Nightmare in the City of Dreams: Civic Consciousness and Industrialization in Imperial Vienna, 1848-1881

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NIGHTMARE IN THE CITY OF DREAMS: CIVIC CONSCIOUSNESS AND INDUSTRIALIZATION IN IMPERIAL VIENNA, 1848-1881

by

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A thesis submitted to the Graduate College in partial fulfillment of the requirements for the degree of Master of Arts
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Since the onset of the Industrial Revolution, a distinct trend toward urbanization has continually reshaped history and society, yet the development and evolution of urban spaces has been largely overlooked by scholars until recent decades. This is especially true for the cities of the Habsburg Empire, although Vienna provides a good case study of industrialization’s impact on the urban landscape due to its history of rapid population growth, extensive environmental change, and established administrative structures. Although the logistical challenges associated with urban administration, such as importing adequate food, accessing clean water, and disposing of waste in a prompt manner were all present in Vienna long before industrialization began, the rapid growth of industry and population elevated these problems to new heights. This forced city officials to assume greater responsibility for the lives and well-being of their residents. Regardless of whether these initiatives succeeded in their goal, the increased level of government involvement and interest in what was previously considered private spheres of activity was a profound shift in how the government viewed its relationship to its inhabitants and helped create a city in which the municipality was responsible for basic needs like water, waste disposal, sanitation, and health.
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J. Alexander Killion
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INTRODUCTION

Vienna in the nineteenth century existed as a glorious contradiction, a city that boasted such magnificent architecture, broad avenues, and highly developed cultural pursuits that one can see how the city could earn the moniker “the city of dreams” even without Sigmund Freud making it the capital of psychoanalysis. But outside of the palaces and cafés, the cityscape was decidedly less grand. Overcrowded homes created abysmal living conditions, widespread outbreaks of epidemic disease threatened even the well-to-do, inadequate sanitation made the streets an unsavory place and heightened the threat of disease, and significant amounts of industrial pollution transformed the land, the water, and the air around the city. For these reasons, Vienna was more a city of nightmares for many of the poor inhabitants that flocked to the city for work during the Industrial Revolution.

Historically, city life had always been dirty for a number of reasons, but after widespread industrialization in Vienna began after 1848, the problems associated with urban living were exacerbated to a level never before seen. The population in Vienna reached record heights in the latter half of the nineteenth century with no sign of slowing down before the First World War, and subsequent dismantling of the empire led to a massive population shock that the city still has not fully recovered from almost a century later. Until that happened, however, municipal administrators were confronted with an ever-growing population that created new logistical challenges for housing, waste removal, and disease prevention. Compounding these struggles was the newly energized industry sector that was creating record levels of urban pollution that affected everything from the air the inhabitants breathed to the water they drank.
Before the urbanization explosion of the nineteenth century, cities were more than happy to leave such problems to the individual or the family to solve. By the 1870s, however, issues of pollution, overcrowding, and disease were becoming too great to simply ignore and hope that private parties would successfully resolve them. Instead, many observers began to believe that a larger body needed to intervene in these problem areas. While popular consciousness tends to portray the nineteenth century as a time in which the promotion of business and industrialization took precedence over any environmental or health concerns in urban spaces (Friedrich Engels’ *The Condition of the Working Class in England* is perhaps the most famous example of this), the situation in Vienna was not so simple. Environmental and public health initiatives were present almost from the beginning of industrialization in the Austrian capital, and the municipal body struggled against the unrelenting tide of industrial development and population growth to foster an urban landscape that was relatively healthy and sanitary. Not every endeavor undertaken by municipal authorities was successful, and the city often struggled to overcome bureaucratic inertia and problems larger than they could effectively deal with, but it is clear that by the 1870s the municipal government was attempting in earnest to step into what was previously considered the private realm in order to protect the welfare of its inhabitants. At this point the question becomes: What was the government doing that was new, and how did it affect the relationship between city government and city inhabitants?

**Methodology**

I chose to focus my analysis primarily on the decade of the 1870s for several reasons. The first was availability of sources. A limited number of municipal health reports for Vienna were accessible to me, most of which had their focus on the years between 1871 and 1877. These reports proved to be a treasure trove of valuable information on the administration of the city.
Not only did the Municipal Health Authority of Vienna (referred to throughout the rest of the work as the *Stadtfysikat*) conduct numerous physical inspections throughout the city that provide first-hand accounts of the living conditions there, it also included recommendations for future policy initiatives. The *Stadtfysikat* compiled its findings in annual reports starting in 1866 and make up the bulk of primary source material informing this work. Each publication discusses a wide variety of issues and concerns, only a fraction of which can be discussed in a work of this size.

More importantly, the 1870s was a key decade in the city’s development. The 1873 World Exposition brought millions to the city, the opening of the First Mountain Spring Pipeline drastically changed the city’s sanitation system and the population’s access to clean water, numerous outbreaks of epidemic disease threatened tens of thousands of inhabitants, the Great Panic of 1873 that started in Vienna threatened the economic livelihood of the city, the regulation of the Danube River changed the very landscape of Vienna, and the transition from biofuel to coal as the primary energy source allowed industrialization and all of its effects to fully take hold in the city. Each of these developments contributed to an evolution in the relationship between the city and its inhabitants, making the 1870s a key decade for the social, economic, and industrial development of Vienna.

My analysis of Vienna during this time period is largely qualitative in nature, relying on narratives and reports written by the Municipal Health Authority of Vienna during the 1870s, but a quantitative approach does underpin much of my research. This is especially true in chapter 5, in which rates of disease in Vienna and Austria are pulled from primary source records and compared to other countries and cities, particularly in regards to the effectiveness of vaccination. I introduced an element of interdisciplinary investigation to my work by drawing upon scientific
analysis and environmental research for the sections that called for it. Because of this interdisciplinary approach, my thesis incorporates a number of historiographical approaches to Vienna in the nineteenth century. Above all, this work is a study of urban development and public administration, particularly focusing on how the city itself evolved during industrialization and how the city government responded to those changes. In order to give a sense of the lived experiences of the (primarily poor) inhabitants of the city and the environmental changes that altered the soil, the water, and the air, I have included in my analysis elements of social and labor history, as well as environmental science.

**Previous Research**

Much has been made of the environmental transformation of Vienna, particularly from researchers in Vienna’s Institute of Social Ecology at the Alpen-Adria Universität Klagenfurt and University of Natural Resources and Life Sciences. This thesis aims to build upon the tradition of interdisciplinary analysis put forward effectively by researchers such as Sylvia Gierlinger, Severin Hohensinner, Gertrud Haidvogl, Simone Gingrich, and Fridolin Krausmann, whose publications have been invaluable in my examination of Vienna’s environmental history. Much of this work deals largely with the scientific side of Vienna’s environmental transformation or the end effects of industrialization on the environment. I hope that my analysis will shed some light on a largely-undiscussed aspect of Vienna during the industrial period, namely, the evolving relationship between the city government and its inhabitants, especially in regards to the responsibility of the former in providing a quality of life and municipal services for the latter.
I begin my analysis of Vienna not in the 1870s, the period with which most of my
narrative is concerned, but immediately after the Revolution of 1848. By doing so, I can explore
the impact the revolution had on jump-starting the process of industrialization. Rather than delve
into the relationship between the revolution and industrialization, which has been documented
before, I instead use it as an opportunity to examine how Vienna developed economically,
industrially, and demographically in the years between 1848 and 1870. Discussing the
industrialization of Vienna sets the stage for the remaining four chapters, which explores the
impact of that industrialization on the people who lived there.

Chapter 2 is largely concerned with the impact of rapid demographic growth in the city as
a consequence of industrialization and its impact on the availability of quality, affordable
housing for the working class. Rather than simply examining the state of housing in Vienna
during this time, this chapter seeks to determine how city officials viewed the housing problems
facing many inhabitants of Vienna and how they approached potential solutions. Chapter 3
discusses the city’s sanitation system, environmental evolution, and urban metabolism, and
contains a much more explicitly scientific approach than most of the other chapters of my work.
It is impossible to gain a comprehensive understanding of the challenges the city faced in regards
to waste removal without calculating how much waste was produced in the city, and the options
available for removing it. Indeed, how the city approached the problem of waste disposal is a key
part of the chapter.

Whereas chapters 2 and 3 largely concerned the impact of population growth on various
aspects of life in Vienna, chapter 4 discusses the pollution that resulted directly from increasing
industrialization. As a comprehensive look at all of the ways the environment was transformed
through industry would fill volumes, I limited myself to some of the more popular and impactful industries in the city, using a scientific approach to lay a basis of understanding for the chemical and biological mechanisms involved in the pollution and a historical approach to examine how city officials attempted to deal with the increasing levels of pollution in the soil, water, and air. My analysis concludes with chapter 5 by discussing epidemic disease, a problem that is hardly unique to industrial cities, but one that was greatly exacerbated by the conditions that accompanied industrialization. As Viennese officials kept fairly detailed records of disease rates and mortality, a comprehensive study of them all would be impractical in a work of this size. As a result, I limited myself to discussing only the most prominent of epidemic diseases, ones which still made up a large majority of the infections and deaths in the city. Particularly important in this chapter are the initiatives undertaken by the city to prevent disease outbreaks and the disconnect between state-level administration and municipal-level administration in the advocacy and implementation of initiatives such as vaccination.

Each chapter puts forward a specific challenge faced by urban administrators that either originated from or was exacerbated by the process of industrialization. These problems, while key to understanding the lived experience of inhabitants in Vienna and the state of the city as a whole, are not my main point of concern. It is what follows the identification of these issues that concerns me, namely, the efforts undertaken by city officials to make Vienna a healthier, more livable place. It is the examination of these labors that, I hope, elevates this work from a mere report about living conditions in industrialized Vienna to a contribution to our understanding of how the relationship between cities and their inhabitants evolved in Europe during the latter half of the nineteenth century, particularly in regards to how the city viewed its responsibilities to their inhabitants.
CHAPTER I: “SUCH FEVERISH ACTIVITY”:
THE INDUSTRIAL AND ECONOMIC DEVELOPMENT OF VIENNA AFTER THE
REVOLUTION OF 1848

Vienna, capital of the Austrian, and later, Austro-Hungarian Empire, underwent a profound demographic transformation in the nineteenth century, exploding from 270,000 inhabitants in 1800 to over two million in 1910.\(^1\) Population levels within the walled portion of Vienna remained relatively stable throughout the first half of the century, largely due to the limited space available there, but the areas outside of the walls were a different story. The Vorstädte, that is, the suburbs just outside of the city walls, experienced the vast majority of this population growth, with the Leopoldstadt region just north of the city almost doubling in the twenty year period from 1830 to 1850, from 22,631 to 40,563.\(^2\) The Landstraße suburb to the southeast of the city also showed rapid growth during this period, from 25,119 to 39,851.\(^3\) This population growth would fundamentally transform the urban landscape of the city in both economic and environmental ways.

Most of this growth was due to migration from the disparate regions of the empire, much of which occurred between 1810 and 1819.\(^4\) As a result of this migration, the native-born population of Vienna amounted to only 43.8 percent of the city by 1856, and it shrank further to 38.5 by 1880.\(^5\) Although they were not counted as part of the population, large numbers of wandering tradesmen looking for work also arrived in Vienna each day, most of whom were not

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2 Andreas Weigl, Demographic Change and Modernization in Vienna, 1700 to 1999 (2003), distributed by GESIS Data Archive, http://dx.doi.org/10.4232/1.8159.
3 Ibid.
4 Ibid.
5 Ibid.
from the city. In fact, in the 1830s and 1840s, an estimated 140,000 to 160,000 arrived in the city each year.\textsuperscript{6}

From 1852 to 1855, over half of the journeymen cabinetmakers arriving in Vienna originated from Bohemia and Moravia, with a similar figure being found for tailors in 1837.\textsuperscript{7} For permanent migrants, the situation was not much different. Figure 1.1 shows that a significant portion of the migrants to Vienna in the latter half of the nineteenth century came from Czech lands and the German-speaking Sudetenland, although migrants came from all across the empire. Indeed, by 1900, more than a quarter of the inhabitants of Vienna originated from Bohemia, Moravia, or Silesia, and another ten percent came from Hungary, Germany, and Italy.\textsuperscript{8}

Figure 1.1: Immigration to Vienna in the Second Half of the Nineteenth Century\textsuperscript{9}

\textsuperscript{6} David Siddle, \textit{Migration, Mobility, and Modernization} (Liverpool: Liverpool University Press, 1998), 169.
\textsuperscript{7} Ibid., 172.
\textsuperscript{8} Fassman and Münz, “Between Melting Pot and Ethnic Fragmentation,” 166.
This rapid population growth had many far-reaching effects on Viennese social and economic conditions and also produced strong social unrest among many in the lower class of Vienna. Employees struggled with work days that were often between twelve and fourteen hours long, as well as low pay and rising costs of living. Weekly wages for women and children would barely cover the cost of food, which was significant considering that these two groups comprised 60 percent of the workforce of the cotton and paper mills in Lower Austria. Many other problems exacerbated the condition of the lower class in Vienna in the years leading up to the revolutions in 1848. A lack of new housing construction in conjunction with the massive increase in population led to drastically worsening living conditions, while a crash in the Vienna Stock Exchange in 1848 resulted in a large credit crunch and soaring unemployment. Further compounding these problems was the European Potato Famine during the mid-1840s, which caused massive starvation throughout much of the continent.

*Neo-Absolutism in Post-1848 Vienna*

This social unrest was a key (although by no means the only) aspect of the popular uprisings that broke out in Vienna in 1848. The first disturbances were felt in March, when student-led revolutionaries, inspired by the successful revolution in Paris, marched to demand major changes: the resignation of Prince Clemens von Metternich, State Chancellor of the Austrian Empire; the formation of a civil guard; and the creation of a constitution. Revolutionary activity continued throughout much of 1848 until imperial forces established decisive control over the city.

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12 Ibid., 80.
Although imperial forces ostensibly defeated the revolutionaries in the Vienna Uprising, the events of 1848 were instrumental in facilitating Vienna’s shift from a pre-industrial city to an industrial one. Much of this shift took place following the Revolution of 1848, during the period known as neo-absolutism. Under the new emperor, Franz Joseph I, the Habsburg Monarchy undertook a series of policies to re-establish imperial control over a diverse and discordant population and establish a new unitary state. This period largely began with the creation of the March Constitution of 1849 and ended ten years later with the defeat of the Austrian military in the Austro-Sardinian War and the resignation of Minister of the Interior Baron Alexander von Bach in 1859.\textsuperscript{13}

The neo-absolutist period was characterized by an increasingly centralized ministerial government and a strong push for social management and economic development. This system was envisioned as a means to modernize the industrial resources of the monarchy and enhance the stability of the state.\textsuperscript{14} What this meant in practice was the creation of a unitary customs zone throughout the empire, the abolition of feudal privileges, and the definitive end to serfdom in the Habsburg realm. The “absolutism” part of neo-absolutism was evidenced by the extremely broad powers accorded to the monarch within the empire and the importance that was placed on the crown.\textsuperscript{15} But despite the characterization of neo-absolutism as a push toward empire-wide centralization, at the local level it actually allowed for increased levels of autonomy. Count Stadion, Interior Minister and drafter of the March Constitution which inaugurated the neo-absolutist period, strongly advocated increasing autonomy at the local level. He believed that by

\textsuperscript{15} Deák, \textit{From Habsburg Neo-Absolutism to the Compromise}, 30-31.
doing so, the imperial government could reduce challenges to the political order at the provincial level. The reasoning went that if a single, autonomous city were to engage in rebellion, the imperial army would be able to repress it fairly quickly. If an entire province rose up in arms, however, the military would have a much more difficult time re-establishing control.\textsuperscript{16}

In Vienna, the Provisional Municipal Ordinance of 1850 was part of this push toward local autonomy. This reform established the very beginning of self-rule for the city, as opposed to direct rule by the imperial government, and allowed the city to develop its first real voting system. The ordinance established a concrete sense of municipal independence after the crushing of the Vienna Uprising, as it was largely created by the city council itself as opposed to the imperial government or the emperor. Additionally, the ordinance facilitated the development of a voting system based mostly on the bourgeoisie. After 1850, and even after some later reforms, most voters were wealthy artisans or shopkeepers. This situation would last until the very end of the empire in 1918.\textsuperscript{17}

In addition to a changing electoral landscape, neo-absolutism contributed to a number of economic and industrial reforms that were characteristic of the economic liberalism that took hold in the post-1848 Austria. A prime example of this is the Industrial Code (\textit{Gewerbeordnung}) of 1859. Promulgated by the emperor on December 20, 1859, the law came into effect on May 1 of the following year and worked to significantly expand “the circle of free trade and commercial activities.”\textsuperscript{18} It accomplished this primarily by abolishing the existing guild regulations throughout most of the monarchy, not including Venice and the military frontier. What this

\textsuperscript{16} Ibid., 32-33.
\textsuperscript{17} Boyer, \textit{Political Radicalism in Late Imperial Vienna}, 16-17.
meant in effect was that anyone with the money and desire could establish a business in any craft, with a few exceptions such as law or medicine, and entrepreneurs could now work within a (relatively) free labor market.\textsuperscript{19}

Starting in 1851, the government also undertook a two-pronged strategy to stimulate trade and commerce in the empire. The first strategy involved unifying the internal market of the Habsburg lands, primarily through the abolition of internal tariffs between the Austrian and Hungarian realms of the Empire.\textsuperscript{20} While the creation of a single customs union would facilitate internal trade, it was the development of railways and steamship navigation that would connect the disparate economic realms of the monarchy.\textsuperscript{21} To that end, the Habsburg administration invested a large number of resources toward the development of transportation infrastructure resulting in the creation of a railway network that spanned 2,160 kilometers by 1866.\textsuperscript{22} The second strategy focused on the external economy and foreign trade. Starting in February of 1852, the government implemented changes that reduced maximum duties and the number of tariff articles, as well as creating a list of duty-free items. External trade was further stimulated in the mid-1860s by commerce treaties with England and France which introduced the concept of most favored nation to Austrian trade policy.\textsuperscript{23} The neo-absolutist period was extremely important in shaping the political and economic system of the empire. Policies during this period worked to move the economic life of the empire in the direction of freer market conditions, which contributed to the rapid industrialization of the city in the post-1848 period.\textsuperscript{24}

\textsuperscript{19} Boyer, \textit{Political Radicalism in Late Imperial Vienna}, 55.
\textsuperscript{21} Deák, \textit{From Habsburg Neo-Absolutism to the Compromise}, 127-128.
\textsuperscript{22} Ibid., 128.
\textsuperscript{23} Ibid., 127.
\textsuperscript{24} Ibid., 42.
In addition to rapid industrial development, the period from 1848 to 1873, oftentimes referred to as the Gründerzeit, or Founders’ Period, saw increasing financial activity on the Vienna Stock Exchange. Even the public health reports of the time mention “such feverish activity of the stock market” that drew so many people to the city, contributing to the population growth. After a period of economic optimism and over-extension, the financial situation in Vienna took a turn for the worse, and by the latter half of 1871, the markets rapidly wavered between bullish optimism and bearish pessimism. Despite this, those who worked in the financial sector saw each market rebound as stronger than the one before, and the fact that shareholders in the National Bank could expect a return on investment of nearly 10 percent in 1871 (an extremely high rate in such a short period of time) certainly helped promote an optimistic view of the market. In mid-1873 the bubble burst due to a variety of factors, including significant over-production and a glut of new companies (including 115 new banking institutions founded between 1868 and 1873). Despite being the epicenter of what would become known as the Panic of 1873, the city continued to grow in leaps and bounds, creating new opportunities and new challenges for administrators.

