. Accompanied by his wife and two children, he arrived in Rome in July 1775 and began work immediately. He rapidly fulfilled his brief, and he and his family were supposed to leave Rome in November, but the illness of their son, Jean Noël, delayed their departure and they did not arrive back in Paris until mid January 1776. Joseph Marie Vien, who was accompanied by his pupil, Jacques Louis David, succeeded Noël Hallé as director of the Academy of France in Rome.

Noél Hallé was well rewarded for the success of his mission, as the King signed the letters of anoblissement in 1776 and he became a chevalier in the Order of Saint Michael. He was supposed to receive a pension as well but it was several years until he finally received it. Nevertheless, he continued his philanthropy and was well known for his compassion and for the financial help he gave to those less fortunate than he, particularly to the students of the Academy. From September 1777, he held the post of Treasurer of the Academy, but in March 1778 he had to resign because of cardiac problems and he died in June of that year. He was interred in the church of Saint Benoît in a ceremony conducted by the *curé*, assisted by thirty of the clergy and in the presence of his son, Jean Noël Hallé, and other relatives.[34]

Jean Noël had been born in Paris on 6 January 1754 into this well off and well-educated family, with its connections in the worlds of art, law and medicine. Although he was taught the elements of drawing and painting during his early education, he did not pursue a career as an artist. It was the advice of his maternal uncle, Anne-Charles Lorry, which pushed him towards the study of medicine. Lorry

[34] Estournet, O., *La Famille des Hallé*, p. 120.

was a celebrated doctor who had been called upon to treat Louis XV during his illness with small pox. He had interests in dermatology, alimentation and psychiatry, and his famous treatise on skin disease has led to him being considered as the father of dermatology in France.[35] He was also among the earliest to call for more humane treatment of the insane. He concerned himself with his family, and when his brother, a professor of Law, died in his mid forties, Anne-Charles saw to the welfare of his nieces and nephews.

Jean Noël made rapid progress as a student in ancient and modern languages, music and drawing. After his return with his family from Rome in 1776, he studied medicine in the Faculty of Medicine at the University of Paris. It was in 1776 also that the Royal Society of Medicine was established, with Anne-Charles Lorry recruited to it a few months after its foundation. In 1778, Hallé was invited to become a member of the Society, even before the completion of his studies. Unfortunately, the old, established Faculty of Medicine became embroiled in a power struggle with the young Royal Society of Medicine and refused to confer the degree of *docteur régent* on several students who had fulfilled all necessary requirements, including payment of a very large sum of money, but who associated themselves with the Royal Society. Among these students were Jean Noël Hallé and a certain Antoine Fourcroy.

After the completion of his medical studies in 1778, Hallé practised medicine in Paris and established a reputation for treating the poor without payment. He was said to have never turned anyone away.[36] He regularly attended meetings of the Royal Society of Medicine, which met twice weekly to discuss scientific advances, to form committees to investigate areas of interest and to present results of research. He was a

[35] Lorry, Anne-Charles, *Tractatus de Morbis Cutaneis*, Paris, 1777.
[36] Cuvier, Georges, *Recueil des éloges historiques lus dans les séances publiques de l'Institut royal de France*, Paris, F.G. Lerault (éd.), tome 3, 1827.

member of numerous committees, and the results of his own work were published in the journal of the Society.[37]

Hallé lived and worked in a society where he was the colleague of many of the influential scientists and medical men of the day – men such as Antoine Lavoisier (1743-1794), Antoine Fourcroy and Félix Vicq d'Azyr (1748-1794). The 1789 Revolution initially had little effect on the lives of the medical and scientific community but, as the political current led towards the excesses of the Terror, many found it prudent to absent themselves from the capital. Hallé survived, in spite of his father's ennobling, as he was known as the doctor of the poor. He was a man of principle and courage, as demonstrated by his formal defence of Lavoisier at a time when it was particularly unwise to do so. Unfortunately, it was to no avail, and Lavoisier was guillotined on 8 May 1794.

During the early years of the Revolution, all the learned societies worked without interference, but by 1792 it was clear that they would no longer be able to do so. Finally, a decree of the Convention abolished all learned societies in August 1793.

The reform of education, including medical education, had been an interest of a number of the intellectuals of the time, including Lavoisier, who put his mind to the subject later in his life. A number of proposals aimed at reforming medical education had been put forward from about 1770.[38] In 1790, Lavoisier's protégé, Félix Vicq d'Azyr, in his capacity as secretary of the Royal Society of Medecine, put forward one of the most significant proposals. His plan for the reform of general medical education, which he presented to the Health Committee of the National Assembly, was not acted upon at the time. However, it had a considerable influence on

[37] *Mémoires de la Société royale de médecine*, 1779, pp. 102, 409; 1780-1781, p. 269; 1782-1783, p. 60; 1789, p. lxx.
[38] Hannaway, C. and La Berge, A. (eds), *Constructing Paris Medicine*, Amsterdam-Atlanta GA, Rodopi, 1998. p. 71.

Fourcroy's first plan for the reform of medical education, which he presented to the Convention in 1793. The advent of the Revolution had led to the utopian fantasy of abolishing all non egalitarian institutions, and this included the Faculty of Medicine, the Royal Society of Medicine, the Academy of Surgery and the Academy of Science. Medical licensing was considered to be a symbol of the old inequality.[39] Official medical teaching was abolished between 1792 and 1794 and medical licensing from 1792 to 1803.[40] However, by 1792, the heavy loss of trained doctors in the military (600 in 18 months) led to pressure for the reintroduction of medical education.

At the end of 1794, several months after the death of his mentor and previous advocate of reform, Vicq d'Azyr, Fourcroy, in his capacity as secretary of the Committee of Public Health, presented another report to the Convention. This report drew on his previous report of 1793 and this time its recommendations were accepted almost without change. One of the recommendations was that a number of chairs should be created for the new medical school in Paris. There were twelve chairs, covering areas such as anatomy, chemistry and surgery. Hallé was appointed to the chair of medical physics and hygiene. The implementation of the new scheme was rapid, with the professors at the new School of Medicine having their first meeting at the end of December 1794.[41]

This rapid implementation was aided both by the pressure of military needs and by the abolition of the learned societies. The Revolution, in calling a halt to the progress of reforms which were gradually being undertaken by the various learned

---

[39] Bynum, W.F., *Science and the Practice of Medicine in the Nineteenth Century*, Cambridge University Press, 1994, p. 27.
[40] Ackerknecht, E.A. *Medicine at the Paris Hospital, 1794-1848*, Baltimore, The Johns Hopkins Press, 1967. p. 7.
[41] Bernard, J., (ed.), *L'Acte de naissance de la médecine moderne*, Condé-sur-Noireau, Corlet, 1995, p. 29.

societies in Paris, had also called a halt to the unresolved conflict between the conservative Faculty of Medicine and the more progressive Royal Society of Medicine. Most of the professors of the new medical school were former members of the Royal Society of Medicine, which made the transition easier. A new era for medical theory and teaching had begun.

Hallé's proposals for teaching a course in hygiene show him to be at the crossroads in the move in emphasis from the individual to the collective in terms of health management.[42] Two of the best known of his students, Alexandre Parent Du Châtelet (1790-1836) and Louis René Villermé (1782-1863), completed the shift with their emphasis on the collective. Parent du Châtelet is well known for his work on sewers[43] and on prostitution,[44] and Villermé for his work on prisons[45] and on occupational disease.[46]

It was a long journey from fifth-century BC Greece to eighteenth- and nineteenth-century France and the change from the individual to the collective view of public health. The details on how to maintain personal health varied over the centuries, but the message of personal responsibility remained strong. The past was encapsulated in Galen's work, particularly in his belief that good health was attained and maintained by following the advice of the experts along with some personal moral integrity. Ramazzini's work on occupational diseases became a compelling influence on the move from the individual towards a more collective approach. By the

---

[42] Hallé, J.N., "Exposition du plan d'un traité complet", *La Médecine éclairée par les sciences physiques, ou Journal des découvertes relatives aux différentes parties de l'art de guérir*, Paris, 1792, pp. 225-235.
[43] Parent du Châtelet, A.J.B., *Essai sur les cloaques ou égouts de la ville de Paris envisagés sous le rapport de l'hygiène publique*, Paris, 1824.
[44] Parent du Châtelet, A.J.B., *De la prostitution dans la ville de Paris, considérée sous le rapport de l'hygiène publique, de la morale et de l'administration : ouvrage appuyé de documens statistiques puisés dans les archives de la Préfecture de police*, Paris, 1836.
[45] Villermé, L.R., *Des prisons telles qu'elles sont et telles qu'elles devraient être... : par rapport à l'hygiène, à la morale et à la morale politique*, Paris, 1820.
[46] Villermé, L.R., *Tableau de l'état physique et moral des ouvriers employés dans les manufactures de coton, de laine et de soie*, 2 vols, Paris, 1840.

time of Hallé's publications, one can see a formal recognition of both approaches. Hallé believed in the importance of both the individual and the collective approach but thought that the collective was the way of the future.[47]

By using Hippocrates' categories of airs, waters and places as reference points to note the changes in scientific knowledge over the centuries, we can follow the road linking the past of Hippocrates with the future of the eighteenth century. Within all three categories, advances in knowledge made possible greater understanding of the influences on health. When these advances were intermingled with economic and social pressures – pressures such as the requirement for a healthy workforce – the road for change was directed from a wholly individual to a mostly collective consideration of public health. This change, which began in the middle of the eighteenth century, was given official blessing by the appointment of Jean Noël Hallé as the first Professor of Public Health in Paris in 1794. He thus stood at the crossroads of the transition.

---

[47] Hallé, J.N., "Exposition du plan d'un traité complet".

Airs

The meaning and understanding of air have varied through the millennia, from the ancient Greek notion of its divine aspect as the essential soul, to the eighteenth- and nineteenth-century search for its actual composition and for the properties of its components. Equally, however, natural philosophers have been profoundly interested in investigating air quality and the natural laws underpinning it, believing that this knowledge would lead to an understanding of how air quality affects health.

The first, and most obvious, way, in which air quality is judged, is by the presence or absence of visible pollutants. When we think about the history of concern with visible air pollution, most of us would call to mind descriptions of the London smogs of the nineteenth and twentieth centuries, the belching smoke stacks of the industrial era factories and the billowing emissions of the cooling towers of power generators. However, visible pollution arising from various sources, particularly the burning of wood and coal, has been perceived to be a problem for a considerably longer time. Even in the third century BC, Theophrastus (371-287 BC), successor to Aristotle, was complaining of the disagreeable and troublesome effects of burning coal. More than three centuries on, Seneca (4 BC-65 AD) noted the oppressive conditions of the air in Rome, bemoaning "the stink, soot and heavy air".[48] Those Romans who could afford to do so retired to the country or the seaside during the summer to escape the heat and polluted air – a custom still observed today in the serried ranks of sun lounges to be found on Italian beaches in July and August.

With the growth of cities came the increased use of wood and coal as fuel and a corresponding increase in visible pollution. By the thirteenth century, many complaints with regard to coal burning were recorded in London and in other cities in

[48] Kessel, A., *Air, the Environment and Public Health*, Cambridge University Press, 2006, Chapter 1.

England and Europe. In 1661, John Evelyn wrote *Fumifugium*, or the *Inconveniencie of the Aer and the Smoak of London Dissipated*.[49] He laid the blame for noxious emissions from burning coal on brewers, dyers, lime-burners, salt and soap boilers in particular. This pernicious smoke caused London to resemble the 'suburbs of hell'. It corroded the stone and iron of buildings, deposited layers of soot and destroyed gardens and orchards. Its corrosive effect on human health was evident in pulmonary diseases in particular. That air pollution by coal burning was still a problem over a century later is shown in Lavoisier's investigations into increasing the water supply to Paris. It had been proposed that steam-driven engines be used for a pumping system and Lavoisier concluded that seven engines would be needed. He knew that these would have used an enormous amount of coal, spreading a thick smoke over the city, a situation not likely to be acceptable to the citizenry.[50]

It was, however, invisible air pollution which most caught the imagination. Invisibility, and all that it implied in terms of hidden menace and threat to human health, puzzled the natural philosophers and created apprehension in the mind of the public. For millennia, miasmas from swamps, still water, caves and other damp places were suspected of being harmful to health. The link between swamps and malaria was well known in the ancient world but the mechanism of disease transmission was a mystery. Hallé and his colleagues investigated miasmas and tried to construct smell maps to find a link with disease but without success. They believed that, while infective agents were not visible, it might be possible to link odour with disease. Perhaps a particular odour was the property of a particular disease. Hallé wrote of the distinctive odours to be found in hospital wards and how they differed between the

---

[49] <http://www.gyford.com/archive/28/04/2009/www.geocities.com/Paris/LeftBank/1914/fumifug.html > viewed 15/1/10.

[50] Poirier, J.-P., *Lavoisier*, Philadelphia, University of Pennsylvania Press, 1996, p. 37.

wards for men, women and children but was unable to draw any useful conclusions from his observations.

Many people also expended much effort in investigating links between climate and disease, the hypothesis being that weather could cause invisible perturbations in the air, which might provoke a particular disease. Corresponding members of the Royal Society of Medicine in Paris collected an enormous amount of meteorological data, but while some diseases were certainly seasonal, linking them to specific weather events proved not to be a fruitful exercise.

In view of all of this inquiry and investigation, it is ironic to note that it was an unsuspected invisible air pollutant which almost certainly had the most significant effect on human health for over two thousand years. This invisible pollutant consisted of the enormous quantities of lead particles emitted into the atmosphere from smelters across Europe.[51] These emissions declined only after the fall of Rome, and then began to rise again during the Renaissance, peaking in the twentieth century as the result of massive use of lead alkyl derivatives in gasoline.[52] Poisoning by inhalation of air-borne lead particles was probably not recognised, since chronic lead poisoning is insidious and the symptoms hard to separate from a number of other maladies. Whether or not Hippocrates made the connection between lead and silver smelting and the resulting air pollution on the one hand, and disease on the other, he did see a link between water polluted by "iron, copper, silver, gold, sulfur, alum, bitumen or nitre" and ill-health.[53] The aforementioned substances are typical of mining effluents.

---

[51] Sungmin Hong, Jean-Pierre Candelone, Clair C Patterson, Claude F Boutron, 'Greenland Ice Evidence of Hemispheric Lead Pollution Two Millennia Ago by Greek and Roman Civilisations', *Science*, vol. 265, 1994, pp 1841-1843.
[52] Warren, C., *Brush with Death. A Social History of Lead Poisoning*, Baltimore, The Johns Hopkins University Press, 2000.
[53] Hippocrates, *On Airs, Waters and Places*, p. 9. See also Nriagu, J.O., *Lead and Lead Poisoning in Antiquity*, New York, John Wiley & Sons, 1983, p. 313.

The accumulation of empirical knowledge of some of the factors affecting air quality provided a base upon which to support a systematic approach to control or change. It also hinted at the possibility of moving from individual to collective action for any control or change. Since public health is defined, in part, as a collective effort to consider and to improve the health or well being of the individual and of society as a whole, it can be seen that air quality was one of the first concerns to come within the purview of those responsible for, or simply interested in, the health of their community.

In the ancient world of Western Europe, the collective effort with respect to public health was uncoordinated and based on the notion of individual responsibility: individual physicians promulgated their views, which were then transmitted by their medical followers, the end result being the availability of information to the individual to act upon if they chose. It was considered that providing the necessary information was the responsibility of the physician and acting upon it was the responsibility of the recipient. There was no centralised system of either the transmission of knowledge or its implementation.

By the time of the French Revolution, the political philosophy of the Enlightenment and its principles of the rights of man led to a societal concern for the natural rights of an individual. Natural rights were universal and they included the right to health and the right to live in a safe environment, which necessarily encompassed clean air. In France, as elsewhere, the field of health was now to be considered with the use of science and reason, not the charity and benevolence of the old days.[54] In previous centuries, religious institutions had provided charity, shelter and health care. During the sixteenth and seventeenth centuries this concept of

[54] La Rochefoucauld-Liancourt, *Rapport du comité de Mendicité*, 1790.

religious care began to change to a secular one[55] and then the eighteenth century saw Enlightenment ideas embrace the concept of science and reason.

After the Revolution, developing a programme for public health was the responsibility of two committees established in 1790. The Duc de La Rochefoucauld-Liancourt (1747-1827) chaired one committee on relief for the poor. The other, a committee on health, was chaired by the physician Joseph-Ignace Guillotin (1738-1814) and was closely linked to the Royal Society of Medicine. These two committees presented to the National Assembly an elaborate plan which would have created the first fully developed national public health system anywhere in the world and would have made medical care available to the entire population. Unfortunately, this ambitious plan did not come to fruition. Nevertheless, at the end of 1794 the new School of Medicine came into being with one of its chairs being in "hygiène publique", the first ever chair of public health. Hallé was the first holder of this chair and, as shown in his essay on "hygiène", [56] he was concerned with both the individual and the societal aspects of public health. Air quality in hospitals and prisons was one of his on-going concerns, along with the possible ill effects of noxious odours and miasmas.

The nature of air had held the interest of natural philosophers over the millennia. This interest led eventually, through scientific experimentation and observation, to the discovery of its composition and the properties of its component parts. The knowledge of the composition of a normal air sample showed the way towards identifying pollutants and, possibly, to establishing their effects and their control. Once a framework was established, collective action became a real possibility

---

[55] Jones, C., "Memoirs on Paris Hospitals", *Bulletin of the History of Medicine*, vol. 73, no. 3, Fall, 1999.

[56] "Exposition du plan d'un traité complet d'hygiène", in Fourcroy, A. (ed.), *La Médicine éclairée par les sciences physiques*, Paris, vol. 4, 1792.

and centralised control an efficient way to implement it. This framework began before the Revolution and continued after it, ultimately being recognised in the establishment of public health as an official domain.

The establishment of the nature, that is to say the actual composition of air, began with Empedocles in the middle of the fifth century BC. He revealed the existence and the nature of air in a crucial experiment which demonstrated the physical existence of air and further established that, although it could not be seen, it was a material substance. Until then air was considered to be infinite and divine, the principle from which all things came into being, in fact, the breath of the world. It is thought that the classical Greek philosophers also believed that air was associated with the soul and hence with life and intelligence.[57] Empedocles also proposed that there were four unchanging substances: earth, air, water and fire. He, and other Greek philosophers of the time, tried to produce a materialistic explanation of the universe based on observation and without reference to any supernatural influence.[58]

The most celebrated of the Greek scientific philosophers was Aristotle (384 - 322 BC). Unlike Empedocles, he did not believe the four elements to be pure and immutable but thought that they could be converted into one another. He proposed that elements also contained two of the following qualities: heat, cold, moisture and dryness. For example, fire was hot and dry; water was cold and moist; air was hot and moist; and earth was cold and dry. Because qualities could vary, change could occur.

Further enlightenment as to the nature of air arose in the third century BC when Strato performed an experiment which led him to the conclusion that air was composed of particles that could expand or contract into the void surrounding them. This was significant, not only because of his conclusions about the nature of air but

[57] *The Internet Encyclopedia of Philosophy*, http://www.iep.utm.edu/a/anaximen.htm, viewed 22 October 2007.
[58] Hudson, J., *The History of Chemistry*, London, The Macmillan Press, 1992, pp. 6-15.

also because it was one of the earliest examples of conducting an experiment using purpose built apparatus.[59] It was also unusual because, in general, the Greek philosophers felt that abstract intellectual activity was the only worthwhile path to take and that physical experimental confirmation was beneath their dignity as free men; manual work of any kind was for slaves or the lower classes. The scientific theories of the philosophers were, therefore, hypotheses arrived at by logical thought and were not necessarily required to be supported by observation.

It was about this time that the two major schools of philosophy, the Epicureans and the Stoics, were founded. Both these schools held that the purpose of philosophy was to promote human happiness; scientific enquiry was a means to this end. It could be used to explain natural phenomena without any reference to the supernatural in any form, be it superstition or religion. The Stoics believed that matter was composed of two principles, the passive and the active. The active principle was the pneuma, the breath or the vital spirit. They proposed that it was the pneuma which held together a complex structure like a plant or an animal – a universal gaseous superglue which slid between interstices like an amoeba.

The Greek world underwent rapid changes brought about by Aristotle's pupil, Alexander the Great (356-323 BC). In the Hellenistic culture, which flourished in his empire, a number of scientific philosophers came to prominence, including such figures as Euclid and Archimedes. One of the best known of the later scientists was Hero (AD 62-150), who accepted Strato's ideas that gases consisted of particles in a void and that they would be forced closer together when compressed.

The Greek idea of the elements, including the nature of air, persisted for millennia, through the Middle Ages and the Renaissance, profoundly influencing

---

[59] Hudson, *The History of Chemistry*, p. 13.

European philosophy in science. From time to time, variations on the theme were put forward. In the Middle Ages, for example, the French philosopher, William of Conches (c1090-1154) proposed that air was the element specific to man, distinguishing humanity from other living creatures, who consisted only of fire, water and earth. Nevertheless there was little real change in the theories of the four elements over the centuries.