A Shift in Civic Consciousness

One of the primary administrative challenges of the time was how to deal with problems of public health. Coordinated medical service had existed in one form or another since at least 1501, when medical faculty from the University of Vienna were organized to supervise the

27 Ibid., 106.
medical services of the city as well as provide free medical treatment for the poor.\textsuperscript{28} Health and sanitation still remained a largely private affair during this time, and there is little indication that the civic body maintained a proactive and organized response to such problems. The organization and structure of the city’s medical system evolved over the proceeding centuries until two key legislative initiatives transformed both the city’s assumption of its responsibility for matters of public health and its capacity to work toward improving that public health.

The larger piece of legislation was the Imperial Health Act of 1870 (\textit{Reichssanitätsgesetz}). Passed by the Austrian Parliament, officially known as the Imperial Council, this law was significant in that it explicitly established the management of medical service and medical affairs as the responsibility of the state administration for the first time. In particular, the state administration assumed responsibility for: the administration of laws governing medical practices; the supervision of all hospitals, asylums, maternity hospitals, foundling and nursing institutions, infirmaries, spas, and vaccination institutions, as well as the authorization of such institutions; the administration of laws on infectious diseases, epidemics, and quarantines; the transportation of drugs and poisons; the management of the vaccination system; the control and monitoring of the entire pharmacy system; the arrangement and execution of autopsies; the administration of laws on funerals, funeral places, exhumations, and corpse transportation; and the supervision of knackeries and the like.\textsuperscript{29}

These were the responsibilities that the state government assumed, while municipal governments were put in charge of other aspects of the public health; either directly or in

\textsuperscript{28} Felix Czeike, \textit{Historisches Lexikon Wien} (Wien: Kremayr und Scheriau, 2004), 5; 297.
coordination with the Austrian Health Authority (Gesundheitspolizei), which operated as an advisory body consisting of at least six members, appointed for three years by the government. The Gesundheitspolizei arose from a recognition of the need for technical expertise, as the government acknowledged that

given the multiple technical elements which are important for the decisions and orders of the sanitary authorities, these bodies are added to by special medical professional training. These bodies have the character of councils, not of authorities. That is, they are intended to advise the political authorities, without the ability to intervene as an authority, except on the basis of specific authorization by those in charge. ³⁰

In municipalities across the Austrian Empire, the Gesundheitspolizei were responsible for various matters of public health, including: the administration of sanitary regulations concerning streets, alleys, corridors, plazas, public meeting places, homes, canals and cesspools, flowing and standing water, food and drinking water, and public bathing establishments; the provision for the availability of the necessary treatment of diseases and childbirth; the establishment, maintenance, and monitoring of morgues and burial grounds; and the surveillance of livestock markets and cattle drives. ³¹

In contrast, the municipalities themselves assumed responsibility for a number of other specific aspects of public health. This included implementation of provisions for the prevention of infectious diseases and their proliferation; implementation of sanitary authority regulations and rules on burials; autopsies; cooperation with all of the political authorities in the municipality for Sanitätpolizei-related inspections and commissions that are to be carried out, especially with public vaccinations, exhumations and autopsies, and provisions for the prevention and

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eradication of animal-based diseases; direct supervision of private hospitals and maternity hospitals located in the municipality by the Sanitätspolizei; direct supervision of knackeries; and the periodic reimbursement of medical reports to the political authorities.\textsuperscript{32}

As the Reichssanitätsgesetz of 1870 was passed by the Imperial Council, it applied to all of the municipalities in the Austrian portion of the empire, not only Vienna. Domestic affairs in the Hungarian portion of the empire had been devolved in the Austro-Hungarian compromise of 1867. Nevertheless, Vienna’s status as one of the most populous cities in Europe meant that it faced a number of unique challenges that smaller municipalities in the empire perhaps did not. The Municipal Health Authority (Stadtfysikat) of Vienna played one of the most significant roles in attempting to overcome those challenges, growing from a small organization that lacked even a dedicated office space to an active institution committed to improving the public health and welfare of residents in the city.

This growth was largely made possible by the other legislative initiative that transformed the city’s capacity to work toward improving the public health. In 1864, the city carried out a reorganization of the Stadtfysikat, during which time an office was constructed and two physicians, Dr. Franz Innhauser and Dr. Eduard Nusser were hired to head it. The two heads of the Stadtfysikat were equal in rank but they divided up the duties and responsibilities of the office between them, one taking charge of chemical and hygienic work, while the other assumed responsibility for more practical medical concerns such as examinations.\textsuperscript{33} Through the Stadtfysikat office, the physicians were given the authority to conduct sanitary and chemical

\textsuperscript{32} Ibid.
inspections throughout the city, not only in public spaces like plazas or businesses, but in private homes as well.

**Conclusion**

Shortly after the Revolution of 1848, the Austrian government undertook efforts to modernize the empire, jump-starting industrialization by stimulating commerce and investing in infrastructure. As the primary economic center of the Austrian Empire, Vienna was perfectly situated to become the prime industrial center of the monarchy as well. The subsequent industrial transformation attracted droves of workers to the city, drastically increasing the population of Vienna at a time when the government of the city was evolving. In the years after Vienna was granted self-rule in 1850, a number of legislative initiatives transformed the duties and responsibilities of the city government, making it clear that it was responsible for the health and well-being of the residents. The Imperial Health Act of 1870 and the reorganization of the *Stadtfysikat* in particular cleared the way for the city to assume new responsibilities in the field of health and sanitation, and is key to understanding many of the developments of the 1870s in terms of housing, sanitation, pollution abatement, and disease prevention.
Both the process of industrialization and the massive growth in population that accompanied it greatly impacted the quality and quantity of the housing available for the population in the city. In terms of quality, the environmental pollution and biological waste that was generated in ever-increasing quantities could often be found impacting the living conditions of the city’s inhabitants, even (sometimes especially) in their homes. Industrialization had a relatively small impact on the number of dwellings available in Vienna, so the population growth that went along with it resulted in more people than there were places to house them. This resulted in all manner of unsanitary living conditions due to overcrowding and the creation of makeshift dwellings, which was documented extensively by the city’s Municipal Health Authority.

The Stadtphysikat was highly aware of the problems with housing in the city and their effects on quality of life for residents. Indeed, one of the very first sections of their annual report deals with housing conditions. In order to obtain the information necessary to make their reports and evaluate the habitability of dwellings, the Municipal Health Authority undertook direct inspections of apartments and living spaces throughout the city. These inspections were conducted by one of two parties, either a medical supervisor or the Imperial Police Department. In the latter case the police undertook the inspections directly, but the Municipal Health Authority would need to inform the Vienna City Council about the location if it wished to undertake an inspection.34

In their investigations, the *Stadtfysikat* used three separate questions to determine the acceptability of an apartment from a medical and sanitary standpoint. First, inspectors looked at the proportion of habitable rooms in relation to the number of rooms needed to house everyone living there. Second, they examined the quality of the residence. And finally, they determined the nature in which the inhabitants used the apartment.\(^{35}\) Most of the dwellings that the city determined unfit for habitation fell under one (or more) of a number of classifications. The most commonly-cited classifications included overcrowding, cellar apartments, excessive moisture, loft apartments, and a lack of light and air. The city recorded the number of unfit dwellings found each year and broke them down by category as well as by district. Figures 2.1 through 2.4 on the following page show a geographic recreation of the number of unfit dwellings reported for each district between 1872 and 1877. The districts numbered one through nine made up the city during this time, with district one corresponding to the old inner city of Vienna. The lightly-shaded area corresponds to the districts later incorporated into the city.

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\(^{35}\) Inhauser and Nusser, *Jahres Bericht im Jahre 1872*, 2.
Figure 2.1: Unfit Dwellings Reported in 1872 by District\textsuperscript{36}

Figure 2.2: Unfit Dwellings Reported in 1873 by District\textsuperscript{37}

\textsuperscript{36} Map created by author. Source: Ibid., 9.

Figure 2.3: Unfit Dwellings Reported in 1875 by District

Figure 2.4: Unfit Dwellings Reported in 1877 by District


In 1871, there were 150 homes reported with the *Stadtfysikat* in which the inhabitants were residing in unhealthy living conditions. A full third of these reported homes were classified as “very damp,” which was just the beginning for the defects present in many apartments. Thirty-seven apartments were located in basements, which led to further drainage and ventilation issues.\(^{40}\) For instance, a caretaker’s home in the Ninth District of the city (modern Alsergrund, to the immediate northwest of the city center) was inundated with rainwater because the poor condition of soil let it seep into the apartment, and two other apartments were faced with sewage leaking in from the higher waste channels of the neighboring house.\(^{41}\)

The period between 1871 and 1872 saw a drastic increase in the number of residences reported to the city as being unhealthy to live in. Whereas 1871 had only seen 150 incidences, this had jumped to 560 a year later, an increase of almost 300 percent.\(^{42}\) Of these, 105 were basement apartments, 69 were loft apartments, 166 were damp, 73 were overcrowded, 87 were only 6 feet high, 17 were basement apartments, and 43 were marked merely as “bad.”\(^{43}\)\[^{44}\] [the unit of measurement in use in Vienna referred to as a foot is equal to approximately 12.44 modern inches.]\(^{44}\) The single greatest concentration of reported homes in 1872 was located in the inner city of Vienna, with roughly 28 percent of the cases originating there. The Third District contained another 18 percent of the cases, and the Second District saw roughly 12 percent. The remaining cases were divided fairly evenly between the remaining six districts of the city.


\(^{41}\) Ibid., 4.


\(^{43}\) Ibid.

By 1873, the living conditions in Vienna had further deteriorated, and 855 apartments were reported as being objectionable. The causes behind dwellings being reported as unfit for habitation were as varied as their geographic distribution throughout the city. Of the 855 apartments, 152 were reported for moisture and dampness, 258 for overcrowding, 109 due to a lack of light and air as well as insufficient height, 157 for being basement apartments, 61 for being further subdivided into sections four to six feet in height, 86 for being loft apartments, as well as 32 highly wet basement workshops which were poorly lit and without air. The city took note of a few particularly bad examples, including apartments located in places such as a former goose shed, a wooden merchant hut, storerooms without windows, greenhouses, abandoned stables, abandoned goat sheds, wooden shanties, a portion of a coal warehouse, and a seven-foot-high basement room with no windows, accessible only through a cellar door.45

The trend of increasing unfit dwellings continued in 1875, breaking one thousand reported cases for the first time during this period. Excessive moisture in dwellings was by far the largest category of unsanitary conditions that the Stadtfysikat found, as it consisted of 535 of the 1,006 cases listed. Overcrowding was a distant second, with 131 cases, nearly half of which were concentrated in the Third District alone. Insufficient access to light was the next-highest category, with 94 cases, and the remaining 246 were split between basement apartments, loft apartments, subdivisions, and “other.”46 One particularly unsavory case reported by the Stadtfysikat was a stable in which forty people slept on straw, as well as thirteen people who slept in a stall which was still used to quarter horses. The report notes that air could only enter

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45 Innhauser and Nusser, Jahres Bericht im Jahre 1873, 2.
46 Innhauser and Husser, Jahres Bericht im Jahre 1875, 3.
the building when the door was opened, which would have undoubtedly led to a particularly
unsavory and unhealthy living space.47

By 1877, the number of cases reported by the Stadtfysikat reached its peak during the
period, at 1,113. Once again, excessive moisture was cause behind the overwhelming majority, at
744. In addition to the number of problems caused by excessive moisture increasing from 1875,
the share of them as part of the whole also increased, from approximately 53 percent in 1875 to
almost 69 percent in 1877. Insufficient access to light was the second-highest category, with 116
cases, and overcrowding was third with 83. Another 50 were split equally between basement
apartments and the “other” category, and the remaining were divided fairly equally between
apartment subdivisions and loft dwellings.

For the most part, residences such as these were inhabited by people like food dealers and
home caretakers, indicating a population that was near the bottom of the socioeconomic
spectrum.48 Even for those assistants and servants whose lodgings were the responsibility of their
employer, the situation was not much better. Singled out in a report by the Stadtfysikat as being
particularly egregious in the treatment of their assistants were the bakers, shoemakers,
inkeepers, and coffee boilers. Beds were sometimes stacked two or three high, and often in the
unhealthiest places. Numerous innkeepers and coffee brewers housed their assistants in dull
storage locations with very little light or air, and some bakers housed theirs in the bakeries
(which were often underground), with only a wooden partition to divide the living quarters and
the working quarters.49

48 Innhauser and Nusser, Jahres Bericht im Jahre 1871, 4.
49 Ibid., 7.
Although the issue of homelessness and overcrowding had its origin in Vienna prior to the advent of widespread industrialization, the problem was exacerbated by the flood of people moving to the city in the latter half of the nineteenth century. Housing construction in the inner city of Vienna was constrained by the walls surrounding it, but the suburbs located outside of the walls did not do much better in terms of housing construction. Indeed, although the population of the city increased by almost 50 percent between 1815 and 1848, there was only an 11 percent increase in housing. The natural consequence of fitting more people into what essentially remained the same space was an acute housing shortage and dwellings that quickly became grossly overcrowded.

What the inspections by the city found were often condemned with language that was tempered only by virtue of being an official governmental report. Nevertheless, it is fairly evident to see in the descriptions of the living conditions that the inspectors were not simply passive observers. In numerous reports, people are described as being “crammed” into spaces much too small for the number of people there, such as the report in 1872 that found ten to twelve people in a space with enough air for three, or another in 1873 where people were found crammed into attics and basements. This demonstrates that Innhauser and Nusser clearly found housing conditions in Vienna unacceptable.

It was not just the health of the individual that suffered in living conditions such as these, however. As many of the inhabitants of these damp and overcrowded apartments were poor laborers, the city was consistently risking losing large portions of the workforce to disease and epidemic. This was the case in the Danube River regulation project, which saw many of its

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50 Hahn, *The 1848 Revolutions in German Speaking Europe*, 78.
workers contracting typhoid and being forced into the hospital. An investigation of the worker accommodations painted a particularly poor sight:

In a shack which contained hardly enough space for six people, forty were crammed together, two of which were sick with typhoid. On the floor of this shack alone there were twelve beds. In another wooden shack covered on the outside with earth and provided with only a small, permanently closed window, there were thirteen people. There was no trace of any lavatories, and cooking had to be done with turbid water from dirty wells; otherwise no wells were available. Also several mud huts were discovered, hardly visible to onlookers, attached to the embankment of the newly-filled dam. These consisted of planks and posts, converging upwards at an acute angle, and externally covered with earth. Entry could only be achieved from a crouching position, and each of these hovels only received light and air through the one foot [12.44 inches] wide entrance. Given these nauseating conditions and the obligation of the Danube regulation enterprise to provide suitable accommodation that meets sanitary requirements for their workers, they were instructed to rebuild shacks and to provide them with wells, toilets and an infirmary to fight against the dangerous consequences in the event of a possible epidemic.  

The Stadtfysikat recognized that the overcrowded nature of the city meant that workers who came to Vienna could easily be exploited by property owners who paid no mind to even basic hygienic measures, exacerbating problems of disease and poor health. Indeed, many workers ended up lodging in attics, stables, cellars, and sheds, among many other places. Despite this wide variety in the type and location of the dwellings, one commonality between many of them was that they suffered from excessive moisture. In fact, of the categories used by the Stadtfysikat to qualify a residence as being essentially unfit for habitation, excessive moisture was one of the largest. In the years between 1872 and 1877, this classification accounted for an average of 42 percent of all dwellings cited, from a low of 18 in 1873 to 67 in 1877. The

53 Johann Friedrich Krüger, Vollständiges Handbuch der Münzen, Masse, und Gewichte aller Länder der Erde (Quedlinburg: G. Basse, 1830), 103.
54 Innhauser and Nusser, Jahres Bericht im Jahre 1871, 6.
55 Innhauser and Nusser, Jahres Bericht im Jahre 1872, 4.
56 Innhauser and Nusser, Jahres Bericht im Jahre 1873, 2.
57 Innhauser and Nusser, Jahres Bericht im Jahre 1877, 3.
presence of excessive moisture in a dwelling can have significant impacts on both the quality of
the residence and the health of the inhabitants living there. Indoor environments that are
sufficiently damp create ideal conditions for mold to thrive, even more so in dwellings without
access to light and fresh air such as those in basements. There are a number of adverse impacts
that indoor mold growth has on those exposed for long periods of time, including a statistically
significant relationship between mold growth and respiratory infections such as pneumonia and
chronic bronchitis.\(^{58}\) Medical scientists have also found varying levels of evidence suggesting an
association between moldy living environments and negative health outcomes such as lower
respiratory illnesses in otherwise-healthy children, pneumonitis in susceptible persons, and more
general symptoms such as wheezing and coughing.\(^{59}\)

Obtaining respiratory infection from mold growth was not the only biological hazard in
many of these excessively damp dwellings. In 1875, the Stadtfysikat reported finding an
apartment in the Fifth District with walls so wet that the straw mattresses had to be situated three
feet away from them, yet they were still disintegrating and rotten.\(^{60}\) Another apartment was
found to be “so wet that even the straw mattresses standing two feet away from the walls were
covered in mold and rotting.”\(^{61}\) Like excessive moisture, decomposing biological material
provides an ideal environment for the growth of bacteria and fungus. One particular species of
fungi that can cause health problems is \textit{Aspergillus fumigatus}, which thrives in residences
exemplified by the housing situation in Vienna. Exposure to this type of fungus can lead to a


\(^{60}\) Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1875}, 6.

\(^{61}\) Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1871}, 3.
disease known as Aspergillosis in individuals who have weakened immune systems, such as those who live in small, dark, damp apartments with dozens of other (possibly ill) individuals.\textsuperscript{62}

Even efforts to deal with the problem of wet apartments could make matters worse. One report indicated that the police department was aware of city magistrates having been asphyxiated trying to heat up wet apartments through the use of burning coal or coke. Even warming apartments in cold weather could lead to death, which led to the city government to insist upon certain precautions when drying or warming apartments. Among these measures were to make sure that windows and doors were open to allow the gases to dissipate, and to make sure to spend as little time as possible indoors while the coal was burning. It is not clear if these precautions were enforced in any way, but the fact that they needed to be issued showed the prevalence of the problem.\textsuperscript{63}

It is no coincidence that many of the problems examined in these reports were the very same issues that Friedrich Engels detailed in his seminal work, \textit{The Conditions of the Working Class in England}. Indeed, many of the descriptions of the living conditions of workers in Vienna are mirror images of the lives recounted by Engels in places such as Manchester and Liverpool, indicating that what occurred in Vienna during industrialization was not a unique development. However, as no two cities are identical, many solutions put forward by administrators had to be tailored toward the unique circumstances of Vienna. It is to these attempts to deal with the worst aspects of industrialization on the conditions of housing that we now turn.

\textsuperscript{63} Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1875}, 31-32.
Municipal Solutions

Despite the magnitude of the problem facing the city, there were a number of strategies which officials could use to mitigate its impact. For instance, evictions were a very common method for the city to tackle the widespread problem of people inhabiting unlivable spaces, with numerous instances cases being referred to by the Stadttfysikat. Rather than a centralized, autocratic decision by the government to kick families out of their homes, however, it appeared to be a bureaucratic process that allowed for individuals to appeal the decision to evict. For instance, in 1871 the city noted that a homeowner had requested permission to continue using his basement apartment, which was denied because it was not only poorly lit and poorly ventilated, but also extremely wet. 64

Indeed, despite the city authorities taking clear action to solve the problem of overcrowding, the sheer number of people living in overcrowded apartments in Vienna meant they were limited in what they could accomplish. In fact, one home in the Third District was inhabited by sixteen people, and not only did the city take action against them to reduce the number of sub-tenants, but it did so five times, with no apparent long-term success. The city authorities were under no illusions as to their effectiveness, writing in 1872 that

a large portion of the activities of the health authority was assisting those affected by the unsanitary conditions. . . It cannot be denied that the force of circumstances made it impossible to achieve the desired purpose in a more preferable manner, but it also cannot be denied that. . . a palpable gap in the legal arrangements manifested itself. 65

Despite this clear handicap, the city kept working to make sure people were not living in substandard housing. After the impromptu housing projects put together on the banks of the

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64 Innhauser and Nusser, Jahres Bericht im Jahre 1871, 5.
65 Ibid., 2.
Danube were brought to the attention of the authorities, the contractor of the Danube regulation project was commissioned by the city to demolish all of the barracks for workers who had completed their task and made it clear that the barracks were only for workers, not their families, who were presumably expected to secure their own housing. By 1877, the city had succeeded in removing all of the existing worker huts around the area of the project, such as the one reported in 1871 that contained forty people. As the major river regulation project had been completed by 1875, it is likely that many of the workers who labored on building the new river decided to simply stay in the huts they had resided in throughout the project. The report of the city makes no mention, however, of where the inhabitants of those removed huts moved to, potentially exacerbating the problem of homelessness or overcrowding.66

The city did not just evict individuals or families living in unhealthy apartments, and leave it at that, however, at least in some cases. The 1873 Stadtfysikat report makes reference to evicting residents from unsanitary dwellings, working to reduce overcrowding, and also mandating the draining of wet apartments. The authors also write that it was not uncommon for these recommendations to only be carried out after the imposition of significant fines. 67 When evaluating which tools the city could use to encourage or discourage certain behaviors, evictions appeared to be levied most often toward tenants living in squalid conditions. For homeowners, however, their most common punishment was a monetary fine, often applied to persuade them to make some necessary changes or upgrades to their residences. For instance, in 1872, the Stadtfysikat reported that twenty-nine homes were required to repair safety-related problems with

66 Innhauser and Nusser, Jahres Bericht im Jahre 1877, 5.
67 Innhauser and Nusser, Jahres Bericht im Jahre 1873, 3.
their staircases, and that one home owner on Mariahilferstraße in the Ninth District only repaired the broken stairs strung together by wire after being fined twenty-five gulden.  

This was a significant amount of money for a typical working class individual in the mid-nineteenth century who was likely already struggling to afford the basic necessities of life. For reference, the Vienna Chamber of Commerce estimated in 1869 that a family of machinery workers in Vienna required approximately 1,200 krone annually for their upkeep, while modern estimates place the need at closer to 958. That same family could be expected to spend over half of their wages (54.9 percent) on food and sustenance, mostly cereals. Another 20.1 percent would be set aside for housing, with the remaining 25 percent split between clothing, fuel, and cleaning & personal hygiene. From this approximation of income and expenditures, it can be seen that almost the entirely of a family’s budget was already accounted for, with precious little room for unexpected costs like fines. The city’s use of fines did not account for a mere slap on the wrist, but was intended as a significant deterrent to behavior it deemed detrimental to the public health and welfare.

Homeowners and residents were not the only ones who had to worry about being fined by the city. Businesses of all kinds were often subjected to inspection by officials and were often the subject of monetary fines for sanitary transgressions. In the Stadtphysikat report of 1872 the authors recorded a case that they described as “remarkable.” In the Second District, a coffee house owner had spent over twenty-thousand gulden to renovate his place of business, but had

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68 Inhauser and Nusser, Jahres Bericht im Jahre 1872, 17.
entirely neglected to update the lighting or the urinals within the establishment. In this case, only a “significant fine” persuaded the owner to remedy the situation.\textsuperscript{70}

A lack of sufficient real estate in the city meant that not only was it difficult to find living space, but it was also difficult to find shop space as well, as evidenced by the number of reported instances of individuals selling wares or making goods out of their homes, or in other poor locations. The city frowned upon this practice for a number of reasons, chief among them being the unsafe and unsanitary nature of the location. In 1871, for instance, a food merchant in the city who set up his business in a cellar had his sales permit revoked due to the insufficient ventilation, prevailing darkness, and the poor condition of the cellar stairs.\textsuperscript{71}

Another case in 1871 involved the city sending a very clear message to the owners of a horn button manufactory in the Fifth District of the city. Here, sanitary officers found that the manufacturing process, which consisted of removing the meat, blood and sinew off of horns and claws, boiling them to soften the material, and then finally pressing them with hot iron, resulted in “malodorous and harmful vapors” that spread to nearby homes and workspaces.\textsuperscript{72} The city’s response to this situation shows one of the clearest examples of the municipality taking an active interest in protecting the health of its residents and the environment in which they lived. In order for the business to maintain its operating license it had to meet four conditions. First, it was to use a ventilation system, gas heated, if necessary, to carry the “gaseous products of putrid fermentation” far away from the streets and residences around the building. Second, it was required to acquire a casing for its boilers. Third, the previously-mentioned ventilation system had to be used when using hot iron plates to press the horn. Finally, waste from the

\textsuperscript{70} Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1872}, 15-16.  
\textsuperscript{71} Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1871}, 5.  
\textsuperscript{72} Ibid., 20.
manufacturing process could not be burned, but rather collected in watertight pits and removed as soon as possible.\textsuperscript{73} There is no reference in the municipal report as to whether the business in question successfully complied with the newly imposed regulations, but the fact that the city was issuing them (and threatening to take away their business license) is an indication of its willingness to take steps for the protection of residents in the city.

\textit{Conclusion}

The most widely used strategies for city officials to combat people living in uninhabitable and unhealthy spaces were monetary fines, evictions, and a revocation of business licenses. Without an increase in housing stock, however, such actions merely treated the symptoms of the underlying cause, which was an increase in population that did not correspond to an increase in the number of homes constructed. This is evidenced by the rapid increase in the number of dwellings found unfit for habitation between 1871 and 1875. Although it is unclear from the sources what caused the drop from 1875 to 1877, it seems unlikely that there was an actual improvement in living conditions as opposed to simply a decline in the capacity of the organization to inspect unsanitary conditions throughout the city. It should be noted that the figures reported are merely those that were brought to the attention by the city or otherwise discovered by the authorities. It is likely that many more apartments with adverse living conditions escaped their notice, if for no other reason than the sheer size of the problem and the limited manpower available.

It seems even more unlikely that the decline in reported dwellings was solely from a general improvement in living conditions when considering the essentially static housing

\textsuperscript{73} Ibid., 20-21.
situation throughout this period. Although new housing units were indeed being constructed, the city reported, “the large number of new buildings constructed in Vienna and the surrounding suburbs in no way satisfied the needs as in just Vienna a large part of the new apartments (while also not an insignificant number of the old ones) were built far from the areas that needed them most.” Indeed, it would not be until the Red Vienna period beginning after the end of the First World War and the fall of the Habsburg Monarchy that a comprehensive system of public housing would be created to significantly reduce the housing shortage problem.

Despite being unable to truly solve a problem of such immense size and complexity as the squalid living conditions throughout the city, the Stadtfysikat was not ignorant of the plight facing the lower classes in Vienna, nor did they believe that fixing such problems was solely the charge of the individual. Rather, these problems represented an aspect of life that the municipality was gradually assuming responsibility for. In fact, it is quite clear from the sources that those in charge of the city’s public health lamented their inability to address the problems Vienna faced in regards to housing and sanitation, and took measures to improve the urban landscape around them. During a period of change so rapid that it was difficult for municipal governments to adapt legislatively, the two men behind the Stadtfysikat worked to identify and address many of the previously unforeseen problems in housing and sanitation facing Vienna as its population exploded during the period of industrialization.

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CHAPTER III: “THREE BUCKETS PER HEAD PER DAY”: THE DEVELOPMENT OF A COMPREHENSIVE SANITATION SYSTEM

As we have seen, the rapid increase in population of Vienna severely impacted the ability of individuals to find adequate housing in the city. While this was a very serious challenge to Viennese urbanites, it was hardly the only one arising from such drastic population growth. Indeed, problems abounded from logistical and administrative perspectives, and while housing was a major one, the challenge of keeping such a large population fed was arguably larger. The fact that bread riots in Paris eventually led to the downfall of one of the oldest monarchies of Europe would have highlighted the importance of a stable urban food supply for monarchs around the continent.

Supplying an urban population with enough food to ensure a satisfied population is only the beginning, however. The rising population in Vienna meant an ever-increasing amount of biological waste being created each day, to the point where the established systems of waste disposal became overwhelmed with demand. In order to remedy this situation, the city took active steps to update its older patchwork system of sewers and cesspools and create a comprehensive and functional sewage system. Although there was debate over how best to approach the problem, the commitment to do so by municipal authorities resulted in much greater success in dealing with the problem than their approach toward the housing shortage and resulted in an effective and efficient method of waste disposal, increased access to toilets for the inhabitants of the city, and a decreased risk of contracting fecal-borne diseases through constant exposure to human and animal waste.


Impact of Population Growth on Food Consumption

Many of the resources of the vast hinterlands of the Austrian Empire went solely toward feeding its urban population, especially Vienna, the empire’s most populous urban core. This relationship was complicated by a series of internal tariffs between the various provinces of the Empire, making it expensive to ship goods from the rural agricultural regions to the populous urban ones. After the 1848 revolution and the institution of neo-absolutism, however, many of the Empire's economic policies changed. One of the most consequential of these changes was the abolition of the tariff wall between Austria and Hungary in 1851, which meant that agricultural products could now flow freely into the capital.\(^75\) This increased availability of food was necessary given the rapid rise in population, and beginning in the 1870s, exports from Hungary grew at an average rate of about 3 percent per year. This growth would continue until the advent of the First World War, and grain accounted for nearly half of all exports from Hungary during this period.\(^76\)

The significant exports of grain from Hungary stemmed from the fact that while the western part of the empire (collectively known as Cisleithania) had a greater output of industrial products such as textiles, it was the eastern portion consisting of Hungary, Croatia and Slavonia (collectively known as Transleithania) that produced much of the nation’s food. And as the Austrian portion of the state industrialized and demand for agricultural products grew, so too did Hungary’s agricultural production grow. The period from 1867 to 1918 saw an average annual growth of 2 percent.

\(^{75}\) Gingrich, “Foreign Trade and Early Industrialisation in the Habsburg Monarchy and the United Kingdom,” 1282.

Austria was not the only part of the empire to industrialize. As the Industrial Revolution progressed, Hungary was able to take advantage of the increased processing capacity that the new industrial technologies were able to offer. Starting in the late 1860s, Hungary shifted from producing raw foodstuffs for export to processed food products such as flour and became one of the only states in Europe that did so. By the turn of the century Hungary had one of the highest milling capacities in the world. Whereas Russia had an export ratio of raw grain to processed flour of 98:2, and Romania had a ratio of 92:8, Hungary boasted a wheat to flour export ratio of 33:67.\textsuperscript{77}

This massive increase in agricultural output and exportation greatly benefited the western portion of the Empire, which imported about a quarter of all cereals produced in the eastern portion by the early 1900s. Estimates of total domestic calorie production from cereals during the nineteenth century ranges from 900 to 1500 kcals per inhabitant per day.\textsuperscript{78} This meant that around half of the daily dietary requirements for the inhabitants of Vienna were filled by cereal products. Figure 3.1 shows that cereals were by far the largest type of foodstuff consumed in Vienna in 1870 (with the exception of beer), at 145 kilograms per capita per year. With a population of approximately one million inhabitants in 1870, this amounts to 145 million kilograms of cereals consumed in 1870 alone. Another 75 million kilograms of meat products were consumed in the city that year, the majority of which consisted of beef and veal within the city itself, whereas pork was more popular in the city’s suburbs. Figure 3.1 shows an estimation of the amount of different foodstuffs consumed within the city as kilograms per capita per year,

\textsuperscript{77} Ibid., 567-568.
\textsuperscript{78} Gingrich, “Foreign Trade and Early Industrialisation in the Habsburg Monarchy and the United Kingdom,” 1286.
as well as the amount of dietary nitrogen produced in grams per capita per day. The latter figures will be examined more in-depth in the chapter dealing with environmental pollution.

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</tr>
<tr>
<td>Vegetables</td>
<td>60</td>
<td>0.65</td>
<td>93</td>
</tr>
<tr>
<td>Fruits fresh</td>
<td>26</td>
<td>0.07</td>
<td>32</td>
</tr>
<tr>
<td>Fruits dry, nuts</td>
<td>1.9</td>
<td>0.01</td>
<td>1</td>
</tr>
</tbody>
</table>

* 5 year average; ** l/cap/yr; *** 5 year average 1906–1910

Figure 3.1: Consumption of foodstuff in Vienna in the Years 1830, 1870 and 1913

Humans were not the only ones that required food in the city, however. In a world before the advent of the automobile, horses were a major part of the transportation network, either through horse-pulled trolleys for public use, or among the more well-to-do who could afford a horse of their own. Unsurprisingly, the dietary requirements of a horse are much higher than those of a human, but there is less historical data available to determine exactly how much feed was required to keep the animal population of Vienna alive and productive during this time. The primary sources of feed for draft animals in the city were oats, straw, and hay, although this may

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have been supplemented by other materials such as the waste left over from the process of 
brewing.\textsuperscript{80} There were a significant number of other waste producing animals in the city as well 
such as pigs, cows, and poultry, for which there is not as much readily available data. 
Nevertheless, it is clear that the actual amount of animal waste produced in the city is 
significantly higher than that produced by horses alone.

\textit{Impact of Population Growth on Biological Waste Production}

While feeding the population of the city was extremely difficult, perhaps the biggest 
problem came from the end result of feeding: waste. Contending with both human and animal 
excreta has been a challenge for municipalities and urban centers for much of history, and the 
rapid increase in urban populations following industrialization only exacerbated the problem 
throughout much of Europe. After centuries of use, the waste system in Vienna reached its 
fuctional capacity in the nineteenth century as a result of the drastic increase in population, 
prompting the city to adapt to the new circumstances by creating a new method of mass waste 
disposal.

An individual human excretes an estimated 130 grams of solid waste each day, in 
addition to 1,200 grams of liquid waste. By 1830, before the process of industrialization had 
gained any significant traction, the inhabitants of the city collectively produced around 420 tons 
of waste each day. By 1870 the population had more than doubled, leading to a proportional 
increase in the amount of waste.\textsuperscript{81} With a population of approximately one million, this equates 
 to an estimated 1,466 tons of waste produced daily, or over 535,000 tons in 1870 alone.

\textsuperscript{80} Ibid., 320.
\textsuperscript{81} Sylvia Gierlinger et al., "Feeding and Cleaning the City: The Role of the Urban Waterscape in Provision and 
In addition to consuming more foodstuffs than humans, draft animals such as horses also produce a significantly higher amount of biological waste. Although, like humans, the exact amount produced per horse can vary considerably from one to another, a number of estimates have found an average of twenty-four kilograms of waste produced per day, or nearly ten tons of waste per year for a single horse.  

Although the horse population in Vienna is harder to estimate than the human population, there appears to have been approximately five thousand in the city by 1830. This meant the production of over thirteen tons of waste each day, or roughly 3 percent of the human total.

Much like the human population of the city, the horse population grew drastically during the nineteenth century. By 1913, there were an estimated 35,500 horses in the city, collectively producing nearly 940 tons of waste per day, or 343,100 tons per year. By averaging the growth rate in the population of horses between 1830 and 1913, one can estimate that the city had an equine population of roughly twenty thousand in 1870, compared to a human population of one million. This figure equates to a production of 529 tons per day, or 193,124 tons of waste in 1870. Although still a smaller figure overall than the amount of waste produced by the human population, it had nonetheless grown from 3 percent of the total in 1830 to 36 percent of the total four decades later. The exact figures of biological waste production are naturally impossible to know a century and a half after the fact, but the estimates illustrate the sheer size of the problem the city faced.

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83 Gierlinger, “Food and Feed Supply and Waste Disposal in the Industrialising City of Vienna,” 323.
84 Ibid.
The Evolution of the Danube River

Although there was a significant amount of pollution released into the air in nineteenth-century Vienna, the city’s waterscape arguably took the brunt of the pollution generated during this period. The increase in biological waste and industrial pollution was hardly the only way in which the Danube changed during the nineteenth century, however. Municipal authorities undertook a number of more deliberate activities to alter the environment of the Danube, the most significant of which was the regulation of the river, which occurred between 1870 and 1875. The impetus for regulation was the frequent flooding that often occurred, with especially bad events in 1830 and 1862. Prior to regulation, the Danube was more akin to a wide, constantly-shifting marsh that would experience sudden channel changes, erosion, and the regular replacements of land with water, and vice versa. Although from an environmental standpoint this situation resulted in a high level of diversity for fish and other organisms, it was considered by developers and planners to be increasingly detrimental because highly coveted land near the urban core was going undeveloped. Figures 3.2 and 3.3 show how the course of the river was changed by human intervention between 1849 and 1875.
The municipal government of Vienna had considered proposals to regulate the Danube since the beginning of the eighteenth century. In 1810, the director of the Imperial Construction Council (Hofbaurat), Josef von Schemerl, proposed digging a new, large channel that would become the main body of the river as it flowed into Vienna. This main channel would run north and east of the city, while a small canal would branch off and lead into the city itself. Political opposition and monetary troubles prevented the project from being undertaken until 1867, however. By 1875, the regulation of the river was completed, and the city now had to decide what to do with the new land that was now available. Ownership of the new land fell to the Second Danube Regulation Commission, which worked with the municipal authorities to promote the development of trade and commerce in the new land north of the city center.