As regards the nature of air, the idea that air consisted of particles which could expand or contract in a void under the influence of pressure proved correct but the actual composition of air was not determined for a long time. In general, it was considered to be a single homogeneous entity and it needed the advent of experimental and analytical science to prove otherwise. It was indeed not until the seventeenth century that experimental science began to flourish and to challenge rapidly (among other things) the millennia-held belief in the theory of the four elements as a basis for scientific explanation. The idea of making observations and carrying out experiments was not new, but it achieved a new prominence, particularly through the influence of Sir Francis Bacon (1561-1626). He emphasised the importance of the planning of experiments and the recording of results, not only so that they could be repeated, but also so that they could lead to new hypotheses.[60]

Over a period of about two hundred years, between the seventeenth and early nineteenth century, there was an area of scientific study known as pneumatic chemistry which concerned itself with trying to understand the physical properties of gases and how they were involved in chemical reactions. It was during this period that several gases were isolated and identified for the first time, although they were still called “airs” by the scientists of the era. It was van Helmont (1577-1644), a Flemish

[60] Hudson, J., *The History of Chemistry*, p. 37.

chemist, physician and physiologist, who introduced the term of gas rather than air. It appears that he was first to understand that there are individual gases, distinct in kind from atmospheric air. Among those who investigated gases were, in England, Robert Boyle (1627-1691), Henry Cavendish (1731-1810) and Joseph Priestley (1733-1804), and in France, Antoine Lavoisier (1743-1794). Boyle is best known for the law deduced from his experiments on atmospheric air, which resulted in the finding that the volume of a gas is inversely proportional to its pressure. This is also sometimes known as the Boyle-Mariotte Law to include recognition of the French scientist who independently discovered the same law several years after Boyle. Boyle also recognised that gases represented a third important class of substances, alongside solids and liquids.[61] This was a difficult concept for natural philosophers of the time, as they believed that a gas could only have chemical or physiological properties if it held tiny solid particles in suspension. Breathing air in certain mines poisoned people, and, as the only known poisons were solid or liquid, the air must therefore contain tiny poison particles.[62]

Boyle dismissed the long held belief in the four elements, pointing out that combustion of wood yielded a different number of products, depending on the conditions under which the combustion took place. This idea had little immediate impact but it did begin the shift away from the old Aristotelian ideas of chemistry.

From late in the seventeenth century until late in the eighteenth century, the theory known as the phlogiston theory dominated the world of chemistry. The phlogiston theory had arisen in an attempt to explain the oxidation processes of combustion and the rusting of metals, processes long believed by natural philosophers to represent the decomposition of a material into simpler substances. It was this

---

[61] Poirier, J.-P., *Lavoisier*, p. 55.
[62] Crosland, M., *Scientific Institutions and Practice in France and Britain, c.1700-1870*, Aldershot, Great Britain, Aldershot Publishing, 2007, pp. ix, 90.

theory that led them to believe that something was emitted or lost in some way during these processes.

In 1667 Johann Joachim Becher (1635-1682), physician, chemist/alchemist, proposed that, as well as the classical four elements of the Greeks, there was an additional element that was contained within combustible bodies and that was released, to lesser or greater degrees, during combustion. In 1669 Becher combined this idea with his suggestion that all bodies were composed of air, water and three earths. One of these earths escaped when combustion occurred. This theory was taken up and extended by Stahl (1660-1734), who called the earth which escaped phlogiston. Phlogiston was supposed to be a very subtle material, which could only be detected when it left a material containing it, and under such circumstances it appeared as fire, heat and light. Combustion was therefore a loss of phlogiston and any remaining residue was the original material deprived of its phlogiston. Carbon was the compound which held the greatest concentration of phlogiston, as its combustion left very little residue.

It had long been known that an inflammable substance would cease burning if the supply of air was limited and Boyle had also demonstrated that combustion would not occur in a vacuum. The phlogiston theory explained this by assigning to air the ability to absorb phlogiston so that, when air was saturated with phlogiston, combustion would cease. Combustion was completely impossible in a vacuum with no air to absorb the phlogiston.

The phlogiston theory was the first unifying theory of chemistry and it was possible to use it to rationalise many new discoveries. One fact which it could not satisfactorily explain was the well-known increase in weight of metals on calcination (combustion), in other words the calx was heavier than the initial metal, when it should be lighter as it had lost phlogiston. This did not appear to be of great concern to quite a number of scientists who were more interested in qualitative than quantitative results, but some proponents of the phlogiston theory tried to explain the phenomenon by saying that the weight of phlogiston could vary from compound to compound. In some metals, phlogiston had negative weight, or was at least lighter than atmospheric air.[63] There were other scientists, including Lavoisier, who thought that, although phlogiston was released during the combustion of metals, air (either atmospheric air or fixed air) was taken in during the process, thus explaining the increase in weight. What was difficult to explain was the discovery that mercury could be turned back into a metal simply by heating its calx, that is, without the presence of a phlogiston rich source such as charcoal. This should not have been possible according to the phlogiston theory.

It was knowledge of the nature and composition of air, in which combustion took place, which was needed to produce a new theory to explain satisfactorily all chemical processes, but progress in this area proceeded in fits and starts. Work had been done in England by Stephen Hales (1677-1761), an English physiologist, chemist and inventor, who, in 1735, observed that plants absorb large amounts of air through their roots and leaves, a finding that led him to believe in the great importance of air in the support of life in plants. Through various experiments, he came to the conclusion that air abounds in all animal, mineral and vegetable substances, where it forms an essential and considerable part of their framework. Without it, "whole nature would then immediately become one unactive cohering lump."[64] His conclusion was that air existed in two forms: that which we breathe and

[63] Hudson, J., *The History of Chemistry*, p. 48.
[64] Hales, S., *Vegetable Statisticks: or An Account of some Statical Experiments on the Sap in Vegetables: Being an Essay towards a Natural History of Vegetation*, London, W. and J. Innys, 1727, p. iv, cited in J.-P. Poirier, *Lavoisier*, p. 56.

that which is intimately combined, indeed fixed, in matter. Hales' interests lay in the hydrostatic processes in plants rather than the composition of air, so it was left to others to advance in that direction.

The work on gases continued, and in England, Cavendish was able to produce hydrogen from the reaction of metals with strong acids. Although he was not the first to produce hydrogen, he is usually credited with recognising its elemental nature. He called it "inflammable air" and noted that it combined with "dephlogisticated air" (oxygen) to form water.

A large volume of work was done by Priestley between 1773 and 1780, his experiments being almost entirely confined to "airs". At one point, Priestley lived next door to a brewery and used the thick layer of "fixed air" found on the surface of fermenting beer in his experiments. He showed that combustion did not occur in this gas and that, when a burning or smouldering object was introduced, it was immediately extinguished. Animals would die in it and only plants could live in it. Not only could plants live in it but they also grew and even had the power to make it breathable again.[65] Others observed that fermentation and the production of this "fixed air" halted the putrefaction of animal substances. From this observation came the possibility of using "fixed air" to treat various human diseases and to prevent the advancement of disease, and perhaps its elimination, in such conditions as fevers, inflammations and cancers. With this aim in view, Priestley devised a method of dissolving "fixed air" in water and produced a form of soda water; not that the commercial possibilities occurred to him. This was left to Johann Jacob Schweppe (1740-1821) who developed a method to charge water with "fixed air". He patented this method in 1783, some time after Priestley had produced his version. Priestley

[65] Poirier, J.-P., *Lavoisier*, p. 52.

proposed to the Lords of the Admiralty that scurvy be treated with his water saturated with "fixed air" and, since scurvy was a great problem in the navy, his proposal assumed considerable military importance. This information was passed on in the form of Priestley's pamphlet, *Directions for Impregnating Water with Fixed Air*, to Trudaine de Montigny, an influential member of the Académie des Sciences. In July 1772, he sent the pamphlet to Antoine Lavoisier, requesting that he investigate the properties of "fixed air". This official request from a high government official (who was also a friend) set Lavoisier along the path to the study of the chemistry of gases which would prove to be decisive for his career.[66]

It is ironic that it was another experiment conducted by Priestley, which led Lavoisier to his eventual establishment of the "exact quantitative composition of atmospheric air"[67] and the repudiation of the phlogiston theory. In 1774, Priestley conducted an experiment in which he focused sunlight on mercuric oxide in a glass tube. This liberated a gas that he called dephlogisticated air and he noted that candles burned brighter in it and that a mouse was more active in it. When he breathed it himself, he said that his breast felt peculiarly light and easy for some time afterwards. He published these findings in 1775 in a paper entitled "An Account of Further Discoveries in Air", which was included in the second volume of his six-volume book *Experiments and Observations on Different Kinds of Air* (1774-1786).

In fact Carl Wilhelm Scheele (1742-1786), a Swedish pharmacist, had already produced oxygen, calling it "fire air" because it supported combustion; but, although he had sent an account of his discovery to his publisher in 1775, it was not actually published until 1777. In 1774, Scheele sent a letter to Lavoisier describing his discovery, but Lavoisier never acknowledged receiving it. Also in 1774, Priestley

---

[66] Poirier, J.-P., *Lavoisier*, p. 54.
[67] Poirier, J.-P., *Lavoisier*, p. 83.

visited Lavoisier in Paris, where he informed him of his experiments and of the new gas he had liberated. Priestley certainly did not realise the importance of his findings and held to the phlogiston theory for the rest of his life.

Lavoisier was aware that almost all the research in the study of airs had been going on in England, Germany and Holland, and that the French were lagging a long way behind. Lavoisier's student, Antoine de Fourcroy (1755-1809), was later to write, that, although the principle of "fixed air" had been accepted in England and the studies of the subject known in France, little attention was paid to these until more than twelve years after their initial publication. In the meantime, a number of important works on the subject had come out of England, Germany and Holland.

Before embarking on the research requested of him by Trudaine de Montigny, Lavoisier read all the available literature on the subject. From this research, he became aware of several fundamental concepts, one being that metallic calces could contain not only phlogiston but also gases. There was also the idea of the presence of air in matter. Some believed that it was atmospheric air that was fixed in matter, others believed that fixed air was a distinct entity, a different gas. It was obviously necessary that fixed air should become an important part of chemical theory.[68]

Over the years, Lavoisier was to elucidate that one of the components (oxygen) of atmospheric air was a component of calces (metallic oxides) and that fixed air was not atmospheric air fixed in matter, but carbon dioxide. The first important step was his suspicion that only a portion of atmospheric air was used in the calcining of metals, an idea he presented in a text to the Académie des Sciences early in 1774. By the end of that year, he announced that his experiments on the calx of mercury had led him to the conclusion that not all of atmospheric air is breathable and

---

[68] Poirier, J.-P., *Lavoisier*, p. 57.

that it was the breathable portion that combines with metals during calcinations. In other words, atmospheric air consisted of at least two different portions, perhaps more.

Lavoisier did not always acknowledge previous discoveries and on one occasion, when challenged on the subject, he laughed and said, "Those who start the hare do not always catch it".[69] In this sense he was right, as he repeated experiments done by others but eventually drew different conclusions. He was indisputably the first to conduct adequate quantitative experiments on oxidation and give the first correct explanation of how combustion works, thus discrediting the phlogiston theory. In 1777, he established the exact quantitative composition of atmospheric air and presented his theory that combustion and related processes were reactions in which oxygen combines with other elements, in a paper entitled "Memoir on Combustion in General".

By 1778, he had refined his notions of the nature of oxygen and the processes associated with it, including oxidation and reduction and also animal respiration. He postulated that respiration was a biological form of combustion in which oxygen breathed in was responsible for the production of body heat. It had been known since Harvey discovered the circulation of blood in 1628 that respiration was a vital function and that air was essential. It changed dark venous blood back to bright red arterial blood. A series of experiments with sparrows confined in a pneumatic trough led Lavoisier to the conclusion that respiration absorbs atmospheric air and expels a contaminated part of it. He also was able to demonstrate the artificial synthesis of

[69] Poirier, J.-P., *Lavoisier*, p. 81.

atmospheric air by mixing "eminently breathable air" (oxygen) and mofette[70] (nitrogen) in the right proportions.

Lavoisier had the chance to repeat his sparrow experiments at a meeting of the Academy of Science attended by Marie Antoinette's brother, Joseph II, and he took this opportunity to point out to the august company the importance of his discoveries in the area of public hygiene. He identified the changes that take place when living creatures breathe for some time in an enclosed space, in particular the depletion of oxygen and the addition of "fixed air" (carbon dioxide) to the non-breathable portion of air. He explained that, in the absence of ventilation, there are layers with mofette, the lightest, rising towards the ceiling, ordinary air in the middle and "fixed air", being the heaviest, sinking to the bottom. The implications for public hygiene in hospitals, prisons, ships and even theatres were obvious.

A number of influential chemists of the time were resistant to the new theories put forward by Lavoisier, feeling that refutation of the phlogiston theory would destroy the structure of chemistry. It was to take until about 1785 for the demise of phlogiston to finally occur. Although many chemists accepted that Lavoisier had carried out his experiments precisely and correctly and that the results were real, they persisted in trying to find an acceptable compromise between Lavoisier's theories and the existence of phlogiston. Finally in June 1785, Lavoisier presented to the Académie des Sciences the first part of "Les Réflexions sur le Phlogistique" in which he attacked the notion of phlogiston. There was still much opposition from older chemists, and the Irish chemist, Richard Kirwan, published a counter attack that was favourably received, not surprisingly, in England, Germany and Sweden. In France, Claude Louis Berthollet (1748-1822), a well known and respected chemist, was one

[70] Mofette was the nitrogen which was left after the removal of oxygen from air by combustion or respiration.

of the first to announce his support for Lavoisier, followed by Lavoisier's protégé, Fourcroy, who was noted for his brilliance as an orator and his formidable intelligence. Fourcroy began teaching the new theory in his chemistry course and his persistence as a champion of Lavoisier's theories played the major role in promulgating them, particularly through his books, which were translated into many languages.[71]

In January 1789, the first copies of the *Traité élémentaire de chimie* appeared after Lavoisier had spent nearly a year in writing. This momentous publication put forward the essentials of the new chemistry, particularly the composition of air and water and the role of oxygen in combustion and in the formation of acids and oxides. It also gave the first explicit statement of the law of the conservation of matter in chemical reactions: nothing is created in an operation, an equal quantity of matter existing both before and after a reaction.[72]

Lavoisier's works put him at the crossroads between the old and the new chemistry, a point physically illustrated by the present-day positioning of his reconstructed laboratory in the Musée des Arts et Métiers in Paris. It is sited so that it sits in a right angle in the chronological progression between early science and that from the late eighteenth century to the present day. It had taken over two thousand years from the time that Empedocles had demonstrated the physical existence of air to reach this crossroad established by Lavoisier's careful presentation of the exact quantitative composition of air.

The implications of elucidating the composition of the atmosphere, were particularly striking in the area of "hygiène publique". In places where ventilation was restricted, such as hospitals, prisons, ships, enclosed public meeting places such as

---

[71] Smeaton, W.A., *Fourcroy, Chemist and Revolutionary, 1755-1809*, Cambridge, England, W. Heffer and Sons, 1962, p. xviii.
[72] Poirier, J.-P., *Lavoisier*, p. 193.

theatres and some domestic situations, it was possible to attribute the ill effects of the atmosphere to increased levels of carbon dioxide. Rather than some kind of indefinable menace, it was an identifiable and quantifiable component of the atmosphere, whose concentration could be changed by physical means. Air circulation and ventilation became one of the first principles of public health. The importance of air quality in maintaining health has had a long history and the elucidating of air composition was one significant step in changing public health practices.

The belief in the importance of air quality can be seen in Hippocrates' *On Airs, Waters and Places*. Hippocrates placed considerable importance on the prevailing winds of a particular site, believing that one could predict the nature, health and even the stature of the inhabitants from the direction and temperature of the winds. The most desirable places to live faced the rising sun and were not exposed to hot or cold winds. Their inhabitants enjoyed good health, superior temper and intellect, and were prolific, the women conceiving and giving birth easily.[73]

This belief in the importance of air quality persisted down through the ages. The Romans, in particular, were aware of the association between marshes and swamps and the incidence of malaria, although the mosquito as the disease vector was not known. One of the earliest warnings regarding the dangers of this type of environment is that contained in *On Agriculture* by Marcus Terentius Varro (published in 36 BC), in which the author cautions about locating a homestead in proximity to swamps:

> […] and because there are bred certain minute creatures which cannot be seen by the eyes, which float in the air and enter the body through the mouth and nose and there cause serious diseases.[74]

---

[73] Hippocrates, *On Airs, Waters and Places*, pp. 5-8.
[74] Wikipedia, <http://en.wikipedia.org/wiki/Germ_theory_of_disease> ,viewed 1 June 2008.

Seventeenth-century physicians and scientists put the Hippocratic doctrine of the relationship of disease and environment under close scrutiny again. Robert Boyle (1627-1691) deduced from meteorological observations that local weather could be linked to epidemics and the healthiness of the air. Thomas Sydenham (1624-1689) built upon Boyle's ideas and classified diseases into those produced mainly as a result of environmental conditions, those produced by atmospheric conditions and those resulting from humoral imbalance.[75] Sydenham contributed greatly to the natural history of disease by his own accurate observation and philosophical comparison of case with case and type with type. His works – *Observationes medicae* and the first *Epistola responsoria* – contain evidence of a close study of the various fevers, fluxes and other acute maladies in London over a series of years, and their differences from year to year and from season to season, together with references to the prevailing weather. The whole body of observations was used to illustrate the doctrine of the epidemic constitution of the year or season. Sydenham believed that the complexity of factors made it impossible to make accurate predictions but felt that there were five that were particularly important, these being heat, cold, moisture, dryness (the four qualities of Galen) and emanations from the bowels of the earth. He believed this last to be the most important, but also impossible of analysis – a useful quality of any postulation. The type of the acute disease varied, he found, according to the year and season, and the right treatment could not be adopted until the type was known. This was virtually the first time since the Hippocratic works that anyone had undertaken such a significant project in trying to determine links between the weather and

[75] Porter, D., *Health, Civilization and the State*, London, Routledge, 1999, p. 55.

disease, epidemic and endemic.[76] The hypothesis that there was a meteorological basis and explanation of disease persisted into the nineteenth century.

The important role of air in the health of a population had been recognised since the time of Hippocrates and probably before that. Galenists carried on the Hippocratic belief that polluted air could produce plagues, proposing the idea that atmospheric disturbances produce disturbances in the body.[77] They recognised the important role of air in epidemics, although they were divided as to the method of action.[78] Diet and exercise had also always been considered as vital ingredients in the maintenance of the health of the individual, but after the middle of the eighteenth century there was a change in emphasis. Although these two factors were still considered to be very important, they were sidelined to a degree by the concern with air quality. The key to a healthy life was to live in an environment where air circulated freely.

This renewed concern with air quality can be traced back to work done by Stephen Hales (mentioned earlier). His main interest was in the physiology of plants, in which area he made extremely important contributions, particularly in hydrostatic processes and the absorption of air. His interest in gases led him to the discovery of the dangers of breathing what he called "vitiated" air – the fetid, de-oxygenated air found in prisons, ships and hospitals – and he invented a device to remove this air. He drew the inspiration for a ventilator, a modified organ-bellows, directly from his own scientific work on the elasticity of air in *Vegetable Statisticks* (published in 1727). This apparatus was successful in reducing mortality in one of the London prisons where it was trialled, and later it was introduced into France by Henri-Louis Duhamel du Monceau (1700-1782, Paris), a French naval engineer and botanist.

---

[76] Wikipedia, http://en.wikipedia.org/wiki/Thomas_Sydenham, viewed 16 October 2007.
[77] Porter, D., *Health, Civilization and the State*, p. 34.
[78] Brockliss, L., and Jones, C.L., *The Medical World of Early Modern France*, p. 462.

The interest and belief in the importance of air circulation are also demonstrated in plans put forward for the rebuilding of the Hôtel Dieu after it burnt down in 1772. The architect, Bernard Poyet (1742-1824), proposed a circular shape which allowed in particular for the free flow of air and hence clean air in all rooms.[79] The increased importance laid upon air quality was a reflection of French physicians' conversion to the belief that the air was the primary external cause of disease. A particular aspect of this concern with the quality of air was the conviction that disease could be caused by unseasonable weather or sudden climatic change. This prompted the request from Félix Vicq d'Azyr (1746-1794), Permanent Secretary of the Royal Society of Medicine, for the multitude of provincial corresponding members of the Society to collect information, not only on the location of particularly insanitary areas in their locality, but also on barometric pressure and temperature. It was hoped that a connection between climatic change and disease could be established and hygienic maps drawn up. This led to a number of medical topographies being published, but it was not possible to draw clear conclusions about the links between the various factors studied.