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85 Gertrud Haidvogl et al., "Urban Land for a Growing City at the Banks of a Moving River: Vienna’s Spread into the Danube Island Unterer Werd from the Late 17th to the Beginning of the 20th Century," Water History 5, no. 2 (2013): 209.
86 Ibid., 211.
87 Ibid., 208.
88 Ibid., 210.
The very existence of the Danube regulation project stemmed from a government that capitalized on the liberal economic trends spurred by the Revolutions of 1848. The project showcased a city administration that was extremely interested in developing the economic and commercial potential of the city through infrastructure development and liberal economic policies for new land development. Indeed, the actions of the municipal government were an urban application of the empire-wide economic policies that characterized the neo-absolutist period after 1848, such as the construction of railway networks and the investment in foreign trade policy.

Although the regulation of the river was widely seen by planners as beneficial to the city and its inhabitants because it improved navigability, reduced flooding, and opened up new land to development, more adverse changes threatened the economic and biological viability of the river. By 1830, the collective human population was excreting 1,160 tons of nitrogen, with the equine population excreting another 205 tons. By the time the population in Vienna peaked immediately prior to the First World War, this figure had increase to an estimated 7,300 and 1,500 tons respectively. The agricultural significance of nitrogen had been understood from a scientific perspective since the 1840 publication of Justus von Liebig’s *Chemistry in Its Application to Agriculture and Physiology*, and scientists began to realize the impact that the chemical could have on urban waterscapes as well. In 1874, Auguste-Charles Gérardin and Félix Boudet measured the oxygen content in the portion of the Seine that flowed through Paris, and found that the river contained only one square centimeter of oxygen per liter, compared to an average of eight or nine square centimeters per liter directly upstream of the city. This drastic

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89 Ibid., 208.
90 Gierlinger, “Food and Feed Supply and Waste Disposal in the Industrialising City of Vienna,” 323.
decrease was a direct result of the biological waste dumped into the river, as the presence of nitrogen helped fertilize the water in the river, leading to an increase in algal growth. After the algae died off, oxygen was consumed in the process of their decomposition, leading to the drastic drop of oxygen measured by Gérardin and Boudet.91

While a decrease in oxygen content in a river has no significant impact on things like navigability, it can drastically affect the biological viability of the waterscape, especially the presence of fish, who require oxygen in the water to survive. A key difference between Paris and Vienna in this regard was the size and flow of their respective rivers. While the Seine discharged an average of 250 m³/sec, the Danube discharged eight times that amount on average. Furthermore, the pollution emanating from Paris was reported to have affected the Seine as far as one hundred kilometers downstream, whereas the Danube only suffered from lowered oxygen content for approximately eight kilometers. It is clear that the self-cleaning capacity of the Danube was higher than that of Paris, but the river was hardly unaffected by the growing amount of waste dumped into it.92

**Cesspools and Urinals**

Like many cities throughout Europe during the time, Vienna lacked a centralized system of waste management, instead relying on a combination of cesspools and a patchwork system of open channels, streams, and sewers throughout the city.93 Cesspools were little more than pits, approximately the size of a standard water well, which were dug throughout the city for waste to be deposited into. These cesspits could be either lined with a relatively non-porous material such

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91 Ibid., 325.
92 Ibid.
93 Gierlinger et al., "Feeding and Cleaning the City," 230.
as brick or stone to prevent the waste from leeching into the soil, or they could be nothing more than holes dug into the ground. The former would require periodic emptying to prevent the cesspool from overflowing, but the latter would allow biological waste to seep into the ground, potentially contaminating the environment around the cesspool.\textsuperscript{94}

In Vienna, the use of unlined cesspools caused a number of environmental problems for residents. First, the large number of apartments located below ground level meant a relatively high number of complaints being reported to the Municipal Health Authority about sewage leaking from cesspools into living spaces. Second, Vienna, unlike a number of other riparian cities, did not draw most of its drinking water from the Danube River. Instead, inhabitants relied overwhelmingly upon water wells located throughout the city. This meant that many wells were at risk of being contaminated by biological waste, rendering the water source undrinkable and potentially spreading diseases such as cholera or typhoid fever.

Despite the drawbacks associated with the cesspool system, it was nevertheless commonly used throughout Europe, largely due to its low cost when compared to other, more centralized systems of waste disposal, as well as the fact that cesspools had been used successfully for centuries. Although the environmental contamination from cesspool use was mitigated early on by a limited population, after industrialization and the ensuing population boom, the soil could no longer safely absorb the massive amounts of waste. Lined cesspools, although preventing environmental contamination around the pit, also began to lose their cost-competitiveness as more and more waste meant that they needed to be emptied much more frequently to prevent the pit from flowing over.

Although population growth necessitated the more frequent cleaning of cesspools, they were nonetheless often allowed to fill beyond capacity, leading to frequent complaints recorded by city officials. Nor were lined cesspools entirely environmentally-friendly. The walls of the cesspools were frequently damaged, allowing biological waste to seep into the soil. In its 1873 report, the Stadtfysikat reported, “because of cesspool overfilling there were twenty-five grievances [and] because of cesspools without brick lining or damaged lining, both of which are permeable, there were thirty-seven complaints.”

Cost-cutting became a problem for residents in more ways than one when it came to cesspools. The Stadtfysikat recorded several cases of apartments which were divided into two or more living units by makeshift partitions in order to fit as many people as possible into them. Unfortunately for the residences, these partitions were often made of brick recycled from old lined cesspools. Although brick walls largely prevented waste from seeping into the soil, the porous nature of the material did allow seepage into the bricks themselves. As the municipal officials reported, “at 10 Scherzer Street, in the Second District, a residential locality was divided into two rooms by a partition of brick which had been taken from a long-used cesspool, which caused such a stench that the locality was uninhabitable.”

Further problems arose when households did not even bother with using cesspools for disposing of their waste. In 1875, the Municipal Health Authority reported seven homes which had no toilets of any kind, and their inhabitants simply dumped their waste in a small hole that let its contents flow out into the home garden when it was full. These impromptu cesspools also affected neighboring residences in much the same way that the larger pits did when they were

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95 Innhauser and Nusser, *Jahres Bericht im Jahre 1873*, 4-5.
96 Innhauser and Nusser, *Jahres Bericht im Jahre 1877*, 5.
not adequately lined to prevent biological waste from seeping into the ground. In the Seventh District, for example, a residence was found to have been completely infiltrated by a “slurry” of biological waste from a neighboring residence.97

The period from 1871 to 1881 saw an increase in the number of unsanitary cesspools reported by the city of Vienna. Whereas the problems concerning housing ranged from excessive moisture and overcrowding to subdivisions and lack of light and air, in regards to cesspools, the Stadtfysikat was concerned almost entirely with ones that were uncovered, overfilled, had damaged lining or possessed no lining at all. In 1871, the Stadtfysikat reported ten cases throughout the city, but forty-seven a year later. The increase continued at a slower pace for the next few years, with sixty-two and eighty-five cases in 1872 and 1873, respectively. Interestingly, 1875 witnessed a very large decrease to only seventeen reported cesspools, which rebounded to eighty in 1881. Given that there is no specific reason given for the drastic decrease in the report, it is likely that the Stadtfysikat had a diminished capacity for cesspool inspection in 1875.

Although used for both liquid and solid waste, cesspools were designed more with the latter in mind. In addition to the cesspool system, there was also a series of public urinals throughout the city, known as pissoirs. Originally invented in Paris in 1830, pissoirs spread throughout Europe during the nineteenth century with the intention of reducing public urination and improving the sanitation of streets. Urinals in nineteenth-century Vienna faced many of the same hygienic problems that plagued many private residences, however. In 1871, for instance, ten urinals were reported by the city for “poor quality” and “uncleanliness,” of which nine were private and one was public.98

97 Innhauser and Nusser, Jahres Bericht im Jahre 1875, 8.
98 Innhauser and Nusser, Jahres Bericht im Jahre 1871, 8.
More than twice as many urinals were reported in 1872 because of uncleanliness or poor construction, with a quarter of the cases occurring in the Second District, and the remainder spread fairly evenly throughout the other districts of the city.99 By 1873, the number had doubled again, to forty-nine. City officials make note in their report that the large increase from one year to the next is very likely due to the 1873 World Exhibition held in Vienna, which lasted for six months and resulted in a large increase in the number of facilities available for public use.

Indeed, the Stadtfysikat wrote:

Numerous toilets (Anstandsorte) were set up in pavilion-like cabins in various locations in Vienna, each of which had separate buildings for men and women consisting of individual cabins equipped with water closets and by the barrel system were furnished with daily disinfection and removal of fecal matter.100

The 1873 World Exhibition in Vienna (Weltausstellung 1873 Wien) was seen by the monarchy as an opportunity to present Austria as a modernized and highly-developed power in Europe, and the organizers’ attempt to out-do the previous world’s fairs in London (1862) and Paris (1867) reflected this. The 250-hectare site was the largest of any previous world’s fair by far, and its fifty-three thousand exhibitors were nearly double the number at the 1862 world’s fair in London.101 For six months, visitors flooded into Vienna to see the tens of thousands of exhibitions and the massive complex of buildings that housed them, and when all was said and done, some seven million people from all over the world attended the exhibition.102 This meant millions of people had an increased awareness of the progress in science, technology, and culture that the monarchy had promoted, but it also meant a massive spike in the number of people in the

99 Innhauser and Nusser, Jahres Bericht im Jahre 1872, 15.
100 Innhauser and Nusser, Jahres Bericht im Jahre 1873, 3-4.
102 Ibid., 247.
city, and with it an exacerbation of all the problems associated with rapid (albeit temporary) demographic growth. Although the temporary toilets were undoubtedly a benefit for the millions of people who visited the exhibition, by 1875 the Stadtfysikat was concerned that they were proving to be less temporary than initially assumed.

The Stadtfysikat advocated against the continued existence of . . . [these] toilets (Anstandshütten und Anstandswagen), which were constructed in various places in Vienna during the World Exhibition. . . because from the outset the small size of the individual compartments used as urinals and toilets resulted in insurmountable grievances. Apart from that, the leakiness of the petroleum barrels used for removing waste was the subject of never-ending complaints.103

The focus on conditions of publicly used urinals continued in the 1877 Stadtfysikat report, with pubs at the center of the controversy rather than temporary urinals for the World Exhibition. The city reported eighteen establishments that were found to be either lacking in urinals or contained ones that were inadequately cleaned, most of which were concentrated in the First District of the city. For the same reasons, another eighteen urinals were reported in private residences, most of which were also concentrated in the First District.104

**Preliminary Sewer System**

Due to the numerous hygienic and environmental problems associated with cesspool use in Vienna, one could assume that this was the overwhelmingly common method of waste disposal in the city. In reality, however, cesspool use was extremely limited, with only 20 percent of waste disposed in the city going into cesspools by 1830. The remainder of the waste was dumped into the previously-mentioned patchwork system of open channels, streams, and sewers, where it would ultimately find its way to the Danube River. This had extensive

103 Innhauser and Nusser, Jahres Bericht im Jahre 1875, 9-10.
104 Innhauser and Nusser, Jahres Bericht im Jahre 1877, 7-8.
environmental impacts on the urban waterscape and hygiene of the city, a fact which will be explored more in depth in the chapter on water pollution.\textsuperscript{105}

Vienna’s topography made the city’s system waste disposal a fairly efficient one until demographic changes led to the production of more waste than could be dealt with effectively. In the nineteenth century, numerous streams flowed from the forests outside the city and into the urban core before emptying into the Danube. This provided a natural system of waste disposal that inhabitants were happy to take advantage of. However, the same problem of population growth that plagued cesspools also created new problems for this system. The large amounts of new waste combined with a relatively weak water flow resulted in waste and refuse piling up repeatedly in these makeshift sewers, sometimes remaining there for weeks. To combat this, the city implemented a number of regulations regarding the time and manner of waste disposal, but much like the initiatives concerning housing, only a major overhaul would prove to be sufficient to solve the problem.\textsuperscript{106}

All of these incidents highlighted a worrisome situation throughout the city. Although the germ theory of disease was not firmly established until the latter portion of the nineteenth century, it was clear since ancient times that a proximity to biological waste was not particularly good for one’s health. Fecal-transmitted diseases such as cholera and typhoid were especially prevalent in this environment, and the city health reports continually refer to these disease and attempts to slow their spread, many of which will be described more extensively in the chapter on disease.

\textsuperscript{105} Gierlinger et al., “Feeding and Cleaning the City,” 230.  
\textsuperscript{106} Ibid.
Debate over New Waste Disposal System

Once the city determined that steps were to be taken to mitigate the problems with waste that were (sometimes literally) piling up in the city, the problem then became how best to devise a solution. Within the pages of its annual report, the Stadtfysikat recounted an ongoing debate over two different approaches to the problem, among which a few fundamental characteristics were necessary. In their search for the most appropriate waste disposal system, city authorities generally agreed that “it is the main condition for any system to remove the excrement as soon as possible and in an undecomposed condition as possible to avoid the infiltration of the soil and the pollution of the air.”107 This debate shows that the city was taking an active role in attempting to mitigate the worst environmental and biological effects of the accumulated waste in the city.

The first waste disposal system considered by the city was a water-born sewage system (Schwenmsystem) similar to what had been the main method of waste disposal up to that point, the main difference being that both liquid and solid waste would be disposed of together in the new system. A number of factors favored this approach, including the topography of the city and the fact that there were already 113 kilometers of sewers in the city by 1833. The biggest problem with instituting such a system, as recognized by the Stadtfysikat, was not access, but rather the inadequate amount of water flowing through the city to flush waste away. Indeed, in 1871, city officials estimated that such a system would require “three buckets per head per day” as well as the widespread introduction of water closets, watertight channels to bear the waste, and an appropriate slope to help prevent clogging.108

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107 Innhauser and Nusser, Jahres Bericht im Jahre 1871, 9.
108 Ibid., 10.
The second system considered by the city was the “bucket” or “barrel” system. In this arrangement, waste from toilets located throughout a building was deposited into a special container located in a dedicated room (See Figure 3.4). The Stadtfysikat discussed the utilization of either wooden or sheet iron barrels which would be hermetically sealed to collect either solid waste or both solid and liquid waste from a dwelling. Once the barrels were filled, they would be collected and transported to a dump site.\textsuperscript{109} Such barrels often had a capacity of less than 45 liters of waste, meaning that, assuming daily production of 1.3 liters (1,330 grams of liquid and solid waste), a single person would fill such a barrel in a little over a month, but the overcrowded nature of buildings within the city would necessitate very frequent (perhaps daily) cleanings.\textsuperscript{110}

In considering the implementation of a barrel system, the Stadtfysikat drew from the work of Bavarian Chemist Max Joseph von Pettenkofer, considered by some to be the founder of the science of hygiene. Pettenkofer worked in Munich as a professor of medical chemistry beginning in 1853, and as a professor of hygiene starting in 1865. It was during this time that he demonstrated the necessity of proper ventilation and fresh air in buildings, a fact which the Stadtfysikat in Vienna fully accepted.\textsuperscript{111} The barrel system under consideration would have followed Pettenkofer’s principles by allowing the associated toilet system to ventilate accumulated gases through the roof of the building, ensuring the relative freshness of the indoor air.\textsuperscript{112}

\textsuperscript{109} Ibid., 9-10.
\textsuperscript{110} Angelakis, Evolution of Sanitation and Wastewater Technologies through the Centuries, 440.
\textsuperscript{111} “Current Periodical Comment and Working Notes,” The Public Health Journal 3, no. 9 (1912): 511.
\textsuperscript{112} Innhauser and Nusser, Jahres Bericht im Jahre 1871, 9.
In regards to proper ventilation, the city went beyond simply advocating a Pettenkofer-approved system, however. As noted in chapter 1, a significant number of dwellings were inspected based upon their lack of access to light and air, making it clear that the city considered it a problem that required intervention of some sort. In 1872, the Stadtfysikat wrote, “another inconvenience that too often emerges in new buildings is the system of toilets, whose ventilation mostly takes place through the light openings near the windows of occupied rooms. When inadequate upward ventilation of toilets occurs, all the fetid exhalations build up and the toilet becomes uninhabitable, an inconvenience that is often criticized, but always recurs.”

City officials wrote of the final decision between the water-born system and the barrel system that “each of these systems has its advantages; however, the water-borne system is to be given preference because of the faster transportation of waste in the least decomposed state.”

Despite this advantage, that was not the end of the debate. Officials recognized that if an appropriate introduction of household water closest could not be achieved as in Frankfurt am

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113 Angelakis, *Evolution of Sanitation and Wastewater Technologies through the Centuries*, 441.
Main or Hamburg, then a barrel system similar to the ones introduced in Zurich, Munich, Heidelberg, or Graz would be preferable. The circumstances present in the city during this time period were not particularly conducive to a comprehensive system of waste disposal. This changed, however, with the introduction of the First Vienna Mountain Spring Pipeline (Hochquellenwasser) in 1873, as there was now a reliable enough water supply to flush waste from the sewers. Thus, city administrators favored the creation of a comprehensive water-borne system after this point.

In addition to the debate over how to get the waste out of the city, there was an additional discussion over what to do with it after that point. Although farmers had been aware of the importance of manure as fertilizer, it was not until the investigations of Justus von Liebig and his publication of works such as *Organic Chemistry in its Application to Agriculture and Physiology* that scientists were aware that plants removed nitrogen from the soil in which they grew, and that to ensure the quality of the soil, nitrogen had to be replaced. Since human and animal waste contains significant amounts of nitrogen (in 1830 it amounted to 1,160 and 205 tons, respectively in Vienna), Liebig advocated for the recycling of sewage so the nutrients would not be lost. He was particularly opposed to the installation of sewer systems that flushed human waste into rivers and streams, thereby removing valuable nitrogen and negatively impacting the ability to grow crops.