Similarly, there was considerable interest in the possibility of categorising smells to provide an insight into the epidemiology of various diseases and to identify and detect harmful gases and miasmas. A number of scientists and amateurs were involved in this investigation of classifying odours and trying to link their findings to particular diseases and their transmission. This impossible mission was not resolved until Pasteur's germ theory of disease put a final end to it in the second half of the nineteenth century. Alain Corbin graphically describes an event which took place in

[79] Musée de l'assistance publique –Hôpitaux de Paris pamphlet, p.15. Website for this museum is www.aphp.fr/musee

1782 at the cleaning of a notorious cesspit in Paris.[80] This cesspit was reputed to contain the odd severed limb, illegally obtained then used and discarded by students of anatomy, as well as the expected putrid contents. A group of experts in hygiene and chemistry had gathered there to judge the efficacy of a new anti-mephitic substance. Among the eight experts present were Lavoisier, Fourcroy and Hallé, the latter publishing a report in 1785, *Recherches sur la nature et les effets du méphitisme des fosses d'aisances*, which included a description of this event. During the cleaning procedure, Hallé and one of his colleagues spent some time climbing up and down ladders in order to measure the degree of stench at different levels. They survived the experience and were luckier than one of the cleaners, who fell into the pit and died after being pulled out. An interesting aspect of this event is that an inspector tried to administer artificial respiration to the unfortunate cleaner, only to collapse himself and suffer some sort of fit. He believed that inhaling the noxious gases from the breath of the dying man was worse than inhaling them firsthand in the cesspit, which shows the persistence of old superstitions in the face of scientific endeavour.

Hallé later contributed an essay to the *Encyclopédie methodique. Médicine* (1787) entitled "Air des hôpitaux de terre et de mer" in which he describes the various odours encountered in different hospital wards; although this is of some interest, it took him no closer to linking specific miasmas with specific diseases. He also comments that, although there was now a greater emphasis on cleanliness than in earlier times, the hospital wards of the poor were still notable for nausea-producing odours.

Lavoisier had been aware of the need for proper ventilation in enclosed spaces for some time, having initially made surveys of coalmines which were reported to the

---

[80] Corbin, A., *The Foul and the Fragrant*, London, Picador, 1994, p. 2.

Academy of Science in 1778.[81] His interest in the quality of air in public places is illustrated by the request of the Royal Society of Medicine that he speak to its members on the subject. In February of 1785, he presented to them a paper entitled "Changes in Breathed Air". He told them that the salubrity of air is bound to be reduced in public buildings and places where large numbers of people congregate, especially if air circulates slowly and with difficulty.[82] As his biographer, Jean-Pierre Poirier, commented, "his vision of the risks of contagious diseases was prophetic":

> It is frightening to think that in any large gathering the air breathed by each individual has passed and repassed a great many times – either wholly or partially – through the lungs of all the audience and has been laden with more or less putrid exhalations. But what is the nature of these emanations? To what extent are they different from one subject to another, in the elderly or the young, the ill or the healthy? What are the illnesses likely to be spread by this kind of communication? What precautions could be taken to neutralize or destroy the dangerous influence of these emanations? There is perhaps not one of these points whose examination cannot be subjected to experiment, and there is nothing more important for the preservation of the human species.[83]

He concluded by saying "the art of living in society, of preserving the vigor and health of large numbers of individuals sharing limited space, of making large towns more salubrious and contagious diseases less communicable, is still in its infancy."[84]

On a more lighthearted note, Lavoisier remarked that he had noticed an "impatience machinale" among the members of the audience at the Academy of Science towards the end of a long meeting. He attributed this to the deterioration of

---

[81] Guettard et Lavoisier, "Description de deux mines de charbon de terre, situeés au pied des montagnes de Voyes, l'une en Franche-Comté, l'autre en Alsace, avec quelques expériences sur le charbon qu'on en tire", *Mémoires de l'Académie Royale des Sciences*, 1778 (1781), pp. 435-441, cited in Duveen, D.I., and Klickstein, H., "Antoine Lavoisier's Contributions to Medicine and Public Health", *Bulletin of the History of Medicine*, 29, 1955, p. 164.

[82] Poirier, J.-P., *Lavoisier*, pp. 152, 153.

[83] Dumas, J.B. (ed.), *Oeuvres de Lavoisier publiées par les soins du Ministère de l'Instruction publique*, Paris, Imprimerie Nationale, 1864-1893, vol. II, p. 687, cited in J.-P. Poirier, *Lavoisier*, p. 153.

[84] Poirier, J.-P., *Lavoisier*, p. 153.

the atmosphere and observed that this was a sad handicap for the last speaker at such a meeting.[85]

One result of Lavoisier's conclusions on the composition and nature of air and the existence of oxygen, was that it was possible to examine air quality. Air quality indeed began to be measured in terms of the amount of oxygen in it, by means of a eudiometer. There was particular interest in mephitic environments, although it proved impossible to construct a meaningful noxious odour-oxygen index. Many scientists/physicians were interested in this area as it was hoped that smell maps could be constructed which would shed light on the transmission of various diseases. Hallé was involved for some time in trying to classify and map noxious odours in cesspits (see earlier cesspit episode) and along the banks of the Bièvre and the Seine.[86] With regard to the Seine in particular, in 1790 Hallé and a friend spent a mild winter's day on a ten-kilometre walk along both banks of the river, during which they meticulously recorded the variety of odours encountered along the way, the results being presented in a report to the Royal Society of Medicine.

This concept that odours could be a linkage in disease transmission stood in contrast to the belief held by some, particularly in the preceding centuries, in the therapeutic value of excrement. It was believed that sewage odours preserved public health by the prevention of plague and that exposure to excrement endowed gut-dressers and sewermen with good health. Fourcroy apparently doubted these alleged properties but, early in his career, he did not feel confident about refuting them publicly. By the time Hallé *et al.* were trying to classify odours, very few medical people still believed in the therapeutic value of excrement, although one of Hallé's

[85] Duveen, D.I., and Klickstein, H., "Antoine Laurent Lavoisier's Contributions to Medicine and Public Health", p. 169.
[86] Corbin, A., *The Foul and the Fragrant*. See chapters 1 and2 in particular for a discussion on this area.

most illustrious students, Alexandre Parent Duchâtelet (1790-1836), was still praising the curative qualities of excrement in the 1830s.[87]

Ventilation, deodorisation and disinfection, as health measures, were resisted by the poor and the peasants, as demonstrated in the 1832 riots by rag pickers in Paris. The police had been involved in trying to speed up the process of cleansing but the protesters prevented the removal of rubbish and excrement by burning the collectors' carts. In the countryside, belief in the beneficial qualities of air in stables and barns, particularly those inhabited by young animals, persisted and many consumptives were sent to breathe animal exhalations.[88] These superstitions were maintained in the face of Lavoisier's work which had already led to the knowledge that it was not sufficient to have the movement of air in a confined space for purification; only renewal would restore it to its proper constitution. In a delineated inhabited space, airing was necessary for the health of the inhabitants.[89] A consequence of this was the attempt to formulate the minimum space needed to meet respiratory needs of prisoners, hospital patients and so on, which led to Lavoisier's suggestion of a cubic norm.[90] Various scientists made quite complicated calculations in order to try to ascertain this theoretical space, although they did not seem to reach a consensus. This concern with air, its quality, its odour and its link with disease, was afforded an importance that is difficult to comprehend now that modes of infection and transmission are generally known.

The theory of disease transmission via miasmas postulated that epidemic outbreaks of infectious diseases were caused by the state of the atmosphere and by emissions of dangerous "airs" from swamps, marshes and standing water, including

---

[87] Corbin, A., *The Foul and the Fragrant*, p. 212.
[88] Corbin, A., *The Foul and the Fragrant*, p, 215.
[89] Corbin, A., *The Foul and the Fragrant*, p.162.
[90] Corbin, A., *The Foul and the Fragrant*, p. 171.

those found in rubbish dumps, graveyards and the like.[91] A modified version of this theory was formulated in the nineteenth century, when the belief developed that poor sanitary conditions produced a local atmospheric state that caused disease. The miasma theory was opposed in the nineteenth century by the contagionists, who believed that specific contagia were the sole causes of infections and epidemic diseases, that emissions from the bodies of the sick caused disease. There were those who tried to reconcile the two theories by recognising that infectious diseases are due to contagia but can only act in conjunction with other elements, such as the state of the atmosphere or social factors.

Although Lavoisier and others had shown that ventilation and the circulation of air were important to the maintenance of health, particularly in closely occupied areas such as prisons, hospitals and public gathering places, there was not the equivalent of Lavoisier in this field of miasmas and contagia to cut through conflicting theories and arrive at the truth. Thus Hallé and his colleagues could be seen, as late as 1790, still trying to arrive at an understanding of disease transmission by the cataloguing of smells, in an attempt to find a linkage between miasma and sickness – and these were the well-educated scientists of the day. Long after that, belief in the positive and curative aspects of emanations persisted in the countryside. It was left to Louis Pasteur (1822-1895) to show that minute infectious particles hypothesised long ago by the Greeks and Romans – the transferable "disease spores" later postulated by Girolamo Fracastoro (1478-1573) and the animalcules of Anton van Leeuwenhoek (1632-1723) – were the agents of infection. The airs and miasmas were exonerated from being the direct agents of disease and relegated to the slightly less important role of periodical carriers.

[91] Rosen, G., *A History of Public Health*, Baltimore and London, The Johns Hopkins University Press (expanded edition), 1993, p. 264.

The belief in the role of air in health, for the individual and for society, has had a very long history in the western world. Although there were sidetracks along the way, the importance of ventilation and circulation in maintaining salubrious air was demonstrated empirically in the eighteenth century. Scientific experimentation provided the answer to the composition of air and the properties of its component gases. With this knowledge came the opportunity to control or modify air and thus the environment both of the individual and of the general public. This was to constitute an important element in the health of the public, the “hygiène publique” taught by Jean Noël Hallé from 1795 at the new medical school in Paris.

Waters

> "No verse can give pleasure for long, nor last, that is written by drinkers of water."
> Horace (Quintus Horatius Flaccus) (65-8 BC), *Epistles*, book 1, number 19, line 2.

Horace's views on the limited poetic abilities of the abstemious, and of their lack of enjoyment of life, carry on a venerable tradition from biblical times. Ecclesiastes, for example, tells us that

> Wine is as good as life to a man, if it be drunk moderately: what is life then to a man that is without wine? For it was made to make men glad.[92]

Horace's view notwithstanding, it is water that is essential for life. For millennia, water, along with air, was considered by natural philosophers to be one of the four fixed elements. Among the Greek philosophers there was much debate about the actual nature of water and whether or not it was the first principle. Some thought it was, others believed air to be the first principle, while a third group supported the case for aetherial fire, from which all things originate and to which they return in a perpetual process of flux. The nature of water was not to be finally uncovered until the late eighteenth century when Lavoisier presented his conclusions to the Royal Academy of Science in Paris in June 1783.

It was Hippocrates (ca 460 BC – ca 370 BC) who turned his attention to less philosophical and more practical matters in considering the importance of water qualities in the health of a population. Other practical considerations of importance, which occupied scientific minds for over two thousand years, were the supply of water, particularly to urban areas, and the use of water for personal hygiene. Water had been supplied to the urban areas of Western Europe for centuries, notably by means of aqueducts, but these fell into disrepair with the decline of the Roman

[92] Ecclesiasticus, ch. 31, v. 27.

Empire. Paris was partly supplied by the Roman aqueduct of Rungis which provided water to the Left Bank until the Normans largely destroyed it in the ninth century. Wells and some fountains sufficed for domestic supplies for several centuries, but by the middle of the sixteenth century water supply to the general population of Paris was very limited. Although attempts were made to rectify the situation, it was not until Napoleon had the Canal de l'Ourcq constructed in 1808 that Paris had an adequate water supply.

Water quality has also long been of concern, as evidenced by Hippocrates' meticulous descriptions of the effects of its source on the quality of water. The Romans were likewise well aware of the differences in the waters delivered by the various aqueducts. Some were of drinking quality, others only suitable for flushing drains. By the end of the eighteenth century, we see Lavoisier's view that the strength and health of citizens depends on salubrious water.

> The study of common waters interests all of society and principally that active part whose arms are both the strength and the wealth of the state.[93]

The presence or absence of water has been an important factor in the course of the history of humankind. The Biblical Flood of Noah is the stuff of legend, although there is some evidence that a flood of catastrophic proportions did actually occur in Europe's prehistory. More within our grasp of time, the historical record attests to eight years of massive rainfall and record flooding over the whole of Europe during 1313-1320, an event which precipitated the Great Famine. It has been estimated that 10-25 per cent of the population of northern Europe and England died during this period.[94]

---

[93] Poirier, J.-P., *Lavoisier*, p. 31.
[94] UNESCO: < http://www.unesco.org.uy/phi/libros/histwater/frame.html, viewed 9 June 2008.

Four and a half centuries later, in the 1780s, a series of rain-damaged grain harvests in France, culminating in one damaged by hail, led to high prices for bread. High prices for bread and flour, which particularly affected the urban poor, led to civil unrest, resulting in riots and pillaging. Again water was the enemy,[95] the unwelcome gift which destroyed crops and created famine. It was a major factor in the discontent leading up to the Revolution in 1789.

The presence or absence of water has been an important factor in the course of the history of humankind. The ability to analyse, quantify and control the physical presence and properties of water has been of interest for several thousand years, not least to the natural philosophers of the Enlightenment, and to those who succeeded them, in establishing the field of public hygiene. It was of interest to those such as Lavoisier in determining the physical structure of water, and to those concerned with water quality such as Hallé and his colleagues.

Water supply must come to the forefront when public health is considered, since it is essential for the support of life. Indeed, urban water supply in Europe and the Middle East has a long history. The earliest towns and cities were generally built on the banks of a river or a lake from which water was drawn directly. However, this posed problems in terms of the physical effort needed to raise and transport water and in terms of pollution, which was inevitable as populations increased. These problems led to the sinking of wells and the construction of storage cisterns, both of which were the main water resources for thousands of years.

To access water from some distance, the construction of aqueducts, or some variation on that theme, was undertaken quite early. The Assyrians built one of the earliest, very similar to later Roman examples, in the seventh century BC. It was 10 metres high and 300 metres long, made of limestone, and used to transport water across a valley to the city of Nineveh. An even earlier version of the aqueduct was the qanat, first used by the Persians in about the eighth century BC. This is an underground aqueduct where a series of vertical well shafts were connected by gently sloping tunnels. These well shafts tapped into subterranean aquifers and delivered large quantities of water to the surface, where it drained by gravity to a lower destination. The qanats allowed water to be transported long distances in hot, dry climates without losing a large proportion of the source water to seepage and evaporation. It was very common in the construction of a qanat for the water source to be found below ground at the foot of a range of foothills of mountains, where the water table is closest to the surface. This type of system, generally using water from aquifer drainage, became widespread from Persia to North Africa, India and the Mediterranean, and to Spain and the Canary Islands. The qanat system was widely used in these areas up until recent times when the construction of dams and the diversion of water have caused a severe diminution in water available. In northern Europe, there is a very well preserved Roman qanat system in Luxembourg comprising a tunnel about 600 metres long with more than 20 well shafts.

Water could be brought into a city not only by using some variation of an aqueduct, but also in ways instigated by the natural philosophers of ancient Greece, such as Eupalinus (sixth century BC, dates of birth and death unknown), Archimedes (ca 287 BC – ca 212 BC) and, later on, Hero (ca 10–70 AD), all of whom made important contributions.

Eupalinus contributed the scientific expertise of constructing underground tunnels for transporting water through natural obstacles. He constructed a tunnel of over 1000 metres in length, which was started at both ends and met in the middle, less than four feet out in alignment – an outstanding feat for the sixth century BC. The tunnel passed under a hill to form part of an aqueduct to bring water to Samos. Two and a half thousand years later, this remarkable engineering feat is still functioning and has a World Heritage listing in recognition of its genius. Several similar aqueducts were constructed in Athens, and other Greek aqueducts are known, that at Pergamon being important because of its great siphon (mentioned in more detail below).[96]

Archimedes contributed the screw which bears his name. The device was a tube, which is internally threaded, with the threads collecting water and bringing it to the surface as the tube rotates. The massive device was run by manpower (usually a slave) to propel the water upward. This apparatus could draw water from any easily accessible source.

Hero was probably the first scientist who could be called an hydraulic engineer. He modernised the drawing of water through a method known as the siphon principle. The siphon allows the pipes that carry the water to follow the contours of the terrain so that, at some points, the pipes can be lower than the following aqueduct, for example when crossing a valley. This meant that the aqueduct and bridging techniques no longer had to be used so often. Using a siphon device also meant that attention had to be paid to the strength of the water-carrying pipes as high pressures were generated. A device such as this was used for the citadel at Pergamon where it has been calculated that 9,500 cubic metres of water were delivered each day.[97] The pipes that brought water to the citadel had to withstand approximately 300 pounds of pressure per square inch and were most likely made of metal in order to withstand this

[96] Bromehead, C.E.N.,"The Early History of Water-Supply", *The Geographical Journal*, vol. 99, no.4, (April, 1942), pp. 183-193.
[97] Darcy, H., Brown, G.O., Garbrecht, J. and Hager, W.H. (eds), *Henry P.G. Darcy and Other Pioneers in Hydraulics: Contributions in Celebration of the 200th Birthday of Henry Philibert Gaspard Darcy*, Philadelphia, ASCE Publications, 2003, p. 121.

pressure. It was not until fairly recently (1970s) that chemical analysis of the soil on which the long vanished pipes rested showed that they were made of lead.[98]

The Romans built aqueducts in all parts of the Empire, especially in Rome itself, where fourteen great aqueducts (some still in use today) brought fresh water to the city. The first aqueduct to be constructed was in Appia in 312 BC and the last at Alexandrina in AD 222- 225. In his *On Architecture*, Vitruvius (born 80-70 BC died after ca 15 BC) set out sanitary ideals for towns, stressing the need for good water supplies.[99] With a good water supply ensured, it was possible to maintain a water and sewerage system which served a large population. Civic officials who oversaw the maintenance and governance of the system made continuous functioning of such a system possible. Frontinus (40-103 AD) was the Roman equivalent of a Water Commissioner, and in this role, he presented an official report to the emperor on the state of the aqueducts of Rome. This report gives a history and description of the water supply of Rome, including all the aqueducts and their discharge rates. He also describes in it the quality of water delivered by each, mainly depending on their source, be it river, lake or spring. One of the first tasks he undertook when appointed water commissioner, was to prepare maps of the system so that he could assess the condition of the aqueducts before undertaking their maintenance. He found that many had been neglected and were not working at their full capacity. He was especially concerned by the diversion of the supply by unscrupulous farmers and tradesmen, amongst many others, who would insert pipes into the channel of the aqueducts to tap the supply. He therefore made a meticulous survey of the intake and the supply of

---

[98] Darcy, H., Brown, G.O., Garbrecht, J. and Hager, W.H. (eds), *Henry P.G. Darcy and Other Pioneers in Hydraulics*, p. 120.
[99] Porter, R., *The Greatest Benefit to Mankind*, New York and London, W.W. Norton & Company, 1997, p. 78.

each line, and then investigated the discrepancies.[100] Tampering with the size of the outlet pipes, as well as bribery and direct theft of water, were considered to be serious misdemeanours in spite of their widespread occurrence.

The Romans were also aware that the composition of the pipes bearing water was important. Lead pipes were used in situations where siphons were involved as part of an aqueduct, to supply the strength needed to withstand the high pressure produced. Even so, classical writers often refer to the bursting of lead pipes.[101] The aqueducts were built to very high standards, with no mortar used as the stones were fitted together precisely. They set a standard not equalled for more than a millennium, since much of the Roman expertise was lost during the Dark Ages, and in Europe, the construction of aqueducts largely ceased until well into the Middle Ages.

Urban aqueducts, which had fallen into disrepair in late Imperial times, were often re-used as the basis for new installations. Examples of this were at Le Mans, Béziers and Pézenas. The Roman aqueduct which serviced the Left Bank in Paris was in use until the ninth century, when the Normans largely destroyed it.[102] This aqueduct, the Aqueduc de Rungis, was built in about 360 AD and supplied water to the public baths on the site of Jardins du Luxembourg. Marie de Médicis used the remains for the aqueduct of Arcueil.

In Paris, wells sufficed for domestic supplies for a long time, although water was available from various fountains and the aqueduct of Belleville supplied water of varying quality. By the middle of the sixteenth century, public fountains were supplying the greater part of the population with a little more than a litre of water per day. The greatest part of available water was diverted to the monasteries and to the mansions of the great nobles.

[100] Smith, N., *Man and Water*, London, Charles Scribner's Sons, 1975, p. 85.
[101] Bromehead, C.N.E., "The Early History of Water-Supply", p. 186.
[102] Squatriti, P. (ed.), *Working with water in Mediaeval Europe*, Leiden, Brill, 2000, p. 167.

Henri IV approved a project for pumping water from the Seine and started the project for the Arcueil aqueduct, which was not finished until 1623, well after his death in 1610. In spite of the pumps and the aqueduct, the situation did not improve much as the pumps were often out of order and the increased supply also increased the amounts diverted by the nobles. By the end of the century, the per capita daily water quantity had increased to about three and a half litres.