One commonly advocated solution to this problem was to create a designated location outside of the city where waste could be dumped and allowed to naturally decompose, returning the valuable nutrients it contained to the soil. These sites were known as sewage fields, and

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116 Ibid.  
117 Gierlinger et al., “Feeding and Cleaning the City,” 231.  
numerous cities throughout Europe had already adopted this system by the 1870s. The German-speaking world’s most notable example was Berlin, which faced with many of the same problems that challenged Vienna. A number of organizations in the new German capital wished to discharge the waste in the river than ran through the city, although still others feared the potential economic and environmental consequences of doing so. After much debate, the city began construction of a radial sewage system in 1873 which successfully carried the waste from each of Berlin’s twelve districts to one of twelve dedicated fields outside the urban core. By 1883, 1.5 million inhabitants of the city had a sewer connection to the fields, and by 1893, there were 584 kilometers of piping and 144 kilometers of canals.\footnote{Ibid., 288-289.}

Although cities such as Berlin showcased the efficient and nutritionally circular nature of the sewage field system, officials in Vienna decided against establishing any such system. Instead, they chose to simply dispose of their waste into the Danube River, which, after its regulation, would now carry it swiftly downstream and out of the urban area. City officials reasoned that they already had enough biological waste from animals to supply their agricultural regions, and adding any more would not be especially helpful.\footnote{Gierlinger et al., “Feeding and Cleaning the City,” 234.} That is not to say that none of the waste produced in the city was recycled as fertilizer, but cases in which it did occur were on a much smaller scale. For instance, in 1871, the \textit{Stadtfysikat} recorded at least two cases of homes using waste from cesspools as fertilizer for kitchen gardens, which it permitted on account of the “totally isolated location” of the garden.\footnote{Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1871}, 8.}

Given the ease with which waste could be disposed of in the Danube, it is perhaps not surprising that city officials decided against the construction of large-scale sewage farms.
Additionally, as Vienna was the capital of a rather large and geographically diverse empire, much of the food consumed in the city came from areas outside of the city’s hinterland. As has already been shown, a significant portion of foodstuffs consumed in Vienna were imported from the Hungarian portion of the empire every year. And while sewage farming may help replenish the nitrogen lost through farming, a majority of this lost nitrogen came from areas that would not benefit from the establishment of a Viennese sewage field. It is also unlikely that officials in Vienna were overly concerned about replenishing the nitrogen content of Hungarian soil regardless of which waste disposal system they adopted.

The Centralized System and its Shortfalls

Six years after the completion of the Mountain Spring Pipeline in 1873, 70 percent of households in the city were connected to it. This greatly facilitated the city’s plan to expand the sewer network, which saw further investment and technical development. New sewers began to be constructed from concrete, a much less porous substance than the brick sewers used previously, but in many cases, new sewer lines did not need to be constructed. The streams that naturally flowed through the city from the outlying foothills could simply be lined and vaulted, with their natural course leading waste into the Danube River. After the incorporation of the suburbs, the new sewer system was also connected to the areas surrounding the old urban core. Figure 3.5 shows how far the system extended by 1900, in addition to further expansion plans, which would not be completed until 1904. The large increase in sewer access coincided with a large increase in water usage throughout the city, from twelve million cubic meters in 1876 to forty-three million in 1910.122

122 Gierlinger et al., “Feeding and Cleaning the City,” 231-232.
The fact that a large portion of households in Vienna were connected to the sewer system did not mean that everyone had free access to a toilet, however, and the Stadtfysikat expressed concern in their 1873 report about changes to the building code that it saw as detrimental to the sanitary condition of dwellings in the city. Officials made their concerns clear by writing that “little attention was paid to the number of toilets required per party in each household.” Whereas previous regulations had two toilets per three households as standard, the number to be included in a new building was often left up to the foreman of construction. As a significant portion of their mission was to improve the sanitary conditions of dwellings within the city, the Stadtfysikat viewed the changes to the building code as potentially making its job more difficult by removing already-established guarantees that ensured a certain number of toilets per person.

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123 Ibid., 233.
124 Innhauser and Nusser, Jahres Bericht im Jahre 1872, 14.
The Stadtfysikat did not only report on homes with insufficient sanitary facilities, although these constituted a large portion. It also detailed sanitary facilities that were unclean, had poor ventilation, or had piping or cesspools that were permeable or otherwise leaked their contents. In 1871, a total of 186 homes were included in the annual report, with the vast majority of cases (72 percent) stemming from a lack of toilets, with most of the remaining homes having a lack of ventilation, in contradiction to Max Joseph von Pettenkofer’s advice on air flow.\textsuperscript{125} By 1872, the number nearly doubled, with 383 homes having sanitation problems significant enough to warrant reporting. Of these, nearly half (163) were for an insufficient number of toilets, while another 125 were included because of their uncleanliness. Another 72 suffered from a lack of light and ventilation, and the final 23 cases had cesspools or channels that were deemed to be unsound.\textsuperscript{126}

The number of reported homes continued to increase in 1873, much like with the incidences of apartments that were overcrowded and excessively wet. That year saw an increase of nearly one-third, for a total of 507. Although the Stadtfysikat declined to break down the nature of the problems in 1873, it did list the geographic distribution of the problems in the city by district, which is represented in Figures 3.6 to 3.8.\textsuperscript{127} Curiously, the city saw a marked decrease of approximately one-fifth of the number of reported cases in 1875, dropping from 507 to 394. In addition to once again providing a geographical distribution of cases, the Stadtfysikat also returned to providing the cause that prompted the complaint in the first place. In 1875, for instance, 166 of the 394 homes had an insufficient number of toilets, while another 127 were

\textsuperscript{125} Innhauser and Nusser, Jahres Bericht im Jahre 1871, 7-8.
\textsuperscript{126} Innhauser and Nusser, Jahres Bericht im Jahre 1872, 15.
\textsuperscript{127} Innhauser and Nusser, Jahres Bericht im Jahre 1873, 3.
either damaged or unclean. The remaining 101 cases concerned toilets that were attached to manure pits and located close to the street.\(^\text{128}\)

By 1877, the number of problems decreased again, to 120 cases, but by 1881 increased again slightly to 149 cases. The report for this year did not include a total breakdown of the number of cases per district, but it did include more details concerning the types of problems officials reported. At 53 Matzleindorferstrasse, for instance, was a house in which there were only two toilets for twenty-one people. There were also nine separate cases in which damaged toilets or piping resulted in the infiltration of moisture into the masonry of the buildings.\(^\text{129}\) Most of the cases, however, were related to unclean toilets that usually had no lid, and usually often had no light either, ensuring they were entirely dark. Slightly over half the cases in 1881 were related to this latter category.

It is unclear if the reduction in the number of reported cases is due to an actual increase in the hygienic standards of the city, or if it merely represents a decreased ability for the Stadtphysikat to inspect the city. But while the problems associated with housing stock and quality were unlikely to be resolved in a positive manner, the successful implementation of the centralized sewer system and the First Vienna Mountain Spring Pipeline make it much more likely that the reduction in complaints actually corresponded to an increase in the sanitary profile of the city. For a more comprehensive breakdown of housing problems identified by the Stadtphysikat, see Appendix A.


Figure 3.6: Homes Reported in 1871 because of Sanitation Problems\textsuperscript{130}

Figure 3.7: Homes Reported in 1873 because of Sanitation Problems\textsuperscript{131}

\textsuperscript{130} Map created by author. Source: Innhauser and Nusser, *Jahres Bericht im Jahre 1871*, 7-8.

\textsuperscript{131} Map created by author. Source: Innhauser and Nusser, *Jahres Bericht im Jahre 1873*, 3.
Even if an individual had ready access to a toilet in their home, it was likely that they spent large portions of the day in places where fewer facilities were available, especially poor workers. As a rapidly industrializing city, Vienna had a large workforce that was often present in factories for twelve hours or more, and the building regulations for industrial sites were decidedly less generous than for residential buildings. The Stadtfysikat stated as much when it referred to the “building regulation concerning industrial buildings – where for fifty workers, working the standard twelve to fourteen hours, only one toilet is required.”\textsuperscript{133} The Stadtfysikat was clear in their opinion that the building regulations as they were fell short of what was ideal for the health of the city.

\textsuperscript{132} Map created by author. Source: Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1875}, 8.
\textsuperscript{133} Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1872}, 14.
Conclusion

The sudden and drastic increase in the population of Vienna forced the city to reevaluate the methods of waste disposal that it had relied on historically. While a significant portion of the city’s dwellings were connected to a sewer of some sort, this did not guarantee fast and reliable removal of biological waste from the urban area. To solve their problem, officials looked for examples from other cities throughout Europe in order to gain a sense of what worked and what did not in urban areas undergoing similar demographic and industrial changes as Vienna. They drew upon the latest scientific evidence to gauge which system was best suited for their own unique circumstances and ultimately decided that a modernization of the system of streams and canals that served effectively as sewers for centuries past was their best option. This single, centralized sanitation system helped the city adjust to the needs of the industrial age, ensuring a supply of clean water to its inhabitants and reducing the risk of disease associated with exposure to waste. Nevertheless, this accomplishment did have some unintended consequences, the worst of which will be explored in the next chapter.
CHAPTER IV: “SUCH AN IMPORTANT PART OF THE PUBLIC HEALTH”:
INDUSTRIAL POLLUTION AND ITS IMPACT ON THE ENVIRONMENT AND THE INHABITANTS OF VIENNA

A consistent theme in the history of industrializing cities such as Vienna is that many of the problems faced by inhabitants existed for decades and centuries previous but were exacerbated to the point of catastrophe by changing demographics. The environmental challenges associated with an increasing population have a particularly large impact on the water that the population drinks and the air that they breathe. Vienna’s developing industrial landscape meant pollution coming from a variety of sources that required a number of equally varied approaches. Waste from businesses such as breweries and tanneries contaminated water sources, while burning coal in homes and factories fouled the air and had both long and short-term impacts on the health of the population. Some of the city’s attempted solutions were reactive in scope, designed to fix a specific problem that already existed, while others were more proactive, and intended to address the root cause of the pollution affecting the city. Both approaches illustrate the city’s evolving attitude toward its role in maintaining the public health of Vienna and its inhabitants.

The most proactive strategies used by the Stadtfysikat to influence behavior was the inclusion of operational conditions before granting business licenses to enterprises like factories and tanneries. It also supported the creation of a city-wide water and sewer system that would eliminate many of the problems with water pollution that arose from Vienna’s industrial development. In a more reactive approach, the Stadtfysikat used punitive measures such as fines to influence behavior, as well as case-by-case fixes for specific environmental problems. Although some of these initiatives were more effective than others at eliminating pollution, the
numerous suggestions put forth by city officials demonstrates that by the 1870s, they were committed to playing an active role in the health and well-being of the city and its inhabitants.

*Water Pollution*

Although the liberalization of economic policy in the neo-absolutist period led to the removal of most guild restrictions that limited who could operate a business in the city, there were still basic standards that budding entrepreneurs had to meet. There are numerous references in the reports of the *Stadtfysikat* of businesses requiring official licenses in order to operate lawfully, making them the perfect tool for the city to attempt to influence the behavior of particularly harmful factories and businesses. In practice, this often meant that the city would attach conditions to any license it granted, usually as a means of protecting the public health. The city did more than simply list a set of demands for operation and hope the businesses would comply with them after the licenses were granted, however. As the *Stadtfysikat* wrote about one case in 1871,

> the approval of this business operation required the examination of the location being used for this purpose and is dependent on the carrying out of the measures which eliminate the aforementioned detrimental health effects and the risk of fire; furthermore, the city physician must be granted permission to monitor the fabrication process at all times.\(^{134}\)

> Although much of the monitoring referred to by the *Stadtfysikat* was likely simple visual inspection of business practices, an equally important aspect of monitoring environmental pollution came in the form of chemical and microscopic analysis. The 1864 reorganization of the *Stadtfysikat* created a dedicated position for this, which was instrumental in maintaining the

\(^{134}\) Innhauser and Nusser, *Jahres Bericht im Jahre 1871*, 21-22.
public health through the examination of water sources throughout the city. This was especially important, as prior to the introduction of the First Vienna Mountain Spring Pipeline in 1873, the city relied almost exclusively on wells to supply its drinking water. With the various industrial sites in Vienna producing waste throughout the city, the chances for these water sources to be contaminated by blood, other biological material, or chemicals was very high. In fact, of the thirty-two chemical examinations of water wells in 1872, eighty-eight percent of them (twenty-eight) showed “clear traces of water contamination by the infiltration of decomposing organic substances.”

The overwhelming number of contaminated water sources solidified the opinion of the Stadtfysikat that a good, clean source of water was necessary. Interestingly, the Stadtfysikat reported in 1872 on the “energetically nurtured agitation in the Second District against the spring water pipeline,” by residents who felt that they already had decent quality water. Despite these protestations, it is clear that the Stadtfysikat was unconvinced. In fact, they declared that Brigittenau (then part of the Second District) did not, in fact, have good drinking water in most homes, a case in which a privileged few may have been making generalizations about the entire district.

The number of microscopic and chemical examinations of well water increased following the report in 1871, from 32 that year to 249 in 1873. Over a quarter of all cases were subjected to a second examination in 1873, and two further cases subjected to a third.

Industrial sites were not the only source of water pollution; cesspools frequently contaminated drinking sources. In 1871 the Stadtfysikat tested two samples of water sent from Brigittenau, both of which were “black-gray in color, disgusting in smell and taste, with high

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135 Innhauser and Nusser, Jahres Bericht im Jahre 1872, 17-18.
136 ibid., 18.
137 Innhauser and Nusser, Jahres Bericht im Jahre 1873, 84.
levels of nitrous acid and gray-black sediment caused by infiltration of the soil from a poorly bricked cesspool located near to the well.” As a result, the Stadtfysikat advocated that the soil in the well be covered with charcoal, and advocated the same action to be taken for two additional homes in the Ninth District with well water that was yellow-brown, filled with yellow flakes, and contained a large amount of nitrous acid and ammonia. In the Third District, the well for a school was found to contain sulfates, chloride compounds, lime, iron oxide, and a considerable amount of organic substances such as wood chips. These cases, in addition to numerous other reports, indicate that well pollution was a significant challenge for the Stadtfysikat and the individuals that relied on the wells for their drinking water.

Oftentimes the Stadtfysikat attempted to find the underlying source of the pollution and put forward suggestions to fix the problem, although officials admitted that it was not always possible. The solutions that were put forward were mixed in their effectiveness. For a home in the Sixth District suffering from acidic water, for instance, the city ordered that the acid be neutralized using alkaline lime paste. While this approach would reduce the acidity of the water, it did nothing to identify or mitigate the underlying cause and simply added additional chemical impurities. In another case, the Stadtfysikat investigated reports from the General Austrian Construction Firm that workers always suffered from diarrhea after drinking from a house well in Brigettenau. After testing the water, it found that it had a medium mineral content, residue of algae and bacteria, gypsum, and an enormous amount of nitrate and ammonia. Testing also identified Glauber’s salt, or sodium sulfate, in the water, a chemical which acts as a laxative even at low levels. The Stadtfysikat pointed to decomposing organic substances that leached into the

139 Ibid., 13.
well through the loose soil as the primary culprit, and to fix the problem, advised that a sack of dense, heavy fabric with rock salt, iron granules and coarse charcoal power be dropped to the bottom of the well.\textsuperscript{140}

On a biological level, the \textit{Stadtfysikat} understood the importance of clean drinking water, and it also recognized the danger that industrial production posed to the wells present in the city, especially in regard to the disposal of byproducts. While in the past, the collection of water had been largely left up to the individual, the changing nature of pollution in Vienna led to an evolution in the way city administrators viewed their responsibility for maintaining the health and well-being of the city’s inhabitants. By the 1870s, the \textit{Stadtfysikat} was implementing or proposing numerous initiatives to protect water sources throughout the city, but the widespread nature of the contamination made it clear that a more comprehensive solution was required. For that reason, it advocated strongly for the construction of the First Vienna Mountain Spring Pipeline, writing, “it appears most suitable to begin work on the obligatory introduction of the First Vienna Mountain Spring Pipeline to all homes as soon as possible. This way, all grievances are remedied thoroughly and permanently. Thus a petition for the latter was put to the Viennese magistrate.”\textsuperscript{141}

The successful completion of the pipeline constituted one of the most effective transformations of public health in the city’s history, with easily contaminated well water rapidly being replaced by fresh, clean water from the Austrian Alps. Only six years after the pipeline first opened, over 70 percent of households in the city were connected directly to the pipeline, meaning that even the working class had much greater access to clean drinking water than they

\textsuperscript{140} Ibid., 13-14.
\textsuperscript{141} Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1873}, 6.
had enjoyed previously. Numerous actors beyond the Statfysikat were involved in the planning, support, and creation of the pipeline, indicating that the city government’s attitude about their responsibility for the public health of the inhabitants had shifted. It was clear that relying on easily-contaminated wells was causing numerous problems, but rather than leave individuals to solve the problems themselves, they took active, concrete steps to completely revolutionize the water system in the city.

**Coal and Dust Pollution**

One of the defining characteristics of an industrial economy is the use of fossil fuels such as coal as the primary source of energy, as opposed to a pre-industrial economy which overwhelmingly relies on biofuels such as wood. After the Industrial Revolution began, the use of coal spiked rapidly, with demand being fed by coal mines in areas such as Northern England and the Ruhr Valley. Vienna, like the Austrian Empire as a whole, was slower to industrialize than Great Britain, but the rate of increase in coal consumption was meteoric nonetheless. In 1870, coal accounted for only 25 percent of the energy produced in Vienna, but only ten years later that share had increased to about 60 percent. This indicates a drastic and extremely rapid transformation in industrial development and energy consumption patterns, making the 1870s a key decade for understanding the environmental development of the city and its attempts at dealing with the side effects of such rapid development. Despite (or perhaps because of) the size of the problem, the efforts undertaken by the city were largely reactive and focused on case-by-case fixes of pollution as opposed to a comprehensive strategy to reduce coal pollution.

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142 Gierlinger et al., “Feeding and Cleaning the City,” 231.
Evidence suggests that the inhalation of smoke from both wood and coal can have significant and adverse health effects. The United Nations World Health Organization has found that residential coal combustion is a significant source of pollutants such as sulfur dioxide, nitrogen oxides, and particulate matter. Compounding this problem is the fact that burning coal can contain toxic elements that are released into the air, such as fluorine, arsenic, selenium, mercury, and lead. Exposure to such toxic compounds can have immediate negative impacts on an individual’s health, but the long term effects of inhaling fine particulate matter can be just as harmful. Particulate matter can exacerbate or lead to health problems such as asthma, chronic obstructive pulmonary disease, reduced lung function and lung cancer in women, stillbirths and low birth weight of newborns.