The technology was available almost to double the water supply to the inhabitants of Paris, as shown by the construction and function of an engineering marvel of the seventeenth century. Louis XIV (1638-1715) was instrumental in having constructed the Marly machine. This was located at the bottom of the hill of Louveciennes, on the banks of the Seine about twelve kilometres from Paris. The Machine de Marly consisted of fourteen gigantic water wheels, each roughly thirty-six feet wide, that moved 221 pumps to bring water 177 yards (162 metres) up a hillside from the Seine River. After three years of construction and a cost of approximately 4,000,000 livres, the massive contraption was completed. Although it suffered from frequent breakdowns, required a permanent staff of 60 to maintain it and often required costly repairs, it nevertheless supplied a volume of water nearly equal to that already supplied to Paris. Unfortunately for Paris, this water was not for the thirsty citizens but instead was to supply the fountains of the King's chateaux at Versailles and Marly.[103] It was to be a long wait for Paris to see its water supply increased and a greater allocation to its inhabitants.

Projects to bring the water of the Yvette or the Ourcq to Paris appeared in 1723 and were discussed and disputed for a nearly a century until Napoleon finally had the Canal de l'Ourcq constructed in 1808. In the 60 miles from its intake, it picks

[103] Smith, N., *Man and Water*, p. 101.

up a number of small tributaries and terminates at the bassin de la Villette. This great reservoir for public drinking water was for many years also the sewer for the 1500 boatmen living on barges working the canal.[104] The connection between pollution and infection had to await the scientists of the nineteenth century.

In 1768, Lavoisier began one of the first technical studies he conducted for the Academy of Science, this being the evaluation of a project proposed by the engineer, Antoine de Parcieux, to supply Paris with drinking water. Parcieux put forward the idea of using an aqueduct from the river Yvette, a small river with its source near Longjumeau. Voltaire was much in favour of the project, writing to Parcieux that his plan would give Paris the water it lacked and put a stop to the misery inflicted on the human beasts of burden who had to carry enormous and heavy buckets of water from the Seine. The citizens of Paris would have the same advantages enjoyed by those of London with regard to supply of good drinking water. It was going to be a very expensive project and was finally shelved because the Opera burnt down and had to be rebuilt. Voltaire, much disappointed, wrote that the maids of the Opera had prevailed over the nymphs of the Yvette.[105]

The debate about supplying Paris with water from the Yvette was renewed in 1771. This time it was proposed to use steam-driven engines for a pumping system and Lavoisier examined the proposal. He concluded that seven engines would be required and the costs in coal, employees and infrastructure would be very high and would recur annually, unlike the aqueduct proposal. He also noted that the enormous use of coal would spread a thick smoke over the city, which would not be appreciated by the citizens. By 1775, the members of the Académie were in agreement with

[104] Bromehead, C.E.N., "The Early History of Water-Supply", p. 189.
[105] Poirier, J.-P., *Lavoisier*, p. 30.

Lavoisier that a canal system, rather than pumps, should be used.[106] In the end, the Yvette canal was never constructed and it was not until the First Empire that the Ourcq canal was built instead.[107]

Steam pumping actually commenced in 1778 at the instigation of the Administration des Eaux du Roi when the Périer brothers installed pumps on the Seine at Chaillot and Gros-Caillou. This trebled the amount of water supplied to Paris. The rights to pumping of the Périer brothers' private company (Compagnie des Eaux de Paris) expired in 1789 and were taken over by the State. The pumps remained in use until 1860 but by then, they had long been replaced as the main water supply by the Canal de l'Ourcq.[108]

Lavoisier was also engaged in a smaller scale project of water supply, although this, too, was of great interest to many, including Louis XVI. Lavoisier was intimately involved in preparations for the La Pérouse expedition, not only in planning an encyclopaedic scientific program, but also in distilling seawater to produce fresh water during the long sea voyage. More than ten years earlier, he had been commissioned by the Minister of the Navy to construct a still which required a minimum of wood to supply the necessary heat for distillation. Wood was often difficult to obtain during long voyages so Lavoisier constructed a still which required only a small amount of charcoal to produce twelve to fifteen pints of pure fresh water per hour, and it was from this model that he made the stills destined for La Pérouse. It was unfortunate that no one would ever know how well these stills performed in actuality, since the two ships of the expedition vanished in the South Pacific in

---

[106] Abrahams, H., "Lavoisier and his contemporaries debate the supply of water for Paris", *The Bulletin of the New York Academy of Medicine*, vol. 57, no. 5, June 1981, p. 363.
[107] Poirier, J.-P., *Lavoisier*, p. 37.
[108] Smith, N., *Man and Water*, p. 106.

1788.[109]

While a sufficient water supply is essential for the support of life, the quality of the water supplied is also very important. Hippocrates turned his attention from consideration of water as the primordial principle to less philosophical and more practical matters. In particular, he wished to underline the importance of water qualities in the salubrity of a site and the health of its inhabitants. At a time when immigration was the only way in which many of the young men in ancient Greece could establish a long-term future, selection of the site for settling/invading was extremely important. It was essential to be able to identify by means of the aspect of a site and the source of its water a place which would support a healthy and robust population. Hippocrates recommended east facing sites and stated that water that flowed towards the east would be clear, fragrant, soft and delightful to drink.[110] He believed that rainwater was the lightest and sweetest of waters. His explanation for this belief shows that he was aware of the water cycle – that sunlight caused evaporation, water vapour was drawn up into the air and formed clouds and mist before being condensed and falling as rain. However it was apparently possible that the vapour-bearing clouds might meet a contrary wind, and the resulting precipitation, while having the appearance of being the best of water, needed to be boiled and strained to prevent illness in those who drank it. Unfortunately, he did not give advice on identifying these contrary winds. Waters from ice and snow were all bad because whatever was light and sweet in them had separated and disappeared during melting, leaving the weightiest (and unhealthy) part behind. This water was the worst of any for all purposes.[111]

Hippocrates also classified the effects of water according to its source. Water

[109] Poirier, J.-P., *Lavoisier*, p. 165.
[110] Hippocrates, *On Airs, Waters and Places*, p. 7.
[111] Hippocrates, *On Airs, Waters and Places*, pp. 11, 12.

from sources such as lakes and large rivers was likely to cause the "stone" because there were so many different tributaries supplying so many different kinds of waters and the qualities of the worst kinds of water would prevail. Stagnant water was particularly harmful, causing many different diseases and leading to premature old age. It was followed, in degree of harm, by water which issued as fountains from mineral-bearing rocks. The best waters flowed from elevated hills and grounds to deep wells, although one still had to be particular about which direction the water source faced. The best were east facing, north facing was adequate but south facing was particularly bad.[112] The ill effects of water from melted snow or ice have already been noted.

The Romans were aware of the importance of water quality and knew that some of the aqueducts were bringing water which was not of drinking quality. This water was used for flushing sewers and for the staging of the sham naval battles (naumachia) popular at the time. The means of delivery of water were also taken into consideration. It was known or suspected that lead pipes might pose some danger to human health. Vitruvius wrote that water from earthenware pipes was much more wholesome than that from lead pipes because the water interacted with the lead to produce white lead. It was strongly believed that white lead was injurious to the human body. Palladius, Roman author of *De re rustica*, in the fourth century AD, recommended wooden or earthenware pipes for supplying villas, with lead used where siphoning was necessary, though these pipes might become poisonous. Bronze pipes were expensive but were used in wealthy households in Rome and Pompeii. In fact, the lead pipes probably did not pose much of a health problem because the calcium carbonate in the water was thickly deposited in the pipes, thus sealing off the

[112] Ibid., p. 10.

lead from the water.[113] This is certainly true for Rome, where the water was sourced from the limestone alpine regions, was carried via aqueducts built of limestone and thus had a high calcium carbonate concentration.

The different kinds of water supplied from various sources were studied closely in both the Greek and Roman worlds. The qualities of the different kinds of waters were considered to be very important, not only for health reasons but also for producing a wide variety of other physical manifestations. They could produce or alleviate a variety of symptoms, including dissolving gallstones, improving your singing or driving you mad.[114] Judging the qualities of the various waters was highly subjective and almost certainly relied on the advantages of suggestibility. Galen, himself, believed that the best water could be judged by its consistency, taste, smell and colour. It should be odourless, tasteless and translucent. He did not make judgments about its effects on musicality or mental health, as far as can be ascertained.

In actual fact, it is probable that not much of the urban water supply was used for drinking. Most was used in municipal baths and fountains, and for cleaning drains and sewers. The water which was drunk was generally mixed with something else, usually wine. Nevertheless, while wealthy Romans may have drunk more wine than water, some did drink water on its own and were quite discerning about quality. Pliny, for example, wrote extensively on the criteria for judging drinking water. Drinking water had to be cool and wholesome, that is, transparent, clean, odourless, and without flavourings. He further observed that well water was only wholesome if it had been kept in motion and came from a water vein in the ground. Well water that had seeped through the sides of the well did not meet his criteria. The emperor Nero drank

---

[113]. Hodge, A.T., *Roman Aqueducts and Water Supply*, London, Duckworth, 1992, p. 308.
[114] Wikander, O. (ed.), *Handbook of Ancient Water Technology*, Leiden, Brill, 1999, p. 97.

the highest quality water: it was boiled first, then poured into a glass and cooled in snow.[115] This must have been one of Nero's few abstemious habits, although his tutor, Seneca, was known, and ridiculed by some, for advocating the health giving properties of water rather than wine.

With the decline of Roman municipal administration, the Church often took up the task of providing a public water supply. In various European cities, the municipality was partially responsible for ensuring the water supply and it attempted to limit pollution of drinking water by preventing citizens from throwing dead animals and rubbish into streams and rivers. Tanners and dyers were prevented from using rivers for disposal of wastes. By the late middle ages, municipal sanitary regulations covered street cleaning, refuse removal and restrictions on the slaughter of animals.[116] The situation in the streets of Paris became so bad that François I issued an edict in 1539 forbidding the disposal of waste in the streets as it caused him great inconvenience when he was travelling. All proprietors of houses, inns and residences were enjoined to install cesspools and not to keep any livestock on the premises. Everyone was to store all waste inside his premises and then to dispose of it in the nearest stream. This meant that that the effect of the edict was to move the problem from the streets to the waterways and in doing so, improved the environment of the city dwellers.[117]

Hippocrates' evident distrust of some sources of water, in spite of the fact that it might appear clean and clear, was still to be seen more than two thousand years later, in the seventeenth and eighteenth centuries. Water could conceal a number of

---

[115] Salzman, J., *Thirst: A Short History of Drinking Water*, Duke Law School, Research Paper 92, December 2006, <http://eprints.law.duke.edu/1261/1/17_Yale_J.L._%26_Human._94(2006).pdf>, viewed 10 September 2008.
[116] Porter, D., *Health, Civilization and the State*, p. 30.
[117] Laporte, D., *The History of Shit*, (translated by N. Benabid and R. el-Khoury) Cambridge, Massachusetts, The MIT Press, 2002, p. 6.

perils since many substances could be dissolved in it and it would still remain clear. Evening dew, and especially saline vapours from the sea, aroused particular distrust. Stagnant water was a threat and was purified by movement. But even fresh water could be extremely dangerous, and during the eighteenth century in France, there were numerous reports of fatalities occurring as the result of inhaling noxious vapours emitted by fresh water. Stagnation, when allied with decomposing organic matter, caused the most danger to health. Marshes encompassed these two conditions and therefore were extremely dangerous, although there was disagreement in the scientific community as to the exact definition of a marsh. The harmful effects of marshes were also to be experienced from exposure to ponds, puddles and ditches. The salt marshes of the Charente were reputed to produce salty vapours with lethal effects.[118]

Lavoisier was interested in the quality of water supplied as well as in its quantity. In 1778, he verified the conclusions of Parmentier on the risks of pollution of the Seine by the cesspools flowing into it. It was said, at the time, that what flowed into the Seine in the morning was drunk by the citizens of Paris in the evening. It was about this time, when he was interested in disinfecting cesspits, that the meeting with Fourcroy, Hallé and others took place for the emptying of one of Paris' most notorious cesspits.

Lavoisier believed that the study of drinking water was much more important than that of medicinal waters. He said of drinking waters that

> it is on them that the strength and health of citizens depend and […] in continuously re-establishing the order and equilibrium of the animal system, saves the lives of a much greater number of persons every day [than medicinal waters]. The examination of medicinal waters strictly speaking interests only a small, dwindling portion of society. That of common waters interests all of society and principally that active part whose arms are both the strength and the wealth of the state.[119]

[118] Corbin, A., *The Foul and the Fragrant*, pp. 32-34.
[119] Poirier, J.-P., *Lavoisier*, p. 31.

Until the arrival of coffee made an impact in the seventeenth century, the most common beverages were, even at breakfast, weak small beer and wine, sometimes diluted. These were safer than water, which was often contaminated. Coffee was made from boiled water and hence safe. [120] Drinking a mixture of water and wine had a long tradition. The Ancient Greeks almost always watered their wine and believed it to be a civilised habit. Only barbarians, such as the Scythians and Macedonians, drank it full strength. Not drinking wine at all was considered almost as bad, as evidenced by Plutarch, a later Greek philosopher (46-120 AD), who said "the drunkard is insolent and rude […] on the other hand, the complete teetotaller is disagreeable and more fit for tending children than presiding over a drinking party."[121]

Hallé believed that infants should never be given wine and that giving it to children could be harmful, even arresting their development. During their youth, young men might partake of it if it did not seem to harm them. During "l'âge viril", men were strong enough for wine not to be an absolute necessity, and it was only during old age that it was a necessary aid for comfort.[122] He did not commit himself to whether or not women should be allowed wine but did comment that some societies forbade women to drink wine on the grounds of undefined decency.

Water supply and quality were primary factors in the maintenance of health, but as populations grew the use of water for personal hygiene became more important. The evidence of plumbing systems for the delivery and disposal of water has been uncovered in many archaeological investigations of early civilizations. Excavations at Olympus, as well as at Athens, have revealed extensive plumbing systems for baths and fountains as well as for personal use. Excavations at Olynthus,

---

[120] Standage, T., *A History of the World in Six Glasses*, New York, Walker & Co., 2005, p. 135.
[121] Standage, T., *A History of the World in Six Glasses*, p. 59.
[122] Hallé, J.N., "Abstème", in *Dictionnaire des Sciences Médicales*, Paris, Panckoucke, 1812, p. 49.

in northern Greece, attest to tiled bathrooms and self-draining tubs. Several of the tubs have survived intact, shaped like present-day models though with one sloping end cut off. From the shapes of the ancient tubs, it seems that the bathers sat upright and rested their feet on a depression formed at the bottom. No doubt they were influenced by Hippocrates, who said that sitting in a tub was more healthy than reclining. Hippocrates also advocated cold water baths as a cure for almost any ill. The hygiene regimen in the form of a shower goes back to the time of the Greeks, as evidenced by extant vases and murals. In any large city from the seventh century BC onwards, one could find a gymnasium that featured hot and cold shower baths, although the use of hot water was considered effeminate. A real man took cold showers; this was typically a quick douse of cold water poured over his head from a marble bowl. Many houses in ancient Greece were equipped with closets or latrines that drained into a sewer beneath the street and may have been flushed by wastewater. Where there was no convenient river into which the sewers could empty, such as in Athens, wastewater was disposed of via a soakage system. The main drain was divided, after it had left the town, into a number of smaller channels which ran underground for some distance and then flowed out onto lower-lying plains to soak away. It is likely that irrigation trenches were used to take advantage of the highly nitrogenous wastewater to grow various crops.[123]

A free citizen in Ancient Greece would undergo ritual bathing at three significant times in his life: at birth, marriage and after death. To assure a long and happy life, a bride would bathe in water taken from a fountain with nine pipes called Calirrhoe. In Athens, the Calirrhoe fountain was also the principal source of water supply, for the most part conveyed by a conduit which brought the water in from the

[123] Hodge, A.T., *Roman Aqueducts and Water Supply*, p. 344.

river Illisius.

In the Roman world, bathing was a central event in daily life. Apart from the normal hygienic functions, the baths provided facilities for sports and recreation. Their public nature created an environment like a city club or community centre, and there was a cultural and intellectual side to the baths since the really large establishments, the thermae, incorporated libraries, lecture halls, colonnades and promenades, and assumed a character like that of the Greek gymnasium.[124]

The Roman passion for bathing is a notable part of their civilisation. The Roman baths can be divided into two categories. The first comprises those established because of the medicinal qualities of the local water, such as hot springs and waters with some mineral content. Since the source, in this case, could not be moved, spa towns grew up around them, some of them still in existence. The second category was that of ordinary baths, which were established for cleansing, relaxation and comfort, although the differentiation between the two categories was never absolute. The spa type establishments generally consisted of pools and basins built on, or communicating with, the spring so that the bathers could undergo varying degrees of immersion. The waters were usually hot and often sulphurous. These waters brought prosperity to the cities which grew up around them, cities named by the Romans after their waters. Still operational in or near France are Aix-les-Bains, Aix-en-Provence, Aix-la-Chapelle and Dax (Aix = Aquae), and there are others in other countries.[125] The conventional Roman bath, as exemplified by the baths of Trajan, Caracalla and Diocletian in Rome and other great provincial complexes, were centred upon a series of large halls heated by the underfloor hypocaust system.[126] There were pools containing water at various temperatures, from warm to cool, which could be utilised

[124] Yegül, F., *Baths and Bathing in Classical Antiquity*, New York, MIT Press, 1992, p. 30.
[125] Hodge, A.T., *Roman Aqueducts and Water Supply*, p. 264.
[126] Hodge, A.T., *Roman Aqueducts and Water Supply*, p. 264.

in the progression from the steam room to lower room temperatures.

It is important to note the strong and persistent connection between bathing and good health in the Roman perception. The prescription of baths in the works of medical writers is the most direct evidence of this belief. In particular, the works of Galen are filled with references to bathing, or not bathing, according to the illness in question. Galen was writing in the second century AD but earlier medical writers in Rome had written extensively on the subject, including one of the best known, Cornelius Celsus (25 BC-50 AD).[127] Whatever were the remedial effects of bathing, its value in maintaining good health may have contributed to its regular use. The hygiene regimen of the Ancient World included recommendations for diet, exercise and bathing, a heritage going back to the Hippocratic school. The bathing aspect assumed a much more prominent role in Rome than in Greece and was absorbed into the knowledge of the general populace, as shown by the writings of non-medical authors of the time. The therapeutic value of bathing in cold water had been lauded from time to time since Hippocrates' prescription in the fourth century BC. Pliny the Elder (23 AD-79 AD) leaves an amusing description of a resurgence of the fashion in Rome. An advocate of cold water bathing had become so influential that "we used to see old men, ex-consuls, frozen stiff in order to show off" because they adhered to the regime even in winter.[128]

It is fair to say, then, that the perception of bathing being important for maintaining health was widespread in Roman times and, in general, people bathed daily. This association of bathing and health was still to be seen in the works of Palladius (fourth century AD). He was the author of a fourteen-part treatise, *Opus agriculturae*, which included a section on bathing. He believed that bathing conferred

---

[127] Fagan, G.G., *Bathing in Public in the Roman World*, University of Michigan Press, 2002, p 87.
[128] Fagan, G.G., *Bathing in Public in the Roman World*, p. 87.

both great enjoyment and health. The "great enjoyment" factor and the popularity of baths posed problems for the early Christian church. They dared not ban them altogether but approved visits for medicinal and hygienic reasons – "as long as the bathers did not enjoy it too much."[129] In the fourth and fifth centuries AD, early fathers of the Church, such as Clement and Jerome, explicitly condemned excessive attendance at the public baths, and attendance for pleasure. They also condemned women's attendance at bathhouses where both sexes were allowed. Jerome, with the streak of moral asceticism and misogyny which afflicted many of his time, felt that female virgins should not bathe with other women lest they be contaminated, and that they should not bathe naked. Nevertheless, the more moderate had no objections to bathing for health reasons.

Roman-type baths continued to operate in the eastern parts of the old Roman Empire through the mediaeval and Renaissance periods, and Islamic writers endorsed bathing. The hammam, referred to in modern times as the "Turkish Bath", was a major feature of Islamic culture and preserved the Roman traditions of cleaning the body first, then soaking and socialising. Some historians believe that the habit of the baths returned to Western Europe from the Middle East with the Crusaders, but documentary evidence suggests that the resurgence of public baths in Western Europe may have been more a function of political and economic stability.

The tradition of bathing was maintained in mediaeval religious establishments, where water was piped to the kitchens, bathhouses and troughs used for hand washing. During the Middle Ages, bathhouses began to become widespread in cities and towns, later spreading to the countryside. They were usually run by the municipality and, after some time, they began to serve, as in Roman times, as social

---

[129] Fagan, G.G., *Bathing in Public in the Roman World*, p. 88.

meeting places. Dürer's prints show bathers eating and conversing, and undergoing medical treatments such as cupping.[130] There are many mediaeval illustrations showing men and women bathing singly or together, sometimes in the open air and often with an audience. In the bathhouses they were usually unclothed, but some wore various drapes in mixed gender situations. In the great houses of the time it was not unusual for bathers to be wearing elaborate head dresses and a variety of jewellery, although not much else. The primary purpose of the mediaeval steam baths was still that of enjoyment, and washing was a secondary, perhaps incidental, benefit. The early tolerance of mixed bathing began to disappear with the changes in perception of decency and modesty spread by the seigneurial courts. By the end of the fourteenth century, most steam baths separated the sexes. A rule of alternation prevailed in some French towns, with certain days for women, others for men and yet others for Jews and actors. This last case shows that decency was not seen in the same light for lesser social and cultural categories. Other places, including Paris and Strasbourg, had separate locations for each sex. In spite of efforts to maintain orderly establishments, steam baths began to gain the reputation of being places of disrepute. They belonged to the world of pleasure, with its jollity and excess summed up by a fifteenth-century German saying from the steam baths: "With water on the outside and wine within, let us make merry."[131] The young female attendants enhanced the air of licence and the clergy gave sermons warning against young men being given the freedom or the money to visit brothels, steam baths or taverns.