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143 Ibid., 224.
145 Ibid., 15.
For some residents of Vienna, the short-term effects of indoor coal burning could kill them before they could experience the worst of the long-term effects. One of the most dangerous aspects of indoor coal burning was the accidental build-up of carbon monoxide, which is released when fuel sources do not combust completely. Once inhaled, carbon monoxide rapidly binds to hemoglobin in the blood, reducing the carrying capacity of oxygen. This leads to tissue hypoxia and potentially death if exposed to carbon monoxide for an extended period of time. Because carbon monoxide is a tasteless and odorless gas, it is easy for it to build up in an enclosed space without being noticed.\textsuperscript{146} This was a significant problem in the era before centralized heating and continues to be a significant hazard for individuals in industrializing nations such as China that still use significant amounts of coal to heat their homes. As coal came to have an increasing share of the fuel burned in Vienna, the risks of home heating multiplied. In fact, numerous accounts appear in the reports by the \textit{Stadtfysikat} of people dying as a result of attempting to warm themselves or even dry out wet apartments. Considering that Vienna is located in a climactic zone where winters routinely drop below freezing, and the fact that wet apartments were one of the single largest problems reported by the \textit{Stadtfysikat}, it is perhaps unsurprising that indoor coal burning was a matter of concern in the city’s annual reports. In, 1875 for instance, the \textit{Stadtfysikat} wrote that,

\begin{quote}
the Imperial Police Department brought to the attention of the Vienna Magistrate cases where death by asphyxiation occurred during the heating of wet apartments, particularly in recently constructed buildings, by means of burning coal or coke. Consequently, the Magistrate insisted on certain precautionary measures to be taken, such as the opening of windows so that unbreathable gases generated during this procedure can dissipate, avoiding any prolonged stay more than is absolutely necessary during the loading of more coal or coke, opening doors, and not sleeping in such locations. It was emphasized that all of these deaths were caused by the fact that the people coming in from cold weather seeking to warm up, use the locale to sleep in for lack of an alternative place to
\end{quote}

get warm. Therefore, it seemed necessary that in such cases, the site management should take provisions to provide employees another place heated by a furnace in which they warm up and sleep.\textsuperscript{147}

Warning Viennese inhabitants about the dangers of burning coal indoors was a relatively reactive strategy in that it only issued such a warning after numerous deaths were reported. Furthermore, this approach did little to solve the root of the problem, which was inadequate heating and wet apartments.

Coal smoke could be a significant problem outdoors as well. Because of Lower Austria’s location on a plain surrounded by mountainous regions to the north, west, and east, the likelihood of the city experiencing a temperature inversion is high. This occurs when an upper layer of air is cooler than a lower one, which inhibits vertical disturbances and atmospheric mixing. Any pollutants released into the air will remain trapped within a particular area rather than be dispersed by the wind and will subsequently be inhaled by the population until the inversion naturally resolves itself.\textsuperscript{148} A number of such pollution traps have been documented during both the Industrial Revolution and in the modern era that highlight the dangers of such an occurrence.

Even when atmospheric conditions were perfect and a strong wind carried coal smoke far from the city, residents were still not spared from adverse exposure to pollutants. Even those who avoided burning coal in their apartments were affected, often because many chimneys and smoke stacks did not reach above the roofs of the inhabited buildings they were situated next to. As a result, a steady stream of coal smoke would flow directly into apartments before the wind ever had a chance to carry it away from populated areas. Indeed, in the Fifth and Seventh
Districts, the *Stadtfysikat* reported that some chimneys were actually located directly below the windows of several apartments.\textsuperscript{149} Unfortunately for the residents, closing the window did not seem to provide much relief, as evidenced by a report in 1872 which stated that a whole street was filled with coal smoke that penetrated into the apartments, even though the windows remained closed.\textsuperscript{150}

The most straightforward method of addressing this concern was one that was in place throughout Europe: creating smoke stacks that were high enough for wind to carry the discharge away from the city. This also became the most common approach for Vienna, which at one point had a height restriction on chimneys of approximately fifteen meters. In 1871, thirty businesses were the subject of complaint, and for each one, the *Stadtfysikat* recommended the construction of taller smoke stacks.\textsuperscript{151} In another instance, the city negotiated over the establishment of a soap maker, and imposed two conditions on the business before assenting to its operation. The first restricted its tallow-melting process to nighttime, so as to avoid any complaints or discomfort among the population. The second condition consisted of two parts. First, the city mandated that the soap maker place smoke collectors (*Dunstsammelmänteln*) over the melting kettles, and second, since “coal was used almost exclusively for firing now,” it “insisted on the use of sufficiently high smoke stacks” so that that the confluence of smoke and vapors would be discharged high over the roof.\textsuperscript{152} City officials recognized that the limit of fifteen meters was insufficient in many cases, and the *Stadtfysikat* reported in 1875 that the allowable height had doubled to roughly thirty meters.\textsuperscript{153}

\textsuperscript{149} Innhauser and Nusser, *Jahres Bericht im Jahre 1871*, 26.
\textsuperscript{150} Innhauser and Nusser, *Jahres Bericht im Jahre 1872*, 28.
\textsuperscript{151} Innhauser and Nusser, *Jahres Bericht im Jahre 1871*, 18.
\textsuperscript{152} Innhauser and Nusser, *Jahres Bericht im Jahre 1872*, 30.
\textsuperscript{153} Innhauser and Nusser, *Jahres Bericht im Jahre 1875*, 26-27.
Although creating tall smoke stacks was among the most common strategies used to tackle smoke pollution, the Stadtfysikat was also willing to exert direct pressure on a business if it was not operating properly. In 1875, the Stadtfysikat reported that during the construction of the Grand Hotel, still currently in operation on the Ringstraße, the business was allowed the installation of a steam engine on the condition that cleaner-burning coke be used instead of coal, so as to prevent the annoyance of local inhabitants. The hotel did not follow this order, much to the detriment of nearby (quite vocal) residents. As a result, the Stadtfysikat “insisted that the management will behave and comply with the terms of the concession, or cease operation.” 154 In another case involving the construction of a pottery factory, the Stadtfysikat imposed a condition that the smoke stacks reach above the neighboring houses so as to prevent any smoke nuisance among local residents. 155

Coal did not have to be burned in order to cause problems. Unlike the natural gas that would later command a major share of domestic fuel consumption, coal could not be transported through pipes directly into burners. Instead, it had to be hauled to where it was needed within the city, meaning that the loading and unloading of coal often occurred in the city streets. In 1871, however, the Stadtfysikat declared that it was going to use every opportunity to find and stop pollution of the air in streets and squares, instituted fines for anyone who dumped coal or coke in the street, and issued sixteen fines for dumping coal in the street that year. 156 By 1872, that number had risen to fifty-five, all of which were between one and two gulden, a not-insignificant

154 Innhauser and Nusser, Jahres Bericht im Jahre 1875, 27.
155 Innhauser and Nusser, Jahres Bericht im Jahre 1871, 23.
156 Ibid., 15.
sum for the average worker at the time. See chapter 1 for a more comprehensive examination of average wages and expenditures.\textsuperscript{157}

Air pollution in Vienna did not solely consist of coal, however. Before the advent of the vacuum cleaner, the most common method of cleaning rugs and carpets was to take them to an outdoor space and beat them, causing the accumulated dirt and dust to fall off. On an individual level, this activity does not cause much harm, but, as with most of the examples of industrial development in Vienna, the increasing numbers of people doing this in crowded urban areas turned it into a significant problem. Although the beating of carpets in popular streets and squares was a less urgent concern than contaminated wells or animals decomposing in the street, it was nonetheless a large enough concern to warrant inclusion into the annual health reports. Despite this attention and the \textit{Stadtfysikat} repeatedly pressing for the police to put an end to the practice, their concerns went unheeded. Instead, carpet beating was practiced “undisturbed, all day,” often in very public places such as in front of the Peterskirche.\textsuperscript{158} The \textit{Stadtfysikat} was vocal in its dissatisfaction with this, writing that it was “disappointed again this year, because despite the repeated complaints of the Vienna City Magistrate and the personal intervention of the city physician, the imperial police authority, in whom the power to eliminate the problem alone is bestowed, does not provide the necessary support.”\textsuperscript{159}

In a time when urban roads often went unpaved, the dry dirt could also easily be kicked up by the numerous passersby and animals until large clouds of dust formed, causing considerable nuisance to travelers and nearby residents. This was a problem even on paved streets, as the households often emptied their dirt and waste directly into the street during this

\textsuperscript{157} Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1872}, 20.
\textsuperscript{158} Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1871}, 29-30.
\textsuperscript{159} Ibid., 20-21.
time, and manure left on the street from the many animals in use eventually dried. All of this could easily create a layer of dirt and dust that would be kicked up by foot and vehicle traffic, and with more and more people crowding into the city, the amount of waste and the amount of traffic only increased year after year. More attention was paid to this problem than carpet beating, as the _Stadtfysikat_ reported, “while the expenses for cleaning and spraying the squares and streets for the purpose of dust reduction multiply every year, the greatest attention is turned to all sides of such an important part of the public health.”\textsuperscript{160}

The simplest method of preventing dust clouds on dirt roads up was to spray water on the roads. This was inherently limited in its effectiveness, however, as the water would inevitably dry up, bringing a return of the dust clouds unless the thoroughfare was sprayed again. A similar approach was taken on paved roads, as the dirt and dust that accumulated throughout the day would be sprayed off with water and into the gutter. A good example of this is the Ringstrasse, which was provided with waterworks and sprayed continuously, although it is doubtful that the rest of the city was as well equipped. There were a number of problems with this approach, however, as the _Stadtfysikat_ recognized that the “major defect lies in the nature of the roads themselves.” Because of this, the _Stadtfysikat_ was supportive of overhauling the road system and paving thoroughfares with bituminous limestone, which it asserted was superior in nearly every aspect from the already-established paving method, and would provide “inestimable benefits for the health of the inhabitants of Vienna,” largely by making it easier to clean and to avoid the generation of dust clouds.\textsuperscript{161}

\textsuperscript{160} Innhauser and Nusser, _Jahres Bericht im Jahre 1872_, 18.
\textsuperscript{161} Ibid., 18-19.
Although certain immediate problems may have been reduced or eliminated through the construction of tall smoke stacks or a threat of closing a business, the amount of coal burned, and thus the amount of pollution released, would continue to increase into the twentieth century. This, combined with Vienna’s lack of a comprehensive strategy for tackling coal pollution, meant that the amount of success it could have had was inherently limited.

Austria was not the only state with the lack of an organized response to the problem of smoke pollution. Just to the north, a newly united Germany struggled to deal with the side effects of its own rapidly developing industrial sector in the face of bureaucratic ambivalence and entrepreneurial lethargy. Like Vienna, bureaucrats in Germany failed to develop any sort of

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comprehensive strategy to reduce smoke emissions, instead relying on a case-by-case basis to deal with complaints that were brought to their attention. This was not necessarily the case in all of Germany, as major cities such as Hamburg, Munich, and Dresden established comprehensive plans and new organizations to combat the problem, but these remained the exception rather than the rule. A broad, proactive strategy to reduce pollution from coal and industry would elude Germany throughout the nineteenth century, as it did in Vienna during the same period.163

Examples of Industrial Pollution

 Coal may have been the main driver of the industrial economy in Austria and Germany, but it was far from the only source of pollution. As manufacturing began to increase in Vienna, so too did the amount of industrial waste produced. Vienna was largely known as a center of textile production, but there was also a significant number of other waste-heavy industries located in the city, especially along the urban waterways. Figure 4.2 demonstrates the numerous and varied industrial sites located in Vienna prior to the demolition of the city walls in 1858. The legend lists (in order from top to bottom) breweries, chemical industries, leather tanneries, dye works, mills, textile printing shops, slaughterhouses, and animal processing facilities. Each of these industries was important for Vienna’s development into a center of production, but along with the economic base, they also generated significant amounts of waste.

 Given the significant cultural importance of beer in central Europe, for instance, it is not surprising that large amounts of it were consumed in Vienna during the nineteenth century. In fact, as was shown in chapter 3, beer was the third-most consumed foodstuff per capita in 1830 (behind cereals and eggs), and the absolute highest in 1870. By comparing the per capita

consumption and total population of the city, one can calculate that Vienna consumed approximately 166 million kilograms of beer in 1870. That is not to say that 166 million kilograms of beer were produced in Vienna in 1870, as a portion of this figure was likely imported from other parts of the empire or non-Habsburg states. Nevertheless, a number of breweries were established in Vienna, producing both beer and the byproducts associated with the brewing process.\footnote{Gierlinger, “Food and Feed Supply and Waste Disposal in the Industrialising City of Vienna,” 321.}

Modern estimates place the ratio of barrels of water to barrels of beer produced at between 3:1 and 7:1. Given the methods of beer production in the nineteenth century compared to those of the twenty-first, it is likely that the actual ratio during this time period was closer to 7:1, although it is certainly possible that it was higher still.\footnote{Brewer’s Association, “Water and Wastewater: Treatment/Volume Reduction Manual” (paper presented at the Craft Brewer’s Conference, Washington, D.C., March 26-29, 2013), 5.} Once the brewing process was complete, each liter of beer would be responsible for seven or so liters of waste water, as well as leftover solid material such as yeast and grain. There is evidence that brewers collected the solid material to be used as animal feed, but it is likely that the waste water was simply dumped into the channels or sewers that eventually led to the Danube.\footnote{Gierlinger, “Food and Feed Supply and Waste Disposal in the Industrialising City of Vienna,” 320.}

As the process of brewing beer during the nineteenth century was less advanced than in many of the high-tech and industrial-sized breweries that supply the modern world with alcohol, brewers in the nineteenth century were less aware of effective methods of pollution control than twenty-first century brewers. Because the brewing process is dependent on fermentation involving grains such as wheat or barley, the resulting waste water is highly organic in nature. Because of this, brewery waste water has a very high Biochemical Oxygen Demand, or BOD,
meaning that a large amount of oxygen is absorbed in the process of breaking down the organic material in the water, resulting in less oxygen available for plants or fish. This has the same net effect on the biological viability of the river that dumping nitrogen into the waterway does.  

Due to the fact that much of the waste produced during the brewing process is liquid, the problems associated with brewery waste were linked closely to the inadequate nature of Vienna’s waste channel system. After being disposed of, the waste flowed through the city toward the Danube River, mixing with the other effluent dumped into the channels, contributing to a larger problem rather than creating one on its own. The Stadtfysikat’s suggestion to create a unified water and sewage system was one of the most effective strategies to overcome not only the pollution generated from breweries, but from many other industries as well. Although this solution only made it easier to dump waste into the Danube, several studies have concluded that the river possessed a capacity for self-cleaning that exceeded the amount of waste disposed of at the time.  

Another major industry in Vienna during the nineteenth century was leather production. Leather was a fundamental component of numerous products, from saddles for the thousands of horses in the city to shoes for its hundreds of thousands of human inhabitants, and even binding for books in an increasingly literate world. This high demand required numerous tanneries for the processing of animal skins to be turned into leather. Figure 4.2 indicates that Vienna had many such tanneries located in its suburbs prior to 1857, a number which may very well have increased throughout the remainder of the century. Tanneries tended to contribute large amounts

168 Gierlinger et al., “Feeding and Cleaning the City,” 234-235.
of both air and water pollution, much to the chagrin of the Stadtfysikat and the individuals who lived near them. Like the pollution from breweries, much of the tannerys’ waste was simply dumped into the city’s waste channels. Unlike in the case of breweries, however, there was a significant amount of other tannery waste and pollution that led to additional, more reactive measures to be taken by the Stadtfysikat.

During the nineteenth century there were a few methods through which leather could be properly tanned to turn it into a useful product, but the references to “tanbark” (Lohe) in the Stadtfysikat reports imply that the primary method used in Vienna was the fairly standard process of vegetable tanning. In this method, tanners used naturally occurring chemicals called tannins that were present in numerous plants to turn the hide into a useable product. After an animal was killed, the skin was cured with salt in order to slow the decomposition process. Once the tannery obtained the hide, workers began the process of tanning by soaking the hide in pits of water to remove the salt and other material such as dirt, dung, and blood. The next step in the tanning process was known as liming, as the hide was immersed in a vat of lime solution so that the hairs would be weakened and thus easily removed. After three or four days of immersion, the hides were stretched out and the hair was removed by a scraping tool. It was at this point that the hide was ready to be processed into useable leather. The newly cleaned hides were submerged in several vats of tannin solution, with each immersion stronger than the previous. The amount of time the hides was submerged varied according to the desired use of the final product. Tannins are substances that are present in plants and are used to tan leather.

product, but the process required at least several months to turn hides into valuable leather. After this point, the product was scraped by hand to remove any residue and then set aside to dry. 171

Each step in the tanning process produced significant waste which could threaten the health and well-being of the population around the tanneries. The numerous steps during which the hide was submerged a solution in particular led to a significant amount of waste water. Any of the material that could not be sold or used (such as hair or bones) was likely dumped into one of the many channels that flowed throughout the city. A large number of these tanneries were located on or near the Vienna River, meaning that any waste dumped in the channels would flow through large portions of the rest of the city, assuming there was enough water to flush it through.

Residents in Vienna were well aware of the unsavory nature of the leather production process, because many of them were directly exposed to the effluent produced by tanneries. In 1872, the Stadtfysikat reported that when construction began on two new buildings in the Second District that were located on former tannery sites, “the excavated soil caused such unbearable, far-spreading stench that for the protection of local residents, the excavation had to be stopped, and only by using stench neutralization efforts, whose use was monitored continuously, could it be allowed to continue.”172 This was not an isolated incident. Just a year later the Stadtfysikat reported, “the excavation of soil at a construction site where another such tannery was located also clearly demonstrated the great extent to which the soil becomes saturated with putrefying animal substances.”173 This infiltration of the soil also caused concern that nearby wells could

171 Ibid., 94.
172 Innhauser and Nusser, Jahres Bericht im Jahre 1872, 23.
173 Innhauser and Nusser, Jahres Bericht im Jahre 1873, 8.
have been contaminated, and to avert this, the _Stadtphysikat_ advocated that tanners keep material such as tanbark in well covered, waterproof pits.\(^{174}\)

It was not only the skins or the waste water that caused complaints. Near a home for the disabled in Vienna’s Third District, the tannery’s habit of allowing piles of wet tanbark and large pools of blood to accumulate in the courtyard caused “such malodorous vapors that the complaint seemed justified and a remedy was necessary.” Such remedies included eliminating the massive accumulation of tanbark and blood in the courtyard, as well as mandating that blood should be diluted with water prior to pouring it into waste channels.\(^{175}\) Even the simple act of drying fresh hides before processing them caused such a problem among residents that in 1873, after intervening eight separate times, the Magistrate finally pronounced a general prohibition of drying such skins.\(^{176}\) The varied pollutants created during the production of leather meant that a variety of different approaches, both proactive and reactive, were more effective than just one or the other. While a centralized water and sewer system would take care of much of the waste, more specific problems such as noxious odors and large pools of blood required the city to intervene directly to get tanners to change their behavior.

Leather was not the only product derived from animals. Materials such as bone, horn, and antler were commonly used to make small household items such as buttons, brush handles, and decorative objects. There were a number of factories dedicated to processing those materials, with horn button factories being among the most common. The first step in the processing of horn buttons is to separate any meat or sinew that may still be attached to the material, which the _Stadtphysikat_ indicated would be accomplished through the process of attenuation. After this, the


\(^{176}\) Innhauser and Nusser, *Jahres Bericht im Jahre 1873*, 8.
horn was softened by boiling it, before finally shaping it by squeezing the material between two hot iron plates. Each of these steps produced “malodorous and harmful vapors” and as such their removal from areas near homes and working spaces was “imperative.”177 The Stadtfysikat approached the pollution from horn button factories in much the same way that it tackled pollution from tanners. Specifically, it banned the use of fresh (or “green”) horns from being used, which would cause stinking vapors to stream through the windows of the factory and into the surrounding area.178

Conclusion

By the 1870s, city officials, particularly those in the Stadtfysikat, were highly supportive of taking concrete steps to improve the living conditions of the inhabitants of the city, even if the cost of taking those steps was significant. By imposing operating conditions on factories before allowing them to open and by promoting a prohibition on certain behaviors, city officials in the Stadtfysikat attempted to take an active role in the city’s health. However, the lack of a comprehensive plan to tackle the problems of pollution meant that while the Stadtfysikat implemented a few proactive policies to tackle pollution at the source, it had to rely on an even larger number of reactive policies that only dealt with one or two individual sites at a time.

177 Innhauser and Nusser, Jahres Bericht im Jahre 1871, 20.
178 Innhauser and Nusser, Jahres Bericht im Jahre 1872, 32.
CHAPTER V: “SUCH LOSSES ARE SOON FORGOTTEN”:
DEATH, DISEASE, AND VACCINATION IN AUSTRIA AND VIENNA

Many of the issues already discussed, such as overcrowding in apartments and a lack of sanitary facilities had effects that go far beyond simple discomfort, especially as these conditions create a perfect environment for disease to spread quickly and easily. Plague and epidemic was a fact of life for urban dwellers around the world in the nineteenth century, largely due to the combination of unhygienic conditions and dense populations. The problem was exacerbated by a modern scientific understanding of biology that was still in its infancy. Diseases like cholera, typhoid fever, and smallpox made the rounds in Europe with deadly frequency, and Vienna was no exception. In fact, many of the conditions of urban living already discussed in previous chapters contributed greatly to the spread of diseases like tuberculosis, an airborne disease that became the deadliest affliction in the city partly as a result of the cramped and overcrowded dwellings, and cholera, a relatively new (to Europe, at least) waterborne disease that spread from contaminated water sources.

Although disease had always plagued cities, Vienna’s rapid growth and increasing density created an unprecedented challenge for urban administrators, which they met in ways that were often innovative when compared to previous efforts in the city. The use of chemical analysis and scientific advances such as the vaccine were important tools in identifying the source of an outbreak of disease and preventing infections from spreading through the general population. The truly novel part of these developments was not the methods with which urban administrators approached the problem of disease, however, but rather the fact that the city felt it was its responsibility to deal with these problems at all. Emblematic of this shift was the push to introduce mandatory vaccination throughout the empire, as even something as private as the
inside of an individual’s body became the subject of debate. For what was once the realm of the private individual became a matter of the public health as the threat of epidemic disease grew to new heights.

Smallpox

The pox ravaged human populations for millennia and by the seventeenth century had become the deadliest of the numerous infectious diseases that plagued Europe. It was a perennial problem in Vienna, which often saw thousands of cases per year that resulted in death or permanent disfigurement from the scarring that accompanied the disease. Smallpox was caused by one of two virus variants; Variola major and Variola minor. The more serious of the two was Variola major, which killed twenty to forty percent of those who contracted it. The disease was not initially fatal but began with a number of minor symptoms including red eyes, a sore throat, pain in the head, back, and groin, weariness, faintness, hot and cold flashes, nausea, and a rapid heartbeat. After a short period of incubation, the disease would cause an outbreak of small red spots on the face, neck, and chest that would spread throughout the rest of the body after several days. During this period, the spots would continue to grow, eventually forming large pustules that covered entire sections of skin. Eventually the pustules would break, dry, and fall off, often leaving large pits behind. For the unlucky twenty to forty percent of victims for which the disease proved fatal, death often occurred within two weeks.

As can be seen in Figures 5.1 and 5.2, the smallpox rate in Vienna spiked in 1872, up from 7.6 cases per 10,000 inhabitants in 1871 to 52.7 a year later. The increase in the number

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180 Ibid., 4-5.
of cases also corresponded to an increase in the number of deaths reported from the disease. The Stadtfysikat reported that 473 people lost their lives to the disease in 1871, which increased almost eightfold in 1872, to 3,334. This was followed by a slow decline over the next five years.\textsuperscript{182} Such a large increase is especially significant given that the General Hospital in Vienna had reported only 6,213 cases in the entire twenty-year period from 1837 to 1856.\textsuperscript{183} The ubiquity of smallpox led to the disease becoming a fact of life in urban spaces during this time period, and except for a few spikes, the rate of death from the disease remained fairly steady. Prior to a particularly large outbreak of the disease in 1872, Austria as a whole saw an average of just over 27 deaths per 100,000 inhabitants annually from 1846 to 1871 (See Figure 5.5). In Vienna, smallpox was responsible for 5.9 percent of the deaths by infectious disease in 1871\textsuperscript{184}, which spiked the next year to 32.5 percent, concurrent with the larger outbreak of the disease as seen in Figure 5.5. Curiously, despite the overall mortality rate in Austria increasing in 1873, Vienna saw a distinct drop in deaths from smallpox to around 13.4 percent. Although an outbreak of cholera in the city that year may initially explain the drop in percentage, the absolute number of deaths from smallpox declined as well, meaning that deaths in Vienna fell while they increased throughout the empire. The percentage continued to drop in 1875, to 11.5 percent, followed by a further decline to 8.3 percent in 1877.\textsuperscript{185}

\textsuperscript{184} In the Stadtfysikat reports, Tuberculosis is given its own descriptive section separate from that of other contagious diseases, so the percentage figures are arrived at by adding the totals from respiratory tuberculosis to the totals from contagious diseases.
Figure 5.1: Deaths by Infectious Disease in Vienna, 1871-1877\textsuperscript{186}

Figure 5.2: Infectious Disease Deaths in Vienna by Percentage, 1871-1877\textsuperscript{187}

\textsuperscript{186} Graph created by author. Source: Ibid.

\textsuperscript{187} Graph created by author. Source: Ibid.
Typhoid Fever

Although not as high profile a disease as smallpox, typhoid fever was a significant challenge for the inhabitants of Vienna, and it frequently killed hundreds of people per year, as shown in figure 5.1. The disease is particularly prevalent among populations that do not have adequate sanitary or hygiene facilities, which characterized much of the urban population of Vienna during the nineteenth century. Caused by the bacterium Salmonella enterica, typhoid fever is a disease primarily transmitted through water or food that is contaminated by the fecal matter of infected individuals. As the inhabitants of Vienna relied upon a system of easily contaminated wells for most of their drinking water until 1873, the chance of typhoid fever spreading was ever-present. If an individual did draw from a contaminated well, numerous symptoms such as fever, headache, malaise, and abdominal discomfort would follow shortly thereafter. Before the development of antibiotics, the disease would simply run its course in an infected individual over several weeks, and as a result the fatality rate of those infected could be as high as twenty percent.  

Typhoid fever remained a steady, if declining, threat to the population of Vienna during the 1870s. In 1871, it caused the second-highest number of deaths from contagious disease in the city, even more than the dreaded smallpox (See Figure 5.1). Over the course of the decade, however, the percentage of lives claimed by typhoid fever steadily declined, from 12 percent in 1871 to 7.4 in 1872. This rate declined even further in 1873 to 6.9 percent, with a steep drop to 4.75 by 1877. In absolute numbers, the number of people dying from the disease declined as

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well, so the drop in percentage cannot be explained by other diseases simply claiming more lives.\textsuperscript{189}

\textit{Tuberculosis}

Although smallpox is often given a prominent place in popular memory of disease, the deadliest affliction in Vienna in the 1870s by far was tuberculosis. Commonly referred to as “consumption,” it is an infection caused by the bacteria \textit{M. tuberculosis} that primarily affects the lungs. The respiratory nature of the disease made it extremely contagious, as the bacteria causing it could be spread easily through coughing, sneezing, or even speaking. In the crowded homes and workspaces of nineteenth-century Vienna, a respiratory-borne illness had a very good chance of spreading, especially among the working class whose health already suffered from the adverse living conditions. Months could pass after exposure to the disease before symptoms became apparent, which include weight loss, night sweats, fever, loss of appetite, fatigue, chest pain, shortness of breath, and extended periods of coughing which may include sputum and/or blood.\textsuperscript{190}

The ease of transmission and the lack of an effective cure or means of prevention all contributed to making tuberculosis the deadliest disease in Vienna during the 1870s. Throughout the whole of Vienna, respiratory tuberculosis claimed 65 percent of all deaths by infectious disease in 1871, or over five thousand people. The share of deaths attributed to tuberculosis dropped fairly sharply in the next two years, but given the relatively small decline in absolute


\textsuperscript{190} Carol Dyer, \textit{Biographies of Disease: Tuberculosis} (Santa Barbara: Greenwood, 2010), 15-16.
numbers, this can be attributed largely to an outbreak of smallpox in 1872 followed immediately by an outbreak of cholera in 1873 (See Figure 5.2). By 1875, the share of deaths from tuberculosis in relation to all deaths by infectious disease had climbed back to 67.7 percent, before decreasing slightly to 67.2 in 1877. Tuberculosis also claimed nearly one-third of all those who died in Vienna that year for any reason, demonstrating that it was an illness that not only rampaged through much of the population, but one that was largely unaffected by the improvements in sanitary conditions that led to a general decrease in other diseases such as cholera or typhoid fever. In fact, the increase in unsanitary housing conditions as discussed in chapter 2 meant more damp and overcrowded spaces that facilitated the transmission of the disease between individuals and did nothing to manage its progression once contracted.

Cholera

Cholera presented a unique challenge for the urban population of Vienna, as it was a relatively new disease that was not fully understood, and which was truly epidemic in nature. In contrast to diseases like tuberculosis or smallpox, which had a large but fairly constant presence in the population (See Figure 5.1), cholera arrived suddenly, inflicting a significant amount of damage on a population before receding for a period of time, only to reappear again a short time later. Although cholera has existed for centuries, it was largely confined to the Indian subcontinent until 1817, when it quickly began to spread throughout the world, undoubtedly facilitated by the increasing rapidity of travel and the more interconnected nature of the world in the nineteenth century. The unsanitary nature of most urban spaces also greatly contributed to the spread of the disease, as cholera is primarily transmitted through water sources infected with

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191 Innhauser and Nusser, Jahres Bericht im Jahre 1871, XXII-XXIV; Innhauser and Nusser, Jahres Bericht im Jahre 1872, XXV-XXVII; Innhauser and Nusser, Jahres Bericht im Jahre 1873, XXX-XXXII; Innhauser and Nusser, Jahres Bericht im Jahre 1875, XVI-XIX; Innhauser and Nusser, Jahres Bericht im Jahre 1877, XVII-XXI.
fecal matter. This was particularly a problem for Vienna, which relied almost exclusively on frequently-contaminated wells for its drinking water as well as the patchwork system of waste disposal discussed in chapter 3 that often resulted in possibly-infected waste lingering in crowded urban spaces for extended periods of time.

Cholera is not caused by the fecal matter itself, but rather the bacterium *Vibrio cholera* which creates a number of symptoms, the most evident of which is severe diarrhea causing an infected person to discharge up to one liter of liquid per hour. This rapid loss of water can quickly lead to severe dehydration and all of the associated side effects, such as lethargy, weakness, muscle cramping due to electrolyte imbalance, and in some cases, altered consciousness, seizures, and coma. Without treatment, the dehydration caused by the bacterium can quickly lead to death, but without a comprehensive understanding of the biological mechanisms involved, the effectiveness of any treatment during the nineteenth century was inherently limited. Compounding the problem was the fact that the most obvious means of treating dehydration is to give the infected person water, which, given the nature of sanitation, may very well have been the source of the infection in the first place.

These problems resulted in a fatality rate for those affected with cholera to be extremely high. An outbreak of the disease in the summer of 1866 was reported in which 42.5 percent of the 6,500 cases resulted in death within four months. In the period between outbreaks, the number of deaths caused by cholera was extremely low, as there was only one reported death from the disease in 1872, and none at all in 1871. Another outbreak occurred in 1873, however,

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193 Ibid., 2469.
and resulted in the deaths of 2,855 people.\textsuperscript{195} Once this outbreak was resolved, the number of deaths fell back into the single digits. Possibly contributing to this reduction was the opening of the First Mountain Spring Pipeline in 1873. Once the inhabitants of Vienna could draw their water from clean sources many miles away instead of from wells frequently contaminated by fecal matter or other biological material, the risks of contracting a disease from drinking water decreased. In fact, the next cholera pandemic that occurred from 1881-96 completely bypassed the city, with Italy, France, Spain, and Hamburg being the only places in Central and Western Europe that were significantly affected by the disease.\textsuperscript{196}

\textit{Inoculation and Vaccination in Austria}

Treating the symptoms of a disease like cholera or smallpox is one thing, but preventing the disease from taking hold altogether is something entirely different. While a comprehensive sewer system and clean drinking water went a long way toward reducing incidences of plague and epidemic in the nineteenth century, the most effective method of preventing certain diseases was (and still is) vaccination. Europeans first became acquainted with inoculation, the precursor to modern vaccination, after Lady Mary Worley Montagu witnessed the practice among the population of Adrianople while serving with her husband, the British ambassador to the Ottoman Empire.\textsuperscript{197} Lady Montagu wrote to her friends in England in April of 1717, describing the process in what has since become a famous passage in the history of preventative medicine:

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\textsuperscript{196} J.N. Hays, \textit{Epidemics and Pandemics: Their Impacts on Human History} (Santa Barbara: ABC-Clio, 2005), 303-305.
\end{flushright}
The small-pox, so fatal, and so general amongst us, is here entirely harmless by the invention of *ingrafting*, which is the name they give it. There is a set of old women who make it their business to perform the operation every autumn, in the month of September, when the great heat is abated. People send to one another to know if any of their family has a mind to have the small-pox: they make parties for this purpose, and when they are met (commonly fifteen or sixteen together), the old woman comes with a nut-shell full of the matter of the best sort of small-pox, and asks what veins you please to have opened. She immediately rips open that you offer to her with a large needle (which gives you no more pain than a common scratch) and puts into the vein as much venom as can lie upon the head of her needle, and after binds up the little wound with a hollow bit of shell; and in this manner opens four or five veins. . . . The children or young patients play together all the rest of the day, and are in perfect health to the eighth. Then the fever begins to seize them, and they keep their beds two days, very seldom three. They have very rarely above twenty or thirty [pocks] in their faces, which never mark; and in eight days’ time they are as well as before their illness. . . . Every year, thousands undergo this operation.¹⁹⁸

Inoculation in this manner worked by virtue of the body’s natural ability to fight off infection. Once a mild case of the smallpox virus is introduced into the bloodstream, natural antibodies are developed which prevent subsequent infection by a more serious strain that might have otherwise led to permanent disfigurement, blindness, or even death.

Despite the benefits brought from smallpox inoculation, the process carried significant risks, as the disease still had a chance to take hold once introduced into the body. It was not until 1798 when a safer alternative was introduced by Edward Jenner in his seminal publication, *An Inquiry into the Causes and Effects of the Variolæ Vaccinæ*. After performing a number of experiments, Jenner concluded that not only was the cow pox less dangerous than the small pox, but infection with the former provided almost complete protection from the latter. As a result, individuals could be protected from smallpox at less risk to themselves.¹⁹⁹ This new discovery

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quickly spread, and the physician Jean de Carro performed the first mass vaccination in continental Europe on December 10, 1800, in the town of Brunn am Gebirge, located about ten miles from Vienna’s First District. By 1803, inoculation was banned altogether in favor of the new, safer method of vaccination. This marked the beginning of vaccination in Austria, as well as a new chapter in the struggle to protect the population from disease. 200

For the first time, humanity had a tool that could proactively address one of the deadliest diseases in history, and for the most part, medical professionals in Austria recognized that fact. Jean de Carro promoted the practice in Lower Austria, Martin Claudius Scherer did the same in Tyrol, specifically Innsbruck, Joseph Bernt was the first to begin vaccinating in Bohemia in 1800, and a host of other doctors performed vaccinations in cities throughout the empire. 201 Despite the clear support from the medical community early on, vaccination rates began slipping, causing the government to issue decrees supporting the practice, including inviting parents to obtain vaccinations for free at the Smallpox Protection Institute in Vienna. Far from being limited to Vienna, however, physicians and surgeons of the cities were required to provide vaccinations every Sunday. 202 Perhaps to help gain the public’s trust, the government was particularly stringent about the qualifications of inoculating physicians, writing: “In order to exercise the cowpox vaccination with virtue and safety, vaccinators must have the most accurate knowledge of the course of cowpox and its characteristics.” 203 Furthermore, “all doctors and surgeons who report to the district physician or are employed in the public vaccination

201 Ibid., 267-268.
202 Ibid., 268-269.
institutions in the capital are required to obtain instruction on the cowpox vaccination, …and no one may be turned away, under severe punishment.”

Further attempts to promote the practice of vaccination were included in the Provision of the Cowpox Vaccination in the Imperial and Royal States, passed in 1836. This act specified that vaccines for cowpox were to be free of charge, stating, “all district doctors, as well as urban and rural physicians are to be obligated to disseminate the cowpox vaccination to the best of their ability, and to make the same free of charge for all those less well-off.” By 1863, the Austrian government was spending 122,460 gulden on vaccinations annually, with 5,234 going to the region of Lower Austria, where Vienna is located. This was out of an overall budget of 401,957,935 gulden. This was a greater figure than was accorded to the Council of Ministers (74,306) and the cabinet office (75,709), and approached that of the State Ministry (150,364). These figures illustrate the significant effort and expense that the Austrian government was willing to undertake in order to promote vaccination in a period when the population was still highly skeptical of the practice. Figure 5.3 shows government spending on vaccinations in Austria from 1863 to 1871.

204 Ibid., 7.
205 Ibid.
207 Ibid., 438.
The Austrian government also turned to religion as a potential way to influence the population and promote vaccinations. The Cowpox law of 1836 not only regulated many aspects of vaccination in Austria, including the means of collecting and storing the necessary biological material, the methods of performing a vaccination, and the certification of medical personnel, but it also encouraged pastors and teachers to “make people receptive of the cowpox inoculation,” particularly encouraging one-on-one discussions with individuals in a congregation rather than

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simply preaching, as “private conversations usually find easier input than teaching from the pulpit.” Priests were also recruited to assuage the fears of the population who may have regarded vaccinations with distrust. To that end, priests were obligated “to be present at any immunizations in their diocese,” which was done to “resolve religious and moral doubts as well as instill trust towards immunization.” Local authorities were also obligated to have an official present at every major vaccination along with the parish council. The explicit promotion of vaccination, as well as the involvement of religion in the vaccination debate shows that the government was beginning to view issues of disease as matters of the public health over which it had authority, rather than purely the realm of the private individual.