The demise of the public steam bath was strongly influenced by increasing intolerance, joined with the increasing fear of the danger to the body of exposure to water. The disappearance of private bathing was most likely to have been strongly

[130] Mumford, L., Turner, B.S., *The Culture of Cities*, London, Routledge, 1997, p. 47.
[131] Vigarello, G., *Concepts of Cleanliness*, Cambridge, Cambridge University Press, 1988, p. 33.

influenced by fear of the dangers of water since it posed neither the legal nor social problems of the steam bath. Georges Vigarello's book, *Concepts of Cleanliness, Changing Attitudes in France Since the Middle Ages*, addresses this change. Part One is entitled "From Water for Pleasure to Water as a Threat". It details the temporary closure of bath houses and steam baths during times of plague, along with the closure of other areas where the public gathered, such as churches and schools. During the sixteenth century, the closures of bath houses became official and systematic, and steam bath keepers fined for disobeying the prohibitions. According to Vigarello, the fear of infection as a result of social contact was accompanied by a fear of the frailty of bodily barriers. Heat and water opened the pores of the skin through which the plague could slip. A number of medical authors, including Ambroise Paré (1510-1590), official surgeon to four French kings, believed that steam baths and bath houses should be forbidden because the softened body and opened pores could allow the rapid entry of pestiferous vapours, which often resulted in sudden death.[132] This prohibition did not extend to thermal baths, and sixteenth-century bathers at various places such as Spa, Pougues or Forges would expect an amelioration of their symptoms, and indeed this was how Montaigne treated his kidney stones.

The fear of baths lasted through the seventeenth century and those who took them had to take extraordinary precautions to maintain their health and equilibrium afterwards. The bath, except for medical reasons when absolutely necessary, was thought to be superfluous and very prejudicial. It could cause gout in men and kill an unborn child in its mother's womb, as well as a veritable catalogue of other ills. During the sixteenth century, cold water had been permissible, even desirable, for washing the hands and face on rising in the morning, cold water being clean and

[132] Vigarello, G., *Concepts of Cleanliness*, p. 9.

healthy. This gave way, in the seventeenth century, to splashing with water and then to wiping with a cloth, as the fear of baths was translated to fear of washing face and hands with water. A publication of the time warned against washing children's faces with water as it could cause toothache and catarrh, not to mention sensitivity to heat and cold. Cleanliness was maintained by wiping with cloths, and water was little used other than to rinse the mouth, when the water was often mixed with wine.[133]

A few bathing establishments survived in Paris in the seventeenth century but they were used only by the aristocracy, and infrequently. Private bathing, which had been restricted to the nobility, or at least to the refined, also largely died out. The bathrooms and marble bath which Louis XIV installed at Versailles were replaced a few years later by accommodation for the Comte de Toulouse. The marble bath was eventually used as a garden pool.

A new cleanliness began to arise in the middle of the eighteenth century when the most important quality of water was its coldness. The shock effect of cold water was thought to make people stronger and more robust, an idea strongly supported by the hygienists of the time. It was presented as fact that nothing was as effective as cold water:

> when it is a matter of dissolving blood or evacuating glutinous matters attached to the lining of vessels; when you want to cleanse the glands and procure a more abundant filtration of animal spirits or make them run more rapidly in the nerves; when you need to induce urine or dissolve obstructions in the liver, the spleen etc […].[134]

This was taken to extremes by some enthusiasts, who subjected their patients to prolonged immersion in icy water. The bath began to have an explicitly hygienic role although it was the effect of cold water in strengthening the body rather than cleanliness which was the important factor. River bathing became popular and there

---

[133] Vigarello, G., *Concepts of Cleanliness*, pp. 17-20.
[134] De Préville, L., *Méthode aisée pour conserver sa santé*, Paris, 1762, p. 368, cited in Vigarello, G., *Concepts of Cleanliness*, p. 114.

were a number of bathing places attached to boats in the Seine which were mentioned in the guidebooks of the time.[135] The cold bath also assumed a moral aspect, an eighteenth-century version of “no pain, no gain”, although there was an added puritanical facet. Théodore Tronchin (1709-1781), doctor to the encyclopaedists, said that, as long as the Romans plunged into the Tiber, they ruled the world, but the hot baths of Agrippa and Nero reduced them gradually to slaves.[136] This notion does not seem to have been the general opinion of historians or intellectuals of the time. Rousseau, in his *Émile*, stated that:

> multitudes of people wash newborn children in rivers or the sea as a matter of course. But ours, softened before even being born by the softness of their fathers and mothers, bring into the world a temperament already spoiled.[137]

Ėmile was washed in ever colder water until he became accustomed to icy temperatures. Rousseau was unable to put his theory into practice, since he placed his own five children in foundling hospitals soon after birth.

Warm baths symbolised decadence and privilege, corruption, laziness and feebleness. The relaxing effect of warm water led to relaxation of habits, to relaxation of vital strength and manly energy, and thus to cowardice. The cold bath was generally a recommendation more honoured in the breach, for obvious reasons. The lauding of Roman ideals and moral philosophy was insufficient to convert the greater part of the bourgeoisie from the intellectual argument to the actual practice of immersing themselves in icy water.

During the eighteenth century, a considerable number of self-help books was published, one of the best known being *Avis au peuple sur sa santé* by Samuel Auguste Tissot (1728-1797), a Montpellier graduate, physician to various courts, and

[135] Vigarello, G., *Concepts of Cleanliness*, p. 116.
[136] Vigarello, G., *Concepts of Cleanliness*, p. 117.
[137] Rousseau, J.-J., *Émile*, Paris, 1951, 1st edition 1762, pp. 37-38, cited in Vigarello, G., *Concepts of Cleanliness*, p. 118.

friend of Rousseau. This book went into many editions and was translated into a number of languages. The manual was aimed in particular at country dwellers who had no easy access to orthodox medical care, and it was noted for the ability of the author to communicate clearly with his readers. The complete works of Tissot were published by his son, Alexandre-Pascal Tissot, in 1820, in 11 volumes, accompanied by a preface and notes written by Hallé. Tissot's work is of particular interest because of its associations with Hallé, who was interested in many of the same areas.

In *Avis au peuple sur sa santé,* Tissot recommended bathing a newborn baby with a warm mixture of one third wine and two thirds water. This could be repeated several days later but it was dangerous to continue the practice much longer. The skin needed to be strengthened and warm water made it weak. Hence, from a few days after birth, the baby should be sponged all over in cold water. He knew that this was not at all popular with the mothers, who hated hearing their babies scream in distress, but said that, if they really loved them, they would persevere. [138] This cold washing was especially good for strengthening weakly children, and the more robust did not need bathing so often. Washing with cold water was to be done regularly every day, and in summer, the infants could be plunged into the basins of fountains, or into streams and rivers. Tissot said that, after several days of crying, the babies got used to it and began to enjoy it. He also believed that cold baths could be employed, with great success, to cure various illnesses at any age. They should be taken before dinner and were especially useful in curing a "faiblesse des nerfs". As excellent as cold baths were, so were warm baths pernicious in disposing one to apoplexy, vapours and hypochondria.[139]

Hallé was not in complete agreement with Tissot. For instance, he did not

---

[138] Tissot, S.A., *Avis au peuple sur sa santé*, (second edition), Paris, Didot le Jeune, 1763, pp. 319-321.
[139] Tissot, S.A., *Avis au peuple sur sa santé*, p. 322.

condemn, as did Tissot, the use of butter to remove vernix from newborns, as long as it was removed promptly. He also made the point that the names of Locke, Rousseau and Tissot were so influential that it was difficult to query the opinions of such authorities with regard to cold water bathing. He wondered if it was reasonable to exempt them from scrutiny and if their general propositions should be thought to apply to all circumstances. He knew that their object in recommending cold baths, cold water washing from birth in all weathers and leaving children lightly clothed at all times, was to render the skin less susceptible to changes in temperature. He believed that cold baths could be a good thing, and might be especially efficacious if undertaken in running water rather than in a domestic bath, but not for everyone. There were those who could not support cold baths and whose constitutions were weakened by the challenge. One had to be discerning in distinguishing the genuinely weakened from the dissembling. He saw no reason why very young babies should be washed with cold rather than warm water. This included their heads, which he said could be brushed for maximum effect. Those mothers who had been misguidedly instructed to wash their babies' heads with ice could cause disaster.[140] Children from good homes where they were well looked after were much better able to support cold baths and light clothing than those from poorer environments.

Hallé believed that the essentials for health were cleanliness of the body and clothes, clean lodgings, a good diet and exercise in fresh air. Baths were not necessary if one washed the body with a sponge and cold water regularly. He said that Tissot's ideals applied to the healthy children of the Swiss cantons but were not always applicable to the children of the poorer French *paysans*.[141]

---

[140] Tissot, S.A., *Oeuvres complètes, Nouvelle édition, publiée par M. P. [Alexandre-Pascal] Tissot, précédée d'un Précis historique sur la vie de l'auteur et accompagnée de notes, par M. J.-N. Hallé*, Paris, 11 vols, 1809-1813, vol. 2 p. 507.
[141]. Tissot, S.A., *Oeuvres complètes*, vol. 2 p. 509.

That the virtue of temperature was paramount was illustrated in the habits of Benjamin Franklin while he was living in Paris. Although he believed that nothing equalled the tonic effect of the cold bath, there was the possibility that it might shock and disturb the body. He got around this difficulty by resorting to the simple alternative of the air bath. Getting up early each morning, he would spend up to an hour moving around naked inside his house in Paris. Cold air apparently had the same healthful effect as cold water, and cleanliness was not a factor in inducing this pastime.[142]

The strengthening properties of cold water led to its use in a number of institutions, including military schools, mainly in the form of washing hands and faces. If there were safe rivers or streams within reach, students were encouraged to bathe from time to time in good weather. The idea that river bathing and swimming were good for the health led to the establishment of swimming schools. The vigorous movements were supposed to be greatly conducive to health.[143] The first swimming school was opened on the Seine in 1785 and was very successful.

Private domestic bathing slowly became established by the end of the eighteenth century, although it was probably restricted to the upper classes. Warm water became respectable. Bathing often took the form of local washing with water from a basin rather than a more complete immersion. There are descriptions of footbaths used by many people, including such as the Empress Josephine and Talleyrand. While the basin was the most common receptacle, there were also hipbaths and footbaths, and by the 1790s the bidet had become relatively common, as had various kinds of syringes.[144]

An aspect of water that was of much concern in the eighteenth century was

---

[142] Vigarello, G., *Concepts of Cleanliness*, p. 124.
[143] Vigarello, G., *Concepts of Cleanliness*, p. 125.
[144] Vigarello, G., *Concepts of Cleanliness*, p. 163.

that of fresh water drowning. It was not an uncommon occurrence and it was sometimes difficult to determine whether the victim was actually dead or not. In France and a number of European countries during the eighteenth century, provision was made for the treatment and attempted resuscitation of the drowned. Drowning and asphyxiation seem to have been quite common, and when allied with the fear of burial alive, led to a considerable investment in time, energy and money by various authorities in attempts to save drowned people. Hand in hand with this was the problem of accurately determining death in order to prevent live burials. Much literature was published on this subject. One of the best known of these works was Edmund Goodwyne's *The Connexion of Life with Respiration*, published in 1786, 1788 and 1798 in Latin, English and French respectively. The French version was published as *La Connexion de la Vie avec la Respiration ou Recherches Expérimentales sur les Effets que produisent sur les Animaux Vivans, la Submersion, la Strangulation, et les Diverses Espèces de Gas Nuisible*, translated by J.-N. Hallé in 1798.[145] Hallé's interest in the subject is not surprising given his interest (already referred to) in air quality, noxious gases and smell maps.

Tissot devoted a chapter in *Avis au peuple sur sa santé* to the treatment of the drowned, as he had been struck by the tragedy of the drowning of a young man on the opening day of the baths – presumably this was one of the river baths. He believed that water entering into the lungs was the factor which caused death, as it was known that those thrown into the water after death did not have water in the lungs. Resuscitation should start with removing the patient's clothes, placing him in a warm bed and, while one person was rubbing his body to warm it, another person should attempt to introduce air into the lungs by closing off the nostrils and breathing

[145] Jordanova, L.J., "Policing Public Health in France 1780-1815", in Ogawa (ed.), *Public Health*, Tokyo, Saikon Publishing Company, 1981, p. 24.

forcefully into the mouth. Tobacco smoke, if available, should be breathed into the mouth, as it was an added stimulant. If there were a surgeon available, the jugular vein should be opened and six to twelve ounces of blood removed. Next, one should introduce tobacco smoke into the intestine via the rectum as quickly and in as large quantities as possible. There were special machines available for this but they were quite rare so one could improvise by using the stem of a lit tobacco pipe or several other similar devices. Following this, one should introduce into the nostrils volatile substances such as ammonia, the smoke of various herbs or more tobacco smoke. If the patient showed any signs of life, he could be given five or six tablespoons of oxymel (a mixture of honey and vinegar), or various herbal infusions, or, as a last resort, water with a little salt. Tissot warned that other methods used for resuscitation, such as rolling the afflicted in a barrel or hanging them upside down by their feet, were dangerous and not at all useful.[146]

Hallé agreed that drying and friction of the skin were very important, along with dilating the lungs with air and stimulating all irritable surfaces. He thought that "une petite saignée" of the jugular might also be useful. He also made the point that it was the lack of air, rather than water in the bronchi, which was the cause of death, and thus suspension of the drowned by the feet was not useful and could be dangerous. Hallé thought that Tissot was wrong, however, to attach importance to introducing warm air and/or tobacco smoke into the lungs. He thought that fresh cold air would be best used, because there was more oxygen available in this air than in warm or tobacco filled air. His knowledge of the oxygen content of air indicates that Hallé was aware of Lavoisier's work in this area.[147] This area of concern with resuscitation of the drowned and determining the point of death is at the periphery of the subject of

---

[146] Tissot, S.A., *Avis au peuple sur sa santé*, pp. 338-343.
[147] Tissot, S.A., *Oeuvres Complètes*, vol. 2 p.515.

waters. Nevertheless it was an area of communal effort and, as such, it was subsumed into the area of control of what was to become a public health authority.

The availability and quality of water were, by their very nature, public health issues, whether they were formally identified as such or not. As communities grew in size, water supply and quality became more important. As previously noted, supply advanced early on from simple methods of drawing water from rivers, streams and wells to the more sophisticated ones of qanats, aqueducts and reticulated systems. With a pause during the Dark Ages, advances continued slowly with the invention of coal-driven engines allowing for large-scale pumping from large rivers and lakes by the eighteenth century. In Paris, an adequate water supply was finally assured by the major engineering work of the Canal de l'Ourcq undertaken under Napoleon's auspices. This was after many years of suggestion and debate in which Lavoisier and other scientists of the day were involved.

The quality of water has a different history. Hippocrates provided information which he believed would enable individuals or small groups to identify water that was safe to drink. He also provided information that would allow one to avoid water which was potentially harmful. He believed that water could lose an element which was intrinsically beneficial and this occurred in melted snow and ice. Water vapour in clouds could meet contrary winds, which would render rain harmful, and this sort of rainwater should be boiled before use. Using this information was the responsibility of the enlightened.

The progression from knowing how to find and identify clean water to supplying clean water and preventing pollution was a progression from individual to communal action: from private health to public health. The Romans knew that the quality of their water supply varied according to the source but took little action other than avoiding drinking water of poor quality and possibly avoiding lead pipes where possible. Some rules were put into place during the Middle Ages to try to prevent the pollution of drinking water sources. This was as at a time when rivers and streams were used for the disposal of all sorts of waste, including that from tanneries and dyers whose waste products were toxic. Large scale organised efforts were to emerge in the eighteenth century, when the responsibility for providing clean water finally became a major public health issue. The quality of water in the Seine was important to the citizens of Paris and the polluted rivers flowing into it were of concern. A particular example was the polluted small river the Bièvre. This river, in the 5th arrondissement, is now completely covered over, but for several centuries it was used as an open sewer as well as the dumping ground for dyers and tanners and other polluting industries. Laws were put into place to stop the pollution for the public good. The quality of water in the Seine and the Bièvre was of concern to Lavoisier, Hallé and others interested in the health of the wider community. Water, in terms of quality and supply, is arguably the first and the most important area of concern in public health. Control of this area can only be effected by moving from individual to communal effort.

Places

Hippocrates' work, *On Airs, Waters and Places*, was written more than two thousand years before the French Revolution. His concern was with the environment and its impact on the health of the individual. Over the years, with the institutionalisation of medicine, place achieved another important dimension. It had a key role in the development of theories and practices relating to individual and collective public hygiene. It was instrumental in the growth of various institutions of learning which were able to promote public hygiene as an intellectual endeavour in it own right.

Place as environment.

Hippocrates' work and the events in Paris in the decades before and after (particularly before) the Revolution both demonstrate the importance of place. Hippocrates' ideas were centred on place as an area that would provide optimal conditions in which to live a healthy life. His aim was to give guidance on choosing a healthy site to live at a time of Greek migration, particularly of young men, to a wide area of the Mediterranean islands and coastal regions. He referred to aspect and climate in terms of sun, wind direction and water quality, and described the diseases and deformities resulting from inhabiting the less propitious sites. The Scythians, in particular, were singled out for being gross, flabby, frequently impotent and infertile as a result of living in a cold northern climate with unfavourable aspects, in addition to spending so much time encased in tight breeches while on horseback.[148]

The importance of place lay in the physical and climatic attributes of particular places and their association with the health of the inhabitants. While the migrations around the Mediterranean gave some scope for taking Hippocrates' advice in choice of place of settlement, there were other factors that restricted choice. One

[148] Hippocrates, *On Airs, Waters and Places*, p. 29.

significant factor was that of occupation and workplace. It was long known that workers in various trades suffered from particular problems, such as lung diseases in miners, quarry workers and masons, and skin problems in dyeing and tanning workers. Many of the workers were slaves with no choice in where they lived and how they worked, and they were expendable. Those who were not slaves often had very little choice in the matter of their workplace either and little power to effect any changes.

Hippocrates' postulations concerning place, were accepted and carried on with surprisingly little change over the millennia. His ideas on place with regard to climate and aspect, water and air quality, were acknowledged as the criteria by which the health of a geographical site should be judged. Hippocrates did not deal with the health of populations in the proactive sense of public health. It was taken for granted, from the time of the Ancient Greeks up until the middle of the eighteenth century, that it was the responsibility of the individual to maintain his own health. It was the role of the physician to counsel the patient on the best ways to do this, and the message changed very little. This message was that the key to good health was moderation in eating, drinking and exercise. Cleanliness of the person was also important, although the means of achieving this aim varied greatly over time.

Occupation and workplace were first drawn into the public health domain in the seventeenth and eighteenth centuries, when the European economies required a healthy working population. A workplace free of dangers would ensure greater productivity, according to the prevailing economic theories of mercantilism. It was during this period that Bernardo Ramazzini (1633-1714) wrote his book on occupational diseases, *De Morbis Artificum Diatriba*, which listed the hazards to the health of workers in 52 different occupations.

Some of the more common dangers encountered by workers, and listed by Ramazzini, were those of noxious substances and of unnatural postures which had to be sustained while working. The importance of place in terms of an area devoted to specific occupational purposes – mines and quarries, ill-ventilated buildings, polluted sites – was highlighted in his work. Previous to Ramazzini's work, it had long been known that workers in various trades suffered from problems particular to their occupation, but it was Ramazzini who was the first to gather together the disparate strands of knowledge and create a new domain of knowledge allowing physicians to link disease to occupation. Ramazzini proposed that physicians should extend the list of questions that Hippocrates recommended they ask their patients by adding, "What is your occupation?" The question underlines the importance of place in health, both of individuals and populations, since occupation is inextricably linked to place of work.

In the eighteenth century, Hallé's proposals for a course in public hygiene still show the separation of individual and collective responsibility for maintenance of health. In these proposals, put forward in 1792 in an article for a journal edited by Antoine Fourcroy, he made the distinction between public and private hygiene.[149] His belief was that it was important for the physician to make the distinction between the two and that "c'est dans l'hygiène publique que le médecin philosophe devient le conseil et l'âme du législateur."[150] The health of the individual was still mainly his own responsibility after receiving medical advice, but public health was becoming a subject of importance in its own right, worthy of the highest consideration.

The importance of place with regard to health was the subject of much

---

[149] Hallé, J.N., "Exposition du plan d'un traité complet d'hygiène", in Fourcroy, A. (ed.), *La Médecine éclairée par les sciences physiques*, Paris, vol. 4, 1792, pp. 225-235.
[150] Hallé, J.N., "Exposition du plan d'un traité complet d'hygiène", p. 228.

investigation during the eighteenth century. As well as recognising the significance of occupation and workplace, many investigators looked for significance in the weather of particular places and collected enormous quantities of meteorological data with the aim of correlating weather and disease. The Royal Society of Medicine had the aim of constructing a "medical geography of France", medical geography or topography being of considerable interest at the time. Hallé, who was intimately involved in the project, wrote a long article conceptually placing medical geography as a foundation for public hygiene in the *Encyclopédie Méthodique* (1787, 1793).[151]

Place as an institution

If the physical aspects of place play an important role in the health of humankind, then the institutional settings dedicated to the advancement and promulgation of knowledge were also of considerable importance to the improvement of public health. The existence or establishment of knowledge- and interest-based institutions in close proximity, as was the case in Paris in the eighteenth century, provided a fertile environment for significant advances in many areas of intellectual pursuit, including science and medicine. The propinquity of the protagonists was important at a time when transmission of knowledge over distance was often very slow. The various institutions of influence held frequent meetings, often twice a week, at which members presented reports and results of experiments, and held discussions on various topics. Many men were members of several institutions and regularly attended meetings over many years, as attested by the records of attendance kept by the institutions' secretaries. Through these records, published reports, books and brochures it is possible to see that those influential in the eventual establishment of a chair in public health, would have known each other well, through weekly or bi-

[151] See Barrett, F.A., "The role of French-language contributors to the development of medical geography", *Social Science and Medicine*, vol. 55, 1, 2002, p. 155.

weekly meetings, over a long period and by working together on various projects. One example of this is a gathering which took place in Paris in March 1782. A group of experts in hygiene and chemistry gathered in front of the Hôtel de la Grenade in the rue de la Parcheminerie. The cesspool of this building, well known for the fatal nature of its effluvia, was to be cleaned out. The occasion was to provide the opportunity for testing a new substance that would get rid of foul smells and prevent miasmas. Both of these were thought to transmit disease at that time and so this was an important experiment. Among the group of eight experts present were Antoine Lavoisier, Antoine Fourcroy and Jean Noël Hallé,[152] the latter writing a report on the matter for the Royal Society of Medicine.[153] They were all members of the Academy of Science and the Royal Society of Medicine, two of them were graduates of the Faculty of Medicine, and they were to collaborate on other projects many times over the years.

In the eighteenth century, the importance of place in developing the field of public health can be seen in these three particularly influential institutions. Two, the Faculty of Medicine and the Academy of Science, were long established in Paris. They had, in turn, considerable influence on the creation of the third and shortest lived institution, the Royal Society of Medicine. While it may have been the shortest lived, however, the Royal Society of Medicine had the greatest influence on the future directions of medicine and in establishing public health as a legitimate domain. The geographical proximity of these three institutions, which were situated quite close together in Paris, was an important factor in the interactions between them.

The Academy of Science owed its foundation to the efforts of Colbert (1619-1683), Minister of Finance to Louis XIV. At the time, Paris was one of the most politically and economically important cities in Europe and was the place in which

[152] Corbin, A., *The Foul and the Fragrant*, p. 2.
[153] Hallé, J.N., *Recherches sur la nature et les effets du méphitisme des fosses d'aisance*, Paris, 1785.

were established a number of academies under royal patronage. Colbert was responsible for a number of initiatives in the fields of art, literature and science, one of the more prominent of which was the founding of the Academy of Science in1666. He chose a disparate group of scientists who had previously met at private gatherings. This small group of scholars met on 22 December 1666 in the King's library, then newly installed on the rue Vivienne in Paris. The first 30 years of the Academy's existence were relatively informal, since no statutes had as yet been laid down for the institution, and it was not until 20 January 1699, that Louis XIV provided a constitution. The Academy received the title of Royal Academy of Sciences and was installed in the Louvre. Comprising 70 members, it was meant to bring brilliance to the crown in the same manner as those academies devoted to literature and the arts. This fitted well with the mercantilist ideas of Colbert and others, in that scientific endeavours could be used to promote technical education which would, in turn, promote trade and productivity.[154] The Academy contributed to the scientific movement of its time through its publications, and played a role as counsellor to those in power. It also had the effect of centralising control of the French scientific world in the hands of the crown and made the livelihood of the scientists dependent on the State. The Government pensions bestowed upon them ensured that they would, if called upon, devote their efforts to the national good.

The first director of the Academy of Science was Christiaan Huygens (1629-1695) who determined that the

> company will be composed of the most learned persons available in all the true sciences, such as geometry, mechanics, optics, astronomy, geography etc., in physics, medicine, chemistry, anatomy, etc., or in the practice of the arts such as architecture, fortification, sculpture, painting,

[154] Hahn, R., *The Anatomy of a Scientific Institution*, Berkeley, Los Angeles, London, University of California Press, 1971, p. 9.

> drawing, the channelling and raising of water, metallurgy, agriculture, navigation etc.[155]

Its membership covered quite a broad range in terms of occupation and social class, and, to accommodate this spectrum, it was forbidden to discuss religion or politics in meetings. This is rather poignant with regard to Huygens' later fate. He stayed in Paris until 1681 when he became ill and returned to The Hague. In 1685, he wanted to return to Paris but, being a Protestant, he was unable to do so because of the revocation of the Edict of Nantes, and thus he spent his ten remaining years in The Hague.

Nevertheless, the fifteen founding members of the Academy were all of a certain social rank and wealth since it was virtually impossible for the lower classes to gain access to the education needed for admission. Even so, Colbert did not hesitate to exclude men of high social standing whom he deemed unworthy for various reasons. He also excluded the Jesuits and Cartesians because they were considered teachers of faith rather than open-minded seekers after truth. The object of the Academy was, after all, to banish all prejudice from science, to base everything on experiments, "to find in them something certain and to open an easy path to truth for those who did so".[156] As a centre for all the Academy's pursuits, the Observatory was built in 1667 in what is now the 14th arrondissement. The housing of all scientific branches of the Academy in the Observatory did not eventuate, but today it is still a site of astronomical pursuits.[157]

The revocation of the Edict of Nantes affected not only Huygens' return but was also responsible for the departure of a number of influential Protestants, including Leibniz. This exodus, combined with the resumption of various military adventures,

---

[155] Hahn, R., *The Anatomy of a Scientific Institution*, p. 11.
[156] Hahn, R., *The Anatomy of a Scientific Institution*, p.16.
[157] This Observatory still exists as part of France's research in astronomy, one of three sites in the Paris region. The outstanding building, designed by Claude Perrault, can be visited by appointment.

led to a decline in the activity of the Academy. In the following decades, however, it was changes to the functioning of the Academy which were to be most significant. What had started off as a disparate group of scientists had evolved, by the end of the seventeenth century, into the scientific authority of France. The consultative aspect of the Academy was dealt with by the committee system and the phrase "approuvé par l'Académie" became a standard feature of favourable reports.[158]

By the end of the seventeenth century, there had occurred another change, which was of great import. This was the move from its committee investigation system to that of functioning as an adjudicator of individual projects and deciding if they were deserving of publication. The practice of communal publication was abandoned for that of individuals publishing under their own name, although the Academy retained the right of review. It could comment on the validity of claims and could solicit more information if there was some controversy.[159] It maintained the original standards required of members to be open-minded seekers of truth, although "simplicity, hard work and unadorned logic" were to be the order of the day. In this way, it established the standards of behaviour expected of the scientific community. It was sufficiently assured of its role in the world of scientific endeavour to publish opposing opinions of its members in a number of controversies, thus establishing an institutional and academic tradition.

During the eighteenth century, the Enlightenment put forward the idea of "science" as the key to banishing ignorance and prejudice. Scientific endeavour would be the pathway to modernity. The individual scientist would help lead the way and the Academy would embody his intellectual ideas and aspirations. Indeed the Academy was held in the highest esteem at this time, with science to be the new

[158] Hahn, R., *The Anatomy of a Scientific Institution*, p. 22.
[159] Hahn, R., *The Anatomy of a Scientific Institution*, p. 29.

messiah. By the end of the eighteenth century, the Academy had become the director and administrator of all aspects of the world of science, with the possible exception of the practice of medicine. It was mandated to communicate with "the scientific community in France and abroad, to stay abreast of all scientific news, to read and discuss important publications, to repeat significant experiments carried out elsewhere and to criticize the works written by its own members."[160]

The right of approval for patent rights augmented its powers, as did the right to have its members' works published without obtaining the approval of the royal board of censors. This latter right evolved by various means into the publication by the Academy of the scientific works of non-members as well. By the time of the Revolution, the Academy embodied not only the world of science but also the administrative organisation of the royal bureaucracy. It retained some degree of autonomy, as shown in the Academy's occasional objections to the appointment (recommended by the Crown) of a candidate that they considered unworthy on intellectual grounds.

Although the Academy was the principal scientific institution of its time, others did arise, particularly in the fields of medicine, surgery and pharmacy, which were incorporated under the general rubric of the healing arts (*l'art de guérir*). The first to arise was the Royal Academy of Surgery, which was formed in 1731 and took on a very similar organisational structure to that of the Academy of Science. It was placed under the jurisdiction of the same Minister and followed the practices of the senior Academy. The Academy of Science willingly proffered its registers, eulogies and annual historical essays as models for the surgeons to adopt.[161]

---

[160] Hahn, R., *The Anatomy of a Scientific Institution*, p. 59.
[161] Hahn, R., *The Anatomy of a Scientific Institution*, p. 102.

The Academy of Science, together with all the Academies based in Paris, was suppressed by the Convention on 8 August 1793, because it and the others were, in the words of Grégoire, "gangrenées d'une incurable aristocratie".[162] Two years later, on 22 August 1795, a National Institute of Sciences and Arts was put in place, bringing together the old academies of the sciences, literature and arts. The Institute's first class (physical sciences and mathematics) was the largest (66 members out of 144). In 1805, the National Institute of Sciences and Arts was transferred to the old College of the Four Nations. This is situated on the Left Bank of the Seine, opposite the Louvre and is known today as the Palais de l'Institut de France. In 1816, the Academy of Science became autonomous, while forming part of the Institute of France; the head of State remained its patron.[163]

The importance of place, as realised in Paris, was previously mentioned in regard to the Academy of Science and to two other institutions with leading roles in the direction of medical science, both content and teaching, and in the eventual creation of a new medical school in 1794. It was at this new medical school that Hallé became the first Professor of Public Health, with Fourcroy in the chair of chemistry. The two institutions of influence were the Faculty of Medicine of the University of Paris and the Royal Society of Medicine. The former had a centuries-long history and considered the latter, formally established only in 1778, as an upstart and intruder in the world of medicine. The Faculty of Medicine in Paris was founded in the late twelfth century, as was the medical faculty of Montpellier University, the only other faculty of medicine in France. The existence of these two schools and the rivalry

---

[162] < http://www.scholarly-societies.org/history/1795idf.html> viewed March 2009.
The Scholarly Societies Project was started by the University of Waterloo Library, Ontario, Canada, facilitating access to information about scholarly societies across the world since 1994. It encompasses 4157 scholarly societies and 3832 websites.

[163] < http://www.scholarly-societies.org/history/1666as.html viewed June 2009.

between them played a significant role in the history of medical teaching and practice and were an influence on the foundation of the Royal Society of Medicine.

Medical students came from a narrow section of society. The ecclesiastical nature of the universities meant that men who were not of the Christian faith were excluded. No women were admitted, and towards the end of the seventeenth century there was a push to exclude Protestants from being accepted into training. Nepotism was rife and preference for admission to training was given to sons or younger relatives of doctors. The very high fees for admission and graduation in Paris were prohibitive for many. This was still true in the eighteenth century, when the Royal Society of Medicine supported Fourcroy financially, as it was outside the abilities of his family to pay for his medical training.

The education of medical students saw them attending lectures for a specified number of years and then applying to become a bachelor of medicine. After that, they had to give a series of lectures, undergo a number of oral examinations (which included giving public dissertations), and finally serve a practical apprenticeship. They were then given their licence to practise by the bishop. The licence from the bishop gave the graduates of Paris and Montpellier the right to practise medicine both in the local community and throughout the world (*hic et ubique*). The right to practise anywhere was only accorded to these graduates, and graduates of smaller provincial faculties, which had sprung up in France over the centuries, could only set up practice in limited geographical areas; they were accorded the legal right of practice only within the confines of the town or city in which they had graduated. The prestige of Montpellier and Paris was, in fact, probably enhanced by the increase in the number of these other faculties because the two older institutions maintained teaching standards and the rigour of their examinations in comparison with the newer faculties.

Both faculties demonstrate the importance of place, in that they were able to maintain standards through the advantages of population size and the financial underpinning afforded by cities. The Paris Faculty was more prestigious than that of Montpellier. This is unsurprising given its incorporation within the University of Paris, which was one of the largest and most important universities in Europe, and given the political and economic importance of Paris itself. No outsider, with one specific group excepted, could practise as a physician in Paris without first being examined by the Paris Faculty.[164] The group who could practise anywhere in France, without the approval of the Paris Faculty, were the physicians of the royal household. The King and some of the royal family appointed particular physicians to their personal service, and these physicians were accorded certain privileges. The most important privilege was the right to practise medicine or act as a consultant in any part of France. This meant they could practise medicine in Paris without being members of the Paris Faculty, and provincial physicians, especially those from Montpellier, who wished to practise in Paris, turned this exemption to advantage. They were absolved from undergoing the long and expensive formalities of affiliation required by the Paris Faculty.[165] This led to a situation where, from time to time, there was a sizeable number of physicians practising outside the control of the Faculty. Unsurprisingly, this resulted in competition, rivalry and conflict. It also led to a reinforcement of the conservatism of the Faculty, since resistance to change maintained its power and control of medical teaching.

The first physician to the King held a position of great power and influence. Two of his most important powers were the control of all aspects of the use and distribution of the mineral waters of the kingdom and, secondly, the control over the

[164] Brockliss, L., and Jones, C.L., *The Medical World of Early Modern France*, p. 189.
[165] Hannaway, C., *Medicine, Public Welfare and the State in Eighteenth Century France: The Société Royale de Médecine of Paris (1776-1793)*, PhD dissertation, Johns Hopkins University, 1974, p. 27.

distribution of licences authorising the sale of proprietary remedies ("remèdes secrets"). The therapeutic qualities of mineral waters had been recognised since ancient times. In France, the Romans had established spas at Badoit and Vittel and Julius Caesar found the warm springs at Vichy much to his taste. The medicinal value of mineral waters was taken for granted and different minerals dissolved in the waters were recognised as having specific benefits. Highly mineralised waters were noted for breaking up kidney stones; those high in bicarbonate were useful for digestive complaints, and there were others, such as Evian, that were used for skin complaints. Mineral waters were therefore an important part of the physician's armoury in the treatment of a great variety of maladies. Control of these, along with proprietary remedies, thus gave the first physician a virtual monopoly over a large portion of medical treatment.

It is possible to see, in the national control of these two substantial pharmaceutical areas, a basis for consideration of health problems on a broad scale. Hannaway feels that this centralisation was, "not of major public health significance", but it was nevertheless a starting point for the changes which led, over less than fifty years, to a greatly increased awareness of the significance of public health in the prosperity of the nation. From this awareness arose the formalisation of public health as a legitimate area of study, with the creation of a chair of public health being a logical conclusion.

Changes to the powers of the first physician and his control of these privileges – mineral waters and proprietary remedies – together with dissension over the demarcation lines between the royal physicians and the Faculty, played a significant part in the formation and development of the third of the important institutions in

Paris to be considered – the Royal Society of Medicine.[166] The formation of this society was assisted by the system of medical care which had arisen over the course of a century or so to provide help to the provinces in times of need. In the eighteenth century, the availability and type of medical care received depended on socio-economic factors. Those who could afford private medical care were few and the poor had to depend on organised assistance. The medical corporations only cursorily provided this assistance and it was the royal administration which did most of the organising and provision of aid. It was able to provide aid in various ways through the conduit of hospitals established in the previous century.

During the seventeenth century, a large number of hospitals had been founded for assistance to the poor. These charitable institutions, founded by the joint endeavour of bishops, town representatives and intendants (royal civil servants), provided not only care for the sick but also shelter for the indigent and handicapped. This was the beginning of a greater involvement by the intendants in overseeing the provision of medical care, and they extended their role to the provision of assistance to the local populations in times of epidemics and to the distribution of free remedies to the poor.[167] The custom of providing remedies to the poor had started during the reign of Louis XIV, when quantities of a remedy for dysentery, made by the then royal physician, were sent to the intendants for distribution to the poor. The control and approval of proprietary remedies by the King's first physician made it possible for them to be manufactured and distributed in an orderly fashion through the network of intendants. The intendants also played an important role during epidemics, when they had the authority to send remedies and other supplies, including financial aid, to their local physicians and surgeons. They were kept informed of the progression of

[166] Hannaway, C., *Medicine, Public Welfare and the State*, p. 28.
[167] Hannaway, C., *Medicine, Public Welfare and the State*, p. 35.

the epidemic, in terms of numbers and severity, by reports from those present, such as local officials, doctors and clergy. Some intendants, on their own initiative, appointed medical men to regular posts as physicians and surgeons for epidemics so that aid was always quickly available.[168]

The intendants also played an important role in epizootics – organising quarantine, dispatching remedies and collecting information. Part of their duties required them to submit regular reports to Paris on outbreaks of disease in humans and in animals in their districts, and the measures they took against them. These reports were potentially very useful except for two factors that limited their use. One was a lack of uniformity in reporting and the other was that there was no centralised body to make use of them. In the end it was the Royal Society of Medicine which recognised the value of these reports as information sources: it made "use of the provincial administration for collection of data and offered a permanent source of professional advice on medical matters to the government".[169]

Earlier in the century, there had been a commission set up to examine evidence with regard to the efficacy of remedies and then to advise the current royal physician of the conclusions. Licence to sell a remedy was renewed every three years if the evidence for its efficacy was favourable. The Commission turned out to be rather ineffective in controlling sales of remedies and was, in the end, undermined by the actions of Jean-Baptiste de Sénac (1693-1770), first physician of Louis XV. He sold licences to anyone willing to pay the price, including licences for some remedies that had been rejected by the Commission. Some members of the Commission were so outraged that they refused to attend its meetings. After the death of Sénac in 1770, the surveillance of remedy licensing lapsed and in 1772 a new body was established –

[168] Hannaway, C., *Medicine, Public Welfare and the State*, p. 39.
[169] Hannaway, C., *Medicine, Public Welfare and the State*, p. 42.

the Commission Royale de Médecine.[170] It was a broad-based group of physicians, surgeons, apothecaries of the royal household and representatives of the Faculty of Medicine, the Academy of Surgery and the Paris Corporation of apothecaries. It met once a month at the Louvre to discuss all types of remedies. It was also given the right, previously the prerogative of the first physician, to control the distribution and sale of mineral waters and proprietary remedies. This was made easier by the fact that the King did not appoint a new first physician immediately after the death of Sénac.

In 1774, the new king, Louis XVI, appointed Joseph Lieutaud (1703-1780) as first physician, with Joseph de Lassone (1717-1788) designated as his successor, since Lieutaud was already 71. In fact, Lieutaud was not a very worldly man and was happy to leave the courtly duties to Lassone, who acted as the de facto first physician.[171] Lassone had become first physician and confidant to Marie-Antoinette when she was still Dauphine so he had powerful court connections. He wished to regain control of the mineral waters and remedies, although he recognised that it was not possible to handle all the regulations alone. He believed that a society of physicians that included able chemists should replace the Commission in assisting the first physician to carry out his duties. His view of the role of the first physician also included his role as a leader in the development of medical science by the organisation of an Academy of Medicine devoted to working for the progress of medical knowledge.[172] He knew that the Paris Faculty of Medicine would oppose the formation of a national Academy, so, in concert with Félix Vicq d'Azyr (1748-1794), a young physician of note, who also strongly supported the idea of an Academy, he proceeded by way of an ad hoc

[170] Hannaway, C., *Medicine, Public Welfare and the State*, p. 61.
[171] Both Sénac and Lieutaud are remembered for significant work in the fields of cardiac anatomy and lung disease (possibly mesothelioma).
[172] Hannaway, C., *Medicine, Public Welfare and the State*, p. 67.

commission for epidemics. An epizootic in 1775 provided the initial opportunity for them to advance their cause.

Félix Vicq d'Azyr was a celebrated anatomist. He was appointed Professor of Anatomy in the Faculty of Medicine in 1773, elected to the Academy of Science in 1774 and in 1775 appointed to a commission which investigated an epidemic in cattle that had occurred in the south of France. Anne Robert Turgot, Comptroller General at the time, had asked the Academy of Science, through the offices of his close friend, Condorcet, to put forward the names of a number of its members who would be able to form a commission to advise on the situation. Two of these commissioners should be sent to the provinces to assess the situation personally. The commissioners appointed only one person to go to the stricken area, this being Vicq d'Azyr.[173] On his return, he suggested the establishment of a permanent commission for the study of epidemics in man as well as animals. Turgot wanted to work out a broad plan to deal with epidemics by way of a questionnaire which was to be sent to the most knowledgeable physicians in affected areas. His collaborators in this endeavour were Lassone and Vicq d'Azyr, who both saw the opportunity for the formation of a new medical institution. The result was that on 29 April 1776, Louis XVI gave permission for the foundation of a commission of eight doctors who were to report on all matters pertaining to epidemics and who were to correspond with doctors throughout France. The six physicians appointed (Lassone and Vicq d'Azyr making up the eight) were Antoine Laurent de Jussieu, Claude Caille, Michel Augustin Thouret, Jean de Lalouette, Dieudonné Jeanroi et Jean-Jacques Paulet. The first five were all young physicians and friends of Vicq d'Azyr, the first three having been recently made doctors-regent of the Faculty, and the last two being in the process of completing their

[173] Hannaway, C., *Medicine, Public Welfare and the State*, p. 86.

medical degrees.[174] Jean-Jacques Paulet was older than the others, having graduated from Montpellier in 1764. He was interested in smallpox vaccination but is best remembered for his work in mycology and in his opposition to mesmerism. In July of the same year (1776) five physicians were recruited from the more experienced and well-known practitioners in the capital, which recruitment would give additional standing to the new society. Among these five was Anne Charles Lorry (1726-1783), maternal uncle of Jean Noël Hallé. Antoine Fourcroy, a student of medicine at the Paris Faculty and protégé of Vicq d'Azyr, was responsible for caring for the books of the commission.[175]

One of the Society's early actions, before it had even received its letters patent, was to request that Antoine Fourcroy translate Ramazzini's work on occupational diseases from the Latin into French. This is a pointer to the areas of interest of the Society, an indication of the way in which occupational health would be amalgamated with other areas of knowledge into the new field of public health. This field would come within the purview of the Society and become a subject of interest and consideration to its members, including, of course, Jean Noël Hallé. Fourcroy added notes and wrote a long introduction to his translation of Ramazzini's work, which he read to the Society towards the end of 1776. He expressed the hope that the Society would encourage its correspondents to continue an interest in the area of occupational disease and extend the work of Ramazzini. If enough new material were available, he was planning to write a new treatise, which would provide a more systematic approach to the subject. He never proceeded with this project but it is interesting that he proposed a systematic classification for a large amount of factual

---

[174] Hannaway, C., *Medicine, Public Welfare and the State*, p. 112. Jussieu, Lalouette, and Jeanroi later in 1779, co-authored a report with Hallé entitled "Détails des expériences pour déterminer les propriétés et les effets de la racine de dentelaire dans le traitement de la gale, rédigé par M. Hallé", in *Mémoires de la Société royale de médecine*, 1779, p. 102.
[175] Hannaway, C., *Medicine, Public Welfare and the State*, p. 113.

material at quite an early stage in his career.[176] His systematic binomial classification of an even larger amount of factual material, that of chemical compounds, would be one of his major achievements later in his career.

The new commission grew rapidly in size and influence, the majority of the new members being physicians of some standing, and in August 1778 it was granted letters patent as the Royal Society of Medicine. The Faculty of Medicine had strongly opposed the granting of the letters patent, as had the surgeons and apothecaries who were members of the Commission Royale de Médecine. However the Commission Royale de Médecine was disbanded and its functions with regard to mineral waters and remedies were returned to the first physician and carried out by the Royal Society of Medicine under his leadership.

The Society consisted of thirty doctors resident in Paris, at least twenty of whom had to be members of the Faculty of Medicine. There were twelve *associés libres* who were not necessarily doctors but were outstanding in other scientific fields, the two Deans of the Faculty of Medicine and the permanent secretary (Vicq d'Azyr). There were also sixty provincial members, sixty foreign members (including Benjamin Franklin and Samuel Tissot) and a large number of correspondents scattered throughout the provinces. The first physician to the King was the permanent president of the Society, which elected annually a director and vice-director from among its members.[177] On 3 October 1778, an additional post of vice president was created, as Lassone's position at court often prevented him being in Paris to preside at meetings. It was a two-year appointment to which Lorry was elected by a majority of votes.[178] In December 1778, Hallé, his nephew, was one of three physicians

---

[176] Smeaton, W.A., *Fourcroy: Chemist and Revolutionary (1755-1809)*, Cambridge, W. Heffer & Sons, 1962, p. 4.
[177] Smeaton, W.A., *Fourcroy: Chemist and Revolutionary*, p. 2.
[178] Hannaway, C., *Medicine, Public Welfare and the State*, p. 133.

appointed to the Society as an *associé ordinaire*.[179] A treasurer was appointed a little later, this being Antoine Laurent de Jussieu, who retained this position until the abolition of the Society in 1793.

Meetings were held in the Louvre every Tuesday and Friday, at which, by virtue of its letters patent, the Society was empowered to discuss all aspects of medicine, not just epidemics. The Society abolished the sale of licences for selling remedies and provided the licences free if the remedy was judged efficacious. It also abolished the sale of positions of intendant at the various watering places. Appointments were made by the Society and the intendants were required to submit regular reports.[180] The Society gained considerably from the mineral water trade as it received a tax on the profit from the sale of the waters; the annual revenue was about 23,000 livres.[181] The Society also showed itself to be interested in furthering medical science by using the scientific discoveries of the time in areas such as electricity and magnetism, chemistry in the areas of combustion and analysis, comparative anatomy and meteorology.

The advancement of medical knowledge was to be pursued through "the systematic collection of data, observations and experiences from medical practice and the communication of this information to other medical men".[182] When large numbers of doses of remedies were sent to areas of need, Lassone had insisted that those in charge of administering the medicines should report back on their efficacy – an "experimental quality control mechanism and products testing service".[183] The provincial network of physicians (and some surgeons and apothecaries) produced detailed reports on epidemics, meteorological data, and interesting and unusual cases.

[179] Hannaway, C., *Medicine, Public Welfare and the State*, p. 132.
[180] Hannaway, C., *Medicine, Public Welfare and the State*, p. 138.
[181] Hannaway, C., *Medicine, Public Welfare and the State*, p. 139.
[182] Hannaway, C., *Medicine, Public Welfare and the State*, p. 44.
[183] Brockliss, L., and Jones, C.L., *The Medical World of Early Modern France*, p. 734.

Meteorological data, in particular, were very carefully recorded as it was thought there was a link between weather conditions and disease.

The Society also performed an enormous number of scientific tasks, not only on its own initiative but also when requested by public authorities.[184] By 1780 the controller general, Necker, was treating the Society as an integral part of public administration, a virtual health ministry in its own right. The Society members were consultants to the government on all the main public health issues of the day: the question of the fate of the Paris Hôtel-Dieu, the relocation of the Innocents cemetery, medical uses of electricity, naval hygiene, sewage works, etc.[185] It had influential support from its *associés libres*, who included important political and government figures such as Lenoir, lieutenant general of police for Paris, and Necker. The Society brought together a network of a large number of the scientific and medical community of the entire country. The transmission of information from the peripheries of the country to the capital, via the extensive network of correspondents, served to emphasise the importance of Paris, which would soon become the epicentre of the developing science of public health.

The Society was also welcoming and friendly to all, particularly provincial members, in stark contrast to the conservative and exclusive nature of the Faculty. When the Society was founded, many of its members were also members of the Faculty but it was not long before difficulties arose, even though the letters patent expressly stated that no member of the Society was to engage in medical teaching unless licensed to do so. Vicq d'Azyr had already had problems with the Faculty. While still a licentiate of the Faculty, he gave an innovative, and successful, course in comparative anatomy in the amphitheatre of the Schools of Medicine during the

[184] Brockliss, L., and Jones, C.L., *The Medical World of Early Modern France*, p. 762.
[185] Brockliss, L., and Jones, C.L., *The Medical World of Early Modern France*, p. 763.

summer recess of 1773. After the break, there was a time conflict: he was denied use of the amphitheatre and had to continue his courses privately. The Faculty was more interested in maintaining tradition than in encouraging the presentation of new material.

The King was asked to restrict the activities of the Society, many of which could easily be performed by the Faculty. The plea was ignored, the work of the Society not restricted and the Faculty continued its opposition. The Faculty tried to set up a rival Academy within its own body but was forbidden to continue by the King. In late 1777, the Faculty wrote to all of the provincial faculties and colleges to try to set up its own network of correspondence to rival that of the Society. This was not very successful owing to the fact that, in the past, the Faculty had been distinctly patronising, in contrast to the friendly and welcoming approach of the Society. Early in 1778, the Faculty demanded that the Society be incorporated into and under the control of the Faculty – that is, would become an internal committee of the Faculty. While not agreeing with this, the Society was willing to enter into negotiations for a peaceful resolution of differences until they were told of Faculty meetings in which the reputations of Lassone and other members were violently attacked. The division between the two became more marked and this caused a crisis for those physicians who were members of both in deciding where their loyalties lay. In April 1778, the Faculty requested the Procurer General of Parliament not to grant letters patent to the Society until the Faculty's opposition had been heard. In response to this, four of the older and better-known members of the Society, one of whom was Anne Charles Lorry, called a meeting of the entire Faculty. It was thought that a new proposal for reconciliation would be offered, instead of which, Lorry, apparently generally a mild man, castigated the Faculty for its protest to the King as this action would displease the royal ministers at a time when the Faculty needed their support to obtain a new building.[186] He also said that the Faculty flattered itself if it thought that it could do what the Society did, particularly in terms of dealing with provincial physicians. He advised that they should concentrate on their primary function – that of teaching.[187] Not surprisingly, this did not lead to a rapprochement, and in June 1778 the Faculty threatened to expel those of its members who were also members of the Society. The Council of State intervened and doctors were allowed to be members of both institutions.

The Faculty appealed again against the granting of the letters patent, to no avail, as the King's council approved them on 29 August and they were registered by Parliament on 1 September 1778. The Society took on board many of the Academy of Science's structures, particularly in the various levels of membership and in the meetings of its office bearers. This was facilitated by many of its members also being members of the Academy; these included Hallé, Fourcroy, Jussieu and Lavoisier. The Faculty next claimed that the Society had taken over rights acquired during the six centuries of the Faculty's existence; it sent its complaints to the King and also published them in a pamphlet. The Faculty objected to the fact that it was possible for only a minority of the members of the Society to be doctors of the Faculty and also that judgement could be made on medical matters by the *associés libres*, who were not necessarily doctors. Moreover, the Faculty had the sole right to teach medicine in Paris but the Society was examining all kinds of medical works and, by approving them, was, de facto, teaching medicine independently of the Faculty. The members of the Faculty also resented the fact that the article of the letters patent required the Society merely to give an annual report of its work to the Faculty. They felt that the

[186] Hannaway, C., *Medicine, Public Welfare and the State*, p. 427.
[187] "Commentaires", cited in Hannaway, C., *Medicine, Public Welfare and the State*, p. 428.

Society, which was largely composed of young men, should rather be coming to the Faculty for guidance. They even spoke of the Faculty as the "mother" institution in their correspondence. Unfortunately for the Faculty, there was a paradigm shift in what it meant to be a physician. Many of the younger doctors saw their loyalty being more to an advancing field of scientifically based medicine rather than to the corporate membership of the Faculty.[188]

When the Faculty found itself unable to destroy the Society by means of legal appeals, pamphleteering and attempts at rivalling the Society's activities, some of its members embarked on a campaign of vilification via anonymous pamphlets. It also found a new means to express its opposition by the harassment of certain members of the Society. At a meeting in January 1779, the members of the Faculty decided, by majority vote, to deny the title of doctor-regent to Jean Noel Hallé for his misconduct in belonging to the Society. They had awarded him his doctorate in September 1778 in view of his knowledge of medicine but said they were not obliged to award him the regency. To be worthy of the regency, medical knowledge was not sufficient; the doctor had to behave in such a way and express sentiments which merited the Faculty's confidence. Hallé had not behaved correctly according to the Faculty, but if he renounced the Society and gave proof of his attachment to the Faculty he could have his regency.[189] This was in spite of the fact that all doctors of the Faculty had testified favourably to Hallé's personal merit.[190] This, of course, provoked more discussion and legal effort but nothing was accomplished and it set a precedent, which was soon followed.

Antoine François Fourcroy was a prime target. Fourcroy had good reason for his loyalties lying with the Society rather than the Faculty. He was descended from a

[188] Hannaway, C., *Medicine, Public Welfare and the State*, p. 407.
[189] Hannaway, C., *Medicine, Public Welfare and the State*, p. 465.
[190] Hannaway, C., *Medicine, Public Welfare and the State*, p. 501.

noble family which had declined and his father was an apothecary. At the age of about sixteen, he was working in Paris as a copying clerk when he had the good fortune of meeting Vicq d'Azyr, who persuaded his father to allow him to study medicine.[191] He attended the meetings of the Society from 1776 and looked after their books. He received his bachelor of medicine qualifications in April 1778 and, on entering his licentiate, he competed with his fellow bachelors for a legacy which would pay all expenses from bachelorhood to regency – a sum of more than 6,000 livres. It was an opinion, widely held, that he was not awarded this legacy because of his association with the Society, a decision that left him despairing as his family could not possibly have found this large amount. Fortunately for him, the members of the Society came to his rescue and found the funds for him to continue. However, to receive his licentiate, the Faculty virtually blackmailed him into agreeing that, in return, he would renounce his membership of the Society. Although he agreed to this, he had no intention of fulfilling his agreement. He received his doctorate on 28 September 1780 and on 10 October 1780 he became an *associé libre* of the Society. In November of the same year, the Faculty decided not to award the regency to Fourcroy and two other doctors, and also confirmed, once again, the non award to Hallé.[192] Despite various legal actions over the years until both the Faculty and the Society were abolished by the Revolution, neither Hallé nor Fourcroy received their regency. After the Revolution, the Faculty tried, in November 1789, to effect a reconciliation but negotiations broke down and there was no further negotiation after early 1790.

On 25 November 1790, Vicq d'Azyr presented to the National Assembly, in the name of the Society, a new plan for the constitution of medicine in France. Most

[191] Smeaton, W.A., *Fourcroy: Chemist and Revolutionary*, pp. 1-5.
[192] Hannaway, C., *Medicine, Public Welfare and the State*, p. 496.

notable was its appeal for the unification of medicine and surgery, its advocacy of clinical instruction and its call for an Academy of Medicine to promote the advancement of medical science.[193] The importance of place is underlined by the plan's proposal that the Academy of Medicine should be physically near the Academy of Science in order to take advantage of its research and general ambience and be exposed to the rigours of scientific method. The idea of research illuminating the field of medicine was embodied in the journal launched by Vicq d'Azyr's protégé, Fourcroy: *La Médecine éclairée par les sciences physiques*. Hallé was one of the contributors to this journal with his article on a course in public hygiene.[194] According to Hannaway, Vicq d'Azyr's plan "represents in its entirety the collective experience and ideals of the Society and is the most eloquent statement of its accomplishments and goals".[195]

The new Revolutionary parliament in Paris took the decisions to reform public education, which, amongst other things, led to the reorganisation of medical teaching. The Assembly had abolished the Faculty in 1792, along with all other faculties of medicine and all universities. All the Academies, as well as the Royal Society of Medicine, were closed down by the decree of 8 August 1793, although Lavoisier had done his best to avert this and had come close to success through his personal connections with Joseph Lakanal (1762-1845), member of the Committee of Public Instruction.[196]

The necessity for training new doctors quickly became apparent. The creation of a new medical training facility became urgent given the shortage of doctors, caused both by the lack of available training over a number of years and by the high casualty

---

[193] Hannaway, C., *Medicine, Public Welfare and the State*, p. 529.
[194] Crosland, M., *Science under control*, Cambridge, Cambridge University Press, 1992, p. 163.
[195] Hannaway, C., *Medicine, Public Welfare and the State*, p. 530.
[196] Poirier, J.-P., *Lavoisier*, p. 45.

rate of military doctors. In 1794, proposals for a new medical school were put into effect by the influence of Fourcroy, protégé of Vicq d'Azyr, and special son of the Society. He had become an important member of the Committee of Public Instruction and in December 1794, as its spokesperson, presented a plan for medical education which was accepted virtually unchanged a few days later by the Assembly. The proposals were very similar to those previously submitted by Vicq d'Azyr, who had in turn been influenced by those interested in public education such as Lavoisier and Condorcet.

Thus it was in Paris in December 1794 that the new School of Medicine was created to replace the old Faculty of Medicine. The new School of Medicine had twelve professorial chairs, one of which was that of public hygiene, a new discipline, and it was to this chair that Jean Noël Hallé was appointed in December 1794. Fourcroy held the chair in chemistry and many of the other professors were former members of the Royal Society of Medicine. Its spirit lived on.

Less than twelve months later, as the result of planning by such as Jean Daunou (1761-1840), Lakanal and Fourcroy, a National Institute of Sciences and Arts came into being. It brought together the former academies of science, literature and arts, including the Académie Française and the Academy of Science. Almost all the former members of the previously abolished Academy of Science were formally re-elected and retook their former seats. There were eleven sections in the new institution for the sciences and this included a section of medicine and surgery. Hallé was one of the six original members of the section, and he was to go on to participate in many reports to the Academy over many years.[197]

---

[197] See *Procès verbaux des séances de l'Académie tenues depuis la fondation de l'Institut jusqu'au mois d'août 1835: publiés conformément à une décision de l'Académie par MM. les secrétaires perpétuels*, Institut de France, Académie des Sciences.

The Royal Society of Medicine had a short history from its formal and legal foundation in 1778 until it was dissolved in 1793 along with all other academies, libraries and learned societies. Hannaway describes it as (like other learned institutions) an institution of the old regime and an agency of the State.[198] While this is true, the passing of the Ancien Régime did not see the end of the essence and purpose of the Society. Although it was formed under the Ancien Régime, it was a portent of the future direction of the teaching and practice of medicine. Ackerknecht saw it as nurturing the younger and more progressive of the doctors and scientists who were instrumental in the establishment of the post-revolutionary teaching schools.[199] When one looks at the holders of the chairs at the new School of Medicine (1794), it is certainly the case that most had been members of the Society. It is also the case that the research and interests of the Society led to changes in the perception of the importance of public health, and in particular to the understanding that it should be a subject of concern to government and worthy of systematic study and logical teaching. This is reflected in the establishment of the first chair of public health in the new medical school and the nomination of its first occupant, Jean Noël Hallé. He had been an early member of the Society and had contributed many reports on matters related to public health areas, including those of smallpox vaccination, miasmas and odours and medical topography.

Hippocrates established the importance of place for reasons of health, but it is by reason of geography that place was important in the Paris of the seventeenth and eighteenth centuries. The establishment and proximity of various influential institutions were key elements in the eventual creation of a chair of public health. For the first holder of this chair, Hallé, the importance of place had several dimensions.

---

[198] Hannaway, C., *Medicine, Public Welfare and the State*, p. 2.
[199] Ackerknecht, E.H., *Medicine at the Paris Hospital: 1794-1848*, Baltimore, The Johns Hopkins Press, 1967, p. 27.

He could be said to have been in the right place at the right time, as well as being the right man for the job. In his case, place was important in the geographical sense in that his family had been established in Paris for several generations. However, the importance of place in the sense of social rank was also significant. His family were of sufficient rank and wealth to allow him an impressively wide education; he was later described as the most erudite man of his generation. The privileges of rank and wealth made it easy for him to study medicine at the Paris Faculty, and to become a member of the Academy of Science and of the Royal Society of Medicine. These privileges also made it possible for him to treat poor patients without charge and to pursue his interests in research without remuneration.

In the long journey from Hippocrates to Hallé, “place” in several meanings has had a major effect in shaping the destiny of public health.

Conclusion

Hippocrates' *On Airs, Waters and Places*, which is considered to be the earliest surviving epidemiological text, was written around two thousand years before the French Revolution. Its three categories are useful points of reference in the consideration of their importance with regard to human health at any given time over the last two millennia. They are also useful divisions in which to follow the advances in scientific knowledge, in particular, as these advances were relevant to public health.

The first of Hippocrates' categories, that of Airs, had already moved on from the ancient Greek belief of air as the essential soul. Hippocrates' focus was on wind direction and temperature during each season. The knowledge of these Airs, he believed, would allow one to predict the health of the inhabitants of the place under consideration. Observations such as these were made and assessed over the centuries, but the natural philosophers also began to concern themselves with the actual nature of air. By the eighteenth century, not only were the composition of air and the properties of its gases known, but also, the importance of ventilation and circulation in maintaining salubrious air had been demonstrated empirically. These advances enabled control or modification of air, and thus the environment, both of the individual and of the general public.

With regard to Waters, Hippocrates wrote of the importance of water quality for human health, and this consideration of quality was always present through the ages. Hippocrates believed that it was the source of water which was the determining factor in it quality. Other practical considerations throughout the ages were those of urban water supply and the use of water for personal hygiene. The actual nature of water was long debated but finally revealed in the late eighteenth century when

Lavoisier presented the results of his experiments to the Royal Academy of Medicine in Paris in June 1783.

The importance of Places, according to Hippocrates, lay in the physical and climatic attributes of particular places and their association with the health of the inhabitants. While the choice of place was available to some, there were factors that made the choice restricted for many people. One of the most significant factors was that of occupation and workplace. Most workers had very little choice in where they worked or in what *métier* they undertook. It was known from Greek and Roman times that workers suffered diseases peculiar to particular trades. Slavery, feudalism and poverty meant that there was a supply of expendable workers. It was not until the seventeenth and eighteenth centuries that a healthy working population was seen to be of economic importance. It was during this period that Bernardo Ramazzini (1633-1714) wrote his book on occupational diseases, *De Morbis Artificum Diatriba*, which listed the hazards to the health of workers in 52 different occupations. This was a starting point for occupation and workplace to be drawn into the public health domain.

This accumulation of knowledge in the areas of airs, waters and places was achieved by the end of the eighteenth century. It was sufficient to comprise a new academic discipline, that of public health or "hygiène publique", as it was known at the time. The subject of public health had been one of the areas of interest to the Royal Society of Medicine. The abolition of this society, along with all other institutes of learning, in 1793 did not greatly impede the progress towards an official recognition of public health as an academic discipline in 1795. In fact, this abolition made the disputes between the Faculty of Medicine and the Royal Society of Medicine null and void and cleared the way for a new institution to replace them both.

The new School of Medicine, which was staffed by many former members of the Royal Society of Medicine, came into existence in 1795 with 12 chairs, one of which was in public health, Hallé being appointed as its first professor.

Hallé was a man of his time, living in the Age of the *Lumières*. The eighteenth century was the age of the "philosophes", and the pursuit of the betterment of humankind, including health, was one of their underlying principles. A well-known quotation from Goethe (1749-1832) illustrates the thinking of the time:

> When we treat man as he is we make him worse than he is; when we treat him as if he already were what he potentially could be, we make him what he should be.

Hallé applied this philosophy in his vision of a plan to teach public health and to influence relevant legislation. He believed that the doctor-philosopher should become the counsel and the soul of the legislator. In the matter of health, people could be shown the way to improving their lives. His thinking was explained in a letter to his colleague Antoine Fourcroy in 1792.[200] He was able to put his ideas into practice when he became the Professor of Public Health at the beginning of 1795.

Hallé's appointment to the position of Professor of Public Health owed much to his character. He has been called the most erudite man of his age and he was certainly very widely and well educated. He was also compassionate, generous of time and money, and was well liked. He was progressive by nature and independent in thought. He was not swayed by influence but did what he thought was right. He was asked to investigate the possible harmful effects of odours emanating from a sugar refinery next to the street in which he and his family and friends lived. When he found them not to be harmful, he was severely criticised by family and friends alike.

---

[200] Hallé, J.N., "Exposition du plan d'un traité complet", in *La Médecine éclairée par les sciences physiques, ou Journal des découvertes relatives aux différentes parties de l'art de guérir*, Paris, 1792, pp. 225-235.

Nevertheless he remained steadfast and said that truth must prevail over private desires.[201]

He was not directly involved in politics, unlike his colleague Fourcroy, but he did not approve of the direction of the Revolution in 1793-1794. He showed courage in his attempt to save Lavoisier from the guillotine, an attempt which could have drawn on him the unwanted and dangerous attention of the Revolutionary Tribunal. Later he became personal physician to Pauline Bonaparte and then to Napoleon himself, whom he appears to have offended at some point.

We find, then, the happy alignment of the accumulation of knowledge, the atmosphere of progression and the drive to create a new medical school and a new discipline. We have also the man who had the knowledge, the character and the ability to be able admirably to head and lead this new discipline. He was the right person at the right time and place.

Hallé's teaching left a legacy for the future by way of his students, two of whom, in particular, were influential in their time in the direction of public health. One of his students, Louis-René Villermé (1782-1863), wrote two important memoirs on the mortality among prisoners and promiscuity in gaols (1820, 1829), and established the *Annales d'hygiène* (1829). His best-known work is his *Tableau de l'état physique et moral des ouvriers employés dans les manufactures de coton, de laine et de soie*. In this work, which was the result of a long investigation, he protested against the use of child labour. It is thought to have had considerable influence on the 1841 law on child labour. Villermé produced further works on workers and their safety and his observations provided an accurate picture of the industrial problems which others tried to remedy.

---

[201] Reid, D., *Paris Sewers and Sewermen*, Cambridge, Massachusetts and London, Harvard University Press, 1991, p. 77.

Hallé's other student who had an influential career in public health, was Alexandre-Jean-Baptiste Parent-Duchâtelet (1790-1836). He was persuaded by Hallé to pursue a career in public health after it was evident that his excessive timidity did not suit him to private practice. His numerous works included essays on the Paris sewers (1822), the influence of tobacco on the health of workmen in tobacco factories (1829), the effect of emanations from putrefying animal matter on food substances (1831), the steeping of hemp in relation to public health (1832), the sanitation of dissecting rooms (1835), and prostitution in the city of Paris in relation to public health, morality and administration (1836).[202] This last publication, which appeared posthumously, is regarded as seminal in the field of public health. In 1829, Parent-Duchatelet, along with Villermé, was one of the founders of the *Annales d'hygiène*, which is still one of the most authoritative journals in the world on hygiene.

Hallé's grandson, Noël François Odon Guéneau de Mussy (1813-1885), followed him into the field of medicine and made contributions in various areas, including a four-volume work entitled *Clinique médicale.* His name was given to the eponymous "Guéneau de Mussy" point which is used in the diagnosis of diaphragmatic pleurisy. There were several other grandsons and great grandsons bearing the Hallé name who carried on the medical tradition in both medicine and surgery.

Although Hallé's descendants continued the family tradition in medicine, it was his students who continued to make France a leader in the field of public health for most of the nineteenth century. They provided a framework for the future which is still evident in the twenty-first century.

[202] *Nature*, vol. 37, 1936, p. 732.

Bibliography

ABRAHAMS, H.J. "Lavoisier and his contemporaries debate the supply of water for Paris", *The Bulletin of the New York Academy of Medicine*, vol. 57, no. 5, June 1981.

ACKERKNECHT, E.H. *Medicine at the Paris Hospital*: *1794-1848*, Baltimore, The Johns Hopkins Press, 1967.

ACKERKNECHT, E.H. *A Short History of Medicine*, Baltimore, The Johns Hopkins Press, 1982.

ACKERKNECHT, E.H. "Hygiene in France, 1815-1848", *Bulletin of the History of Medicine*, vol. XXII, no. 2, 1948.

ADAMS, T.M. *Bureaucrats and Beggars*. New York, Oxford, Oxford University Press, 1990.

AULARD, F.-A. (ed.) *Recueil des actes du Comité de salut public: avec la correspondance officielle des représentants en mission et le registre du Conseil exécutif provisoire*, Paris, Imprimerie nationale, 1893.

BARRETT, F.A. "The role of French-language contributors to the development of medical geography", *Social Science and Medicine*, vol. 55, 1, 2002, pp. 155-165.

BENOISTON DE CHATEAUNEUF, L.F. *Recherches sur les consommations de tout genre de la ville de Paris en 1817*, Paris, Martinet 1820.

BERNARD, J., LEMAIRE, J.-F., LARCAN, A. *L'Acte de la naissance de la médecine moderne*, Le Plessis-Robinson, 1995.

BLAIR, L. (translator) *The Essential Rousseau*, New York, The New American Library, 1974.

BLOCH, J. *Rousseauism and education in eighteenth-century France*, Oxford, Voltaire Foundation, 1995.

BLUNT, A. Review of *Jean Jouvenet et la peinture d'histoire à Paris* by Antoine Schipper, in *Burlington Magazine*, vol. 119, May, 1977, no. 890.

BOURGUIN, F. *Tables Générales de la Législation sanitaire française 1790-1955*, Paris, Imprimerie Nationale, 1957.

BROCKLISS, L., and JONES, C.L. *The Medical World of Early Modern France*, Oxford, Clarendon Press, 1997.

BROMEHEAD, C.E.N. "The Early History of Water-Supply", *The Geographical Journal*, vol. 99, no. 4, April 1942.

BYNUM, W.F. *Science and the Practice of Medicine in the Nineteenth Century*, Cambridge, Cambridge University Press, 1994.

CIPOLLA, C. *Faith, Reason and the Plague in Seventeenth Century Tuscany*, W.W. Norton & Company, New York, London, 1979

COLEMAN, W. "Health and Hygiene in the *Encyclopédie*: A Medical Doctrine for the Bourgeoisie", *Journal of the History of Medicine and Allied Sciences*, vol. 29, no. 4, October 1974.

COLEMAN, W. *Death is a Social Disease*, Wisconsin, Wisconsin University Press, 1982.

CORBIN, A. *The Foul and the Fragrant*, London, Picador, 1994.

CROSLAND, M. *Scientific Institutions and Practice in France and Britain, c.1700-1870*, Aldershot, Aldershot Publishing, 2007.

CROSLAND, M. *Science under control*, Cambridge, Cambridge University Press, 1992.

CUVIER, G. *Recueil des éloges historiques lus dans séances publiques de l'Institut de France*, Paris, Firmin-Didot frères, fils, 1861.

DARCY, H., BROWN, G.O., GARBRECHT, J., HAGER, W.H. *Henry P.G. Darcy and Other Pioneers in Hydraulics: Contributions in Celebration of the 200th Birthday of Henry Philibert Gaspard Darcy*, Philadelphia, ASCE Publications, 2003.

DECHAMBRE, A., LEREBOULET, L. *Dictionnnaire encyclopédique des sciences médicales*, 16 vols, Paris, 1881-1889.

DELAUNAY, P. *Le Monde médical parisien au dix-huitième siècle*, Paris, J Rousset, 1906.

DES GENETTES, M. LE BARON *Éloge de M. Hallé, prononcé le 18 novembre 1822 devant la Faculté de médecine de Paris*, Paris, Didot le jeune, 1827.

DUVEEN, D. I. and H. KLICKSTEIN. "Antoine Laurent Lavoisier's Contributions to Medicine and Public Health", *Bulletin of the History of Medicine*, 29, 1955, pp. 164-179.

ESTOURNET, O. *La Famille des Hallé*, Paris, Plon-Nourrit, 1905.

EVERETT, M.A. "Anne-Charles Lorry, the first French dermatologist", *International Journal of Dermatology*, 18, 9, 1979, pp. 762-764.

FAGAN, G.G. *Bathing in Public in the Roman World*, University of Michigan Press, 2002.

FORREST, A. *The French Revolution and the Poor*, New York, St Martin's Press, 1981.

GARCIÁ-BALLESTER, L. *Galen and Galenism*, Aldershot, Ashgate Publishing, 2002.

GELFAND, T. *Professionalizing Modern Medicine: Paris surgeons and medical science and institutions in the eighteenth century*, Westport, Connecticut, Greenwood Press, 1980.

GODECHOT, J.-L. *Les Institutions de la France sous la Revolution et l'Empire*, Paris, Presses Universitaires de France, 1951.

GOSSE, A.-L. *Propositions générales sur les maladies causées par l'exercice des professions*, Paris, 1816.

GRANT, M. *Galen on Food and Diet*, London and New York, Routledge, 2000.

GREEN, R.M. *Galen's Hygiene (De Sanitate Tuenda),* Springfield, Illinois, Charles C. Thomas Publisher, 1951.

HAHN, R. *The Anatomy of a Scientific Institution*, Berkeley, Los Angeles, London, University of California Press, 1971.

HAIGH, E. "Xavier Bichat and the Medical Theory of the Eighteenth Century", *Medical History*, Supplement no. 4, London, Wellcome Institute for the History of Medicine, 1984.

HALES, S. *Vegetable Statisticks: or An Account of some Statistical Experiments on the Sap in Vegetables: Being an Essay towards a Natural History of Vegetation*, London, W. and J. Innys, 1727.

HALLÉ, J.N.	"Abstème", in *Dictionnaire des Sciences Médicales*, Paris, Panckoucke, 1812, p. 49.
HALLÉ, J.N.	"Exposition du plan d'un traité complet d'hygiène", in Fourcroy, A. (ed.), *La Médecine éclairée par les sciences physiques*, Paris, vol. 4, 1792.
HALLÉ, J.N.	*Recherches sur la nature et les effets du méphitisme des fosses d'aisance, Paris*, 1785.
HALLÉ, J.N. and NYSTEN.	"Hygiène", in *le Dictionnaire des Sciences Médicales*, Paris, 1818.
HANNAWAY, C and LA BERGE, A. (eds)	*Constructing Paris Medicine*, Amsterdam-Atlanta GA, Rodopi, 1998.
HANNAWAY, C.	"From Private Hygiene to Public Health: A Transformation in Western Medicine in the Eighteenth and Nineteenth Centuries", in Ogawa (ed.) *Public Health*, Tokyo, Saikon Publishing Company, 1981, pp. 108-127.
HANNAWAY, C.	*Medicine, Public Welfare and the State in Eighteenth Century France: The Société Royale de Médecine of Paris (1776-1793)*, PhD dissertation, Johns Hopkins University, 1974.
HIPPOCRATES	*On Airs, Waters and Places*, Translated by Francis Adams, Whitefish, Montana, Kessinger Publishing, 2004.
HODGE, A.T.	*Roman Aqueducts and Water Supply*, London, Duckworth, 1992.
HONG, S., CANDELEONE, J.-P., PATTERSON, C.C., BOUTRON, C.F.	"Greenland Ice Evidence of Hemispheric Lead Pollution Two Millennia Ago by Greek and Roman Civilisations", *Science*, vol. 265, 1994, pp. 1841-1843.
HUDSON, J.	*The History of Chemistry*, London, The Macmillan Press, 1992.
JONES, C.	*The Charitable Imperative. Hospitals and Nursing in Ancien Regime and Revolutionary France*, London and New York, Routledge, 1989.
JONES, C.	"Memoirs on Paris Hospitals", *Bulletin of the History of Medicine*, vol. 73, no. 3, Fall 1999, pp. 502-503.
JORDANOVA, L.J.	"Policing Public Health in France 1780-1815", in Ogawa (ed.), *Public Health*, Tokyo, Saikon Publishing Company, 1981, pp. 12-32.
KAWAKITA, Y., SAKAI, S., OTSUKA, Y. (eds)	*History of Hospitals – The Evolution of Health Care Facilities*, Proceedings of the 11th International Symposium on the Comparative History of Medicine – East and West, Tokyo, Japan Printing Company, 1989.
KESSEL, A.	*Air, the Environment and Public Health*, Cambridge, Cambridge University Press, 2006.
LA BERGE, A.	"The Paris Health Council, 1802-1848" *Bulletin of the History of Medicine*, vol. 49, no. 3, Fall 1975, pp. 339-352.
LA BERGE, A.	"The early nineteenth-century French public health movement: the disciplinary development and institutionalisation of *Hygiène Publique*", *Bulletin of the*

	History of Medicine, vol. 58, no. 3, 1984, pp. 363-379.
LAPORTE, D.	*The History of Shit*, Cambridge, Massachusetts, The MIT Press, 2002.
LA ROCHEFOUCAULD-LIANCOURT	Rapport du comité de Mendicité, 1790.
LAROUSSE, P.	*Grand dictionnaire universel du XIX^{e} siècle: français, historique, géographique, mythologique, bibliographique, littéraire, artistique, scientifique, etc.*, Genève, Slatkine, 1982.
LEDÉSERT, P.-J.	*Dissertation sur l'hygiène des femmes enceintes,* Paris, 1818.
LINDEMANN, M.	*Medicine and Society in Early Modern Europe*, Cambridge, Cambridge University Press, 1999.
LORRY, Anne-Charles	*Tractatus de Morbis Cutaneis*, Paris, 1777.
MICHAUD, L.-G.	*Biographie universelle ancienne et moderne*, Paris, 1843.
MITCHELL, H.	"Politics in the service of knowledge: the debate over the administration of medicine and welfare in late eighteenth century France", *Social History*, vol. 6, 1981, pp. 185-207.
MUMFORD, L., TURNER, B.S.	*The Culture of Cities*, London, New York, Routledge, 1997.
NRIAGU, J.O.	*Lead and Lead Poisoning in Antiquity*, New York, John Wiley & Sons, 1983.
NUTTON, V.	*Ancient Medicine*, London, New York, Routledge, 2004.
NUTTON, V. (ed.)	*Medicine at the Courts of Europe 1500-1837*, London, Routledge, 1990.
OBERHELMAN, S.M.	"The diagnostic dream in ancient medical theory and practice", *The Bulletin of the History of Medicine*, vol. 61, Spring 1987, pp. 47-60.
OGAWA, T. (ed.)	*Public Health. Proceedings of the 5th International Symposium on the Comparative History of Medicine – East and West*, Tokyo, Saikon Publishing Company Inc., 1981.
PARENT-DUCHÂTELET, A.J.B.	*De la prostitution dans la ville de Paris, considérée sous le rapport de l'hygiène publique, de la morale et de l'administration: ouvrage appuyé de documens statistiques puisés dans les archives de la Préfecture de police*. Paris, 1836.
PARENT-DUCHÂTELET, A.J.B.	*Essai sur les cloaques ou égouts de la ville de Paris envisagés sous le rapport de l'hygiène publique.* Paris, 1824.
PINARD, VARNIER, HARTMANN, VIDAL and STEINHAL.	*Commentaires de la Faculté de Médecine de Paris*, *1777-1786*, Paris, 1903.
POIRIER, J.-P.	*Lavoisier*, Philadelphia, University of Pennsylvania Press, 1996.
PORTER, D.	*Health, Civilization and the State*, London, Routledge, 1999.
PORTER, D. (ed.)	*The History of Public Health and the Modern State,*

Amsterdam-Atlanta GA, Editions Rodopi, 1994.

PORTER, R. *The History of Medicine: Past, Present and Future*, Uppsala, Skrifter, 1983.

PORTER, R. *The Greatest Benefit to Mankind*, New York and London, W.W. Norton & Company, 1997.

PORTER, R. (ed.) *Medicine in the Enlightenment*, Amsterdam, Rodopi, 1995.

PORTER, R., PORTER, D., and BAKER, R. *The Codification of Medical Morality*, Dordrecht, Boston, Kluwer Academic Publishers, 1993**.**

RAMAZZINI, B *De Morbis Artificum Diatriba,* Modena, 1700.

RAMSEY, M. *Professional and Popular Medicine in France, 1770-1830: the Social World of Medical Practice*, Cambridge & New York, Cambridge University Press, 1988.

RAMSAY, M. "Public Health in France", in D. Porter (ed.), *The History of Public Health and the Modern State*, Amsterdam-Atlanta GA, Editions Rodopi, 1994.

REID, D. *Paris Sewers and Sewermen. Realities and Representations*, Cambridge, Massachusetts, and London, Harvard University Press, 1991.

RISSE, G.B. *Mending Bodies, Saving Souls: A History of Hospitals*, New York and Oxford, Oxford University Press, 1999.

ROSEN, G. *A History of Public Health,* Baltimore and London, The Johns Hopkins University Press, 1993.

RUSNOCK, A. *Vital Accounts: Quantifying Health andPpopulation in Eighteenth-Century England and France*, Cambridge, Cambridge University Press, 2002.

SALZMAN, J. *Thirst: A Short History of Drinking Water, Duke Law School*, Research Paper 92, December 2006, <http://eprints.law.duke.edu/1261/1/17_Yale_J.L._%26_Human._94(2006).pdf >

SMEATON, W.A. *Fourcroy, 1755-1809*, Cambridge, Heffer &Sons, 1962.

SMITH, N. *Man and Water*, London, Charles Scribner's Sons, 1975.

STANDAGE, T. *A History of the World in Six Glasses*, New York, Walker & Co., 2005.

SQUATRITI, P. *Working with Water in Medieval Europe*, Leiden, Brill, 2000.

TEMKIN, O. *Galenism. Rise and Decline of a Medical Philosophy*, Ithaca & London, Cornell University Press, 1973.

TISSOT, S.A. *Oeuvres complètes, Nouvelle édition, publiée par M. P. [Alexandre-Pascal] Tissot, précédée d'un Précis historique sur la vie de l'auteur et accompagnée de notes, par M. J.-N. Hallé...*, 11 vols, Paris, 1809-1813.

VESS, D. "The Collapse and Revival of Medical Education in France: A Consequence of Revolution and War, 1789-1795", *History of Education Quarterly*, vol. 7, no. 1, Spring, 1967, pp. 71-92.

VIGARELLO, G. *Concepts of Cleanliness,* Cambridge, Cambridge University Press, 1988.

VILLERMÉ, L.R. *Des prisons telles qu'elles sont et telles qu'elles devraient être... : par rapport à l'hygiène, à la morale et à la morale* *politique,* Paris, 1820.

VILLERMÉ, L.R. *Tableau de l'état physique et moral des ouvriers employés dans les manufactures de coton, de laine et de soie,* 2 vols, Paris, 1840.

WARREN, C. *Brush with Death. A Social History of Lead Poisoning*, Baltimore, The Johns Hopkins University Press, 2000.

WIKANDER, O. (ed.) *Handbook of Ancient Water Technology*, Leiden, Brill, 2000.

WILK-BROCARD, N. *Une dynastie: les Hallé*, Paris, Arthena, 1995.

YEGÜL, F. *Baths and Bathing in Classical Antiquity*, New York, MIT Press, 1992.