Vaccinations continued over the next few decades, but rates did not climb high enough to achieve herd immunity. Between 1872 and 1877, the number of total vaccinations in the region of Lower Austria increased by roughly fifty percent, from 30,915 to 46,264. Given Vienna’s status and population, it can be expected that a large portion of those vaccinations took place in the capital. Even if the vast majority did, however, the figures reported are far too small to ensure the development of herd immunity against the targeted diseases, particularly given the rapid rate of population growth in the city. Compounding this problem is the fact that not all vaccinations were successful. On average, 2.5 percent of the vaccinations given in Lower Austria between 1872 and 1877 were reported as unsuccessful. An even greater number of vaccinations were

209 Kaiserthum Oesterreich, Vorschrift über die Kuhpocken-Impfung, 6.
210 Ibid., 7.
211 Ibid.
reported as having unknown results; an average of 7.2 percent of all vaccinations given in Lower Austria between 1872 and 1875. For a more comprehensive breakdown of vaccinations in Lower Austria, see Appendix B.

In an examination of public health laws and their impacts, it is important to develop an understanding of approaches taken by other states, so as to determine which strategies would be the most effective and which would be a waste of time and resources. In the case of Austria, Prussia provides a useful case study of another central European state that took a different approach to smallpox. The Prussian government implemented mandatory vaccination in April of 1874, shortly after a large outbreak of smallpox in central Europe.214 After this point, the rate of deaths from the disease fell precipitously, and between 1880 and 1883, there was a death rate in Prussia of only 0.29 per 10,000 inhabitants, compared to Austria, which suffered from a death rate of 7.05 per 10,000 inhabitants from 1879 to 1883 (See Figures 5.4 and 5.5).215 Vienna itself provides perhaps the starkest example of this difference, which saw 89.29 deaths from smallpox per 100,000 inhabitants from 1875 to 1881, while Berlin saw only 1.7 per 100,000 during the same time period.216

Figure 5.4: Mortality from Smallpox per 100,000 Inhabitants in Prussia, 1847-1884\textsuperscript{217}

Figure 5.5: Mortality from Smallpox per 100,000 Inhabitants in Austria, 1847-1884\textsuperscript{218}


\textsuperscript{218} Ibid.
Despite the clear evidence that mandatory vaccination programs lead to a significant drop in smallpox cases, not everyone agreed on the necessity of vaccination. The Stadtfysikat recognized that there were still significant obstacles to ensuring that a critical mass of the population was properly vaccinated. In its 1871 report, the Stadtfysikat wrote:

The main obstacles that hinder the desirable distribution of this prophylactic agent are, for the most part, the lack of trust in the protective power of vaccination, the unfounded prejudices against them, the difficulty of acquiring reliable vaccines, the unjustified half-heartedness on part of those institutions which are obligated to practice or promote vaccinations, and finally the completely erroneous view of many public vaccinators that their passive conduct is justified through the non-existence of a mandatory vaccination law in Austria.\(^\text{219}\)

Each of these obstacles made the struggle against diseases such as smallpox more difficult, and tackling each of them would require varying strategies. The problem with obtaining reliable vaccines, for instance, was purely an issue of production, whereas the issue of passive vaccinators required changing individual attitudes. The hardest difficulty to overcome, however, was public opinion. Doing so required officials to either convince 80 percent of the population to accept what was then a relatively new procedure (with that being the number needed to achieve effective herd immunity),\(^\text{220}\) or to compel a large enough section of the population to achieve that figure as soon as possible.

There were numerous reasons for officials to believe that the former approach (that is, convincing a large majority of the population to accept vaccination) was not an option, particularly given the amount of time it was likely to take, as well as the number of people who


would undoubtedly die before herd immunity could be achieved. Not only would changing public opinion be starting from a difficult position, it would also be an uphill battle in many parts of the empire. In Salzburg, for instance, it was reported that recalcitrant attitudes had increased year after year since 1848, to the point where, by 1864, only between one-tenth and one-fifth of all children who needed vaccinations received them. Furthermore, only a few parishes boasted of no opposition to vaccination. Even numerous incidents of unvaccinated children succumbing to smallpox did not change widespread attitudes because, “such losses are soon forgotten.”

As it was clear that waiting for the population to come around to vaccinations on their own was not a realistic option, the Austrian government sought to implement more direct strategies to influence the population. For instance, although the officials relied on persuasion to promote vaccination in many cases during this period, certain populations were much more vulnerable to institutional coercion than the general public. Pupils in orphanages and other state care institutions, for instance, were required to be vaccinated in 1836 if they had not already survived the illness or been vaccinated earlier. The government also exercised its authority in the realm of education, writing that those “who cannot show a certificate of surviving the cowpox vaccination should not obtain any scholarships and shall not be accepted into any free public educational institutions.” Fifty years later, the Austrian government would expand this authority to include military personnel, requiring mandatory vaccination for soldiers in the army.

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223 Ibid., 6.
Even as these indirect (and not-so-indirect) attempts to influence vaccination rates were undertaken, the idea of introducing mandatory vaccination still maintained some momentum. When Salzburg requested the introduction of such a program, a ministerial decree demanded a report on the issue from committees in each constituent provinces of the monarchy, as reported by the *Fremden-Blatt* on September 19, 1864. A month later, the *Neue Freie Presse* reported that a conference took place to discuss a proposal for the implementation of general compulsory vaccination, with exemptions only for those who had been vaccinated three times without success, and those who had already survived smallpox. For children born after the proposed implementation of the law, they would have to be vaccinated within their first year of life. Considering that no compulsory vaccination law was passed following this meeting, a significant number of the provincial committees must have been opposed to the measure.

Numerous other efforts to introduce mandatory vaccination throughout the years all failed to gain significant traction. After Germany introduced a mandatory vaccination program in 1874, several governors wrote to the Austrian Ministry of the Interior, warning against the waning public interest in protective vaccinations and demanding an introduction of a system similar to Germany’s. On April 11, 1891, the Sanitary Council met and raised the subject of a vaccination bill written by Dr. Franz Celestine Ritter von Schneider, a teacher of many Austrian hygienists. This bill went nowhere, as did a 1907 call for a mandatory vaccination program by the House of Deputies in the midst of a smallpox outbreak in Vienna. Even as late as 1915, the Senior Physician to the Children’s Hospital of the University of Vienna wrote that

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when we consider the history of the great epidemic of 1870-1873, we can with certainty prophesy that the present war epidemic will not cease to-morrow [sic] nor next year, and that it will affect hundreds of thousands, unless energetic legislative measures are taken. . . . Unless we decide on compulsory vaccination, we shall have to adopt it in three to five years, for this epidemic will not cease until we have introduced those measures with which the German nation suppressed smallpox, once and for all, forty years ago.228

Even by the twentieth century there was no comprehensive plan for mandatory vaccination, which likely came as a result of the complex differences between the different regions of the empire (such as Salzburg’s desire for a vaccination program and Styria’s opposition), as well as the previously-discussed issues such as a general lack of trust, issues with production, and a lack of enthusiasm among public vaccinators about the practice.

Alternative Solutions

Highlighting the struggle between public health officials and disease was the disconnect between policies and approaches at the urban level and the empire level. Whereas the Stadtfysikat was clearly supportive of mandatory vaccination, policy makers in the imperial government were either unwilling or unable to enact any such plan. Without an effective policy of mandatory vaccination, city officials were thus forced to rely on other methods to reduce outbreaks of certain contagious diseases such as smallpox. For diseases that had no effective vaccine, however, these alternative solutions were the only ones that authorities could implement. What this meant in practice was a push for improved sanitation conditions such as the creation of a dedicated sewer system and clean drinking water, as discussed in chapter 3. But while these larger projects did much to improve the larger sanitary profile of the city, the

Stadtfysikat played an important role in more specific initiatives intended to improve the public health.

In 1871, officials were concerned about several outbreaks of Cholera that were occurring near Austria, specifically in Russia and later in Galicia, a crown land of the Austro-Hungarian Empire bordering Russia and Hungary. This prompted the implementation of a “weekly, twice-over disinfection of all toilets in Vienna by means of ferrous sulfate through, and at the expense of, the municipality.” This was carried out by dividing the all the houses of a district into sections, and then carrying out the disinfection “according to the instruction drafted by the Stadtfysikat.” This plan was implemented in September of 1871 and by December of that year, the Stadtfysikat reported that ten thousand Zentner of the chemical had been applied. A Zentner is an archaic unit of measurement that translates to one hundred kilograms, meaning that in roughly four months, the Stadtfysikat used 2.2 million pounds of iron sulfate to disinfect the toilets of Vienna. Particular care was paid attention to “schools, care homes and everywhere where a larger crowd came together,” which were cleaned daily rather than twice weekly.229

By 1873, the process of disinfection had become more precise, and began targeting waste channels in addition to toilets. Furthermore, the Stadtfysikat began using other disinfectants as well, including using crystallized carbolic acid in conjunction with iron sulfate, crude carbolic acid, zinc sulfur, ferric hydroxide, sulfate of lime, and carbolic acid. The Stadtfysikat used a total of 35,333 Zentner and 29 Pfund of iron sulfate in 1873, or nearly 7,775,000 pounds.230 Rounding out the disinfection process was another 27,308 pounds of crystallized carbolic acid, 16,290 pounds of crude carbolic acid, and 26,888 pounds of zinc sulfate. The total cost of this process,

229 Innhauser and Nusser, Jahres Bericht im Jahre 1871, 31.
230 Innhauser and Nusser, Jahres Bericht im Jahre 1873, 82.
including payment for the workers performing the disinfection, was 279,690 gulden in 1873, which was over twice the amount spent on vaccinations throughout Austria the previous years (See Figure 5.3).\textsuperscript{231} This indicates that the municipal government was highly dedicated to enacting preventative measures designed to reduce outbreaks of deadly disease, perhaps even more so than the imperial government.

Despite these numerous and expensive precautions, Vienna was faced with a devastating outbreak of Cholera in 1873 that killed nearly three thousand people and accounted for almost one-third of all deaths by infectious disease in the city (See Figure 5.1 and 5.2). To combat this epidemic, the governor of Lower Austria required that all well water in districts affected by cholera was to be examined, a task which was assigned to a newly created commission consisting of a delegate of the municipal council, the city engineer, the magistrate, and a physician. Although a physical examination of water can reliably determine whether the source of the water is infected or not, the sheer scale of the outbreak meant that testing all of the required water sources was simply not feasible. The \textit{Stadtfysikat} wrote as much in their annual report, stating that even if the city did not shy away from the significant costs associated with testing all of the wells in the city, it would still take several years to complete. And given the nature of cholera as a disease which arrives in short but devastating outbreaks, the epidemic of 1873 would have long passed before the final examination was complete.\textsuperscript{232}

In some cases, the methods used by the \textit{Stadtfysikat} to fight cholera were ahead of the science that was available or were related to theories that had only recently been developed. After observing numerous cholera epidemics, for instance, the \textit{Stadtfysikat} proposed the

\begin{itemize}
  \item \textsuperscript{231} Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1873}, 82-83.
  \item \textsuperscript{232} Ibid., 6.
\end{itemize}
compulsory disinfection of biological waste from individuals infected with the disease because they were not yet able to conclusively establish whether an individual was a carrier of the “cholera toxin.”\textsuperscript{233} The germ theory of disease had still not been fully accepted by the medical community during the 1870s, but it was generally understood that dead bodies posed a health risk, even despite the medical community’s wholesale rejection of Ignaz Semmelweis’ 1860 publication linking frequent exposure to cadavers among doctors in the Vienna General Hospital with extremely high puerperal fever rates in the hospital maternity ward.\textsuperscript{234} Regardless of the medical community’s rejection of Semmelweis’ theory, corpses in Vienna that were infected with cholera were prohibited from leaving the city, presumably to restrict the ability of the disease to spread.\textsuperscript{235}

Other proposals were more far-reaching in their scope and ambition. In 1873, for instance, the \textit{Stadtfysikat} wrote of the importance of public education and convincing everyone, down to the very last day laborer that “the overall hygiene is one of the strongest pillars of the public and private welfare,” and that “the beneficent practical results thereof can only be achieved through the cooperation of all.” Key to improving the overall hygiene was the dispelling of pauperism and “all of its horrors,” including crowded and dirty apartment spaces without any light or air.\textsuperscript{236} As seen in chapter 1, however, efforts to improve the housing situation in the city were largely ineffective, and eliminating poverty required systemic changes that would not be earnestly attempted until the Red Vienna period after the First World War.

\textsuperscript{233} Ibid., 81.
\textsuperscript{234} Joshua Manor, Nava Blum, and Yoav Lurie, ”"No Good Deed Goes Unpunished": Ignaz Semmelweis and the Story of Puerperal Fever,” \textit{Infection Control and Hospital Epidemiology} 37, no. 8 (2016): 881-882.
\textsuperscript{235} Innhauser and Nusser, \textit{Jahres Bericht im Jahre 1873}, 22.
\textsuperscript{236} Ibid., 81-82.
Conclusion

Despite clear evidence that mandatory vaccination programs reduced deaths from disease, particularly in comparison to states like Germany, no mandatory vaccination program was developed in the Austrian Empire. Thus, in the absence of a such a program, the Stadtfysikat and other governmental bodies had to rely largely on changes to the environment and an evolution of sanitation to reduce outbreaks of epidemic diseases. Although the Stadtfysikat publicly supported vaccination programs and encouraged their use among the broader population, it also identified that there were many obstacles preventing authorities from vaccinating enough people to achieve herd immunity. Public opinion struggled to accept a relatively new and controversial procedure, production issues hindered proper dissemination of vaccines throughout the empire, and unenthusiastic vaccinators undermined the effectiveness of the programs that were in place. Nevertheless, changes in the sanitary environment did impact rates of disease to the benefit of the population, especially for cholera, which was essentially banished from the city upon the completion of the First Mountain Spring Pipeline.

Such efforts undertaken by the municipal government were not unique to issues of disease, but were rather indicative of a broader trend of growing civic commitment toward improving life in the city. Because nearly every aspect of life in Vienna was connected in some way to another, it was impossible for the government to make any meaningful improvement by focusing on a narrow range of problems. Introducing vaccination would not stop tuberculosis during this period, nor would curbing smallpox fix the unsanitary system of waste disposal or industrial pollution that plagued inhabitants. As a result, the city was forced to greatly increase its activeness in the private sphere. Indeed, from household wells to the human body itself, the number of things that the municipal government of Vienna believed fell within its scope.
expanded greatly during the 1870s, demonstrating the broader change in the government’s understanding of the role it played in what was previously considered entirely private spheres of activity.
CONCLUSION
A distinct trend toward urbanization has continually reshaped history and society since the onset of the industrial revolution, and understanding the major social, political, and economic shifts that occurred during this time is vital for approaching the problems faced by urban administrators of the present and the future. Vienna provides a good case study of industrializing cities due to its experience with rapid population growth, extensive environmental changes, and developing urban administration. The changes in the built environment that came about as a result of industrialization affected the health and well-being of the inhabitants of Vienna in four distinct but interconnected topics: the availability of quality housing in a time when people were flocking to the city faster than new housing could be built for them; the development of sanitation and attempts to preserve access to clean water supplies while faced with unprecedented levels of demand for both; the drastic increase in the amount of industrial waste released from dozens of newly-created factories and workshops; and the susceptibility of the population to disease in a city that was increasingly cramped and squalid. These changes occurred extremely quickly, radically reshaping the urban landscape within the space of a few decades. Unlike many issues of health and pollution that occurred in centuries past, the city’s attempts at curbing the problems marked a transition toward a city that felt it was responsible for public services like water, waste disposal, and sanitation.

The records from the Municipal Health Authority of Vienna allow for a relatively detailed overview of the housing situation at the height of the industrial revolution to come into focus. Unsurprisingly, the working class struggled to find decent or affordable housing, often living dozens to a room with no light or ventilation. But even the middle and upper classes found it difficult to secure decent housing due to the fact that Vienna’s unique position as one of the
last major walled European cities limited potential housing development. Urban administrators in the city were painfully aware of the poor housing situation in nearly every district of the city but struggled to come up with a coherent strategy to combat the problem. They relied instead on a patchwork system of fines, evictions, and administrative leverage over business licenses that did nothing to address the underlying cause of the problem. This may have been the result of the sheer scale of the problem faced by urban administrators, as well as the limited resources available to them rather than any measure of incompetence or maliciousness, particularly if one takes into account the ever-increasing population of the city.

Housing was not the only part of the city affected by such rapid demographic growth. As more individuals flocked to Vienna, the urban metabolism of the city was transformed, with more food and energy to import and more biological waste to export. Vienna relied largely on a primitive sewer system that in many places consisted of open-air channels that (theoretically) carried waste to the Danube River, but would often become clogged, resulting in biological waste of all varieties festering in the open and creating a significant biohazard for passerby. Less utilized but equally as dangerous were cesspools connected to homes throughout the city in which waste was dumped. Although collecting the waste in a hole in the ground is undoubtedly preferable to having it decay in the streets, if the cesspools were damaged or unsealed, there was a distinct possibility that they could contaminate the wells that provided nearly all of the drinking water for the city’s inhabitants. Unlike the disjointed response to the housing crisis, however, city officials conceived and executed a plan that guaranteed access to clean drinking water, eliminated the risks associated with waste build-up in the streets, and ensured biological waste left the city quickly and efficiently. Each of these achievements were secured through the creation of the First Mountain Spring Pipeline, which brought fresh water from the Austrian Alps
into the city to replace the numerous and easily-contaminated wells. Furthermore, it ensured the city had access to a steady supply of water and thus was able to implement a fully-integrated underground sewer system that flushed waste into the newly-regulated Danube River which quickly carried it out of the city.

Industrial waste in the city proved to be as much of a challenge for urban administrators as biological waste. Key to the process of industrialization was the use of coal for fuel, which surpassed the use of biofuel in the 1870s to become the single largest source of energy for the city. This shift resulted in significantly higher levels of pollution being released into the air than from wood, creating clouds of obnoxious black smoke that drew the ire of many inhabitants. Much of the pollution plaguing Vienna during industrialization was also industry-specific, with many of the new factories and workshops in the city creating environmental hazards that inhabitants often complained about. Brewers, tanners, horn-makers, and more all took advantage of the relatively laissez-faire attitude that characterized business development in the industrial era, often dumping their waste in locations that may have been convenient for them, but harmful for nearby residents. As the inhabitants of the city began to increasingly raise objections to these unsavory business practices, the city’s understanding of its role in protecting the public evolved. Urban administrators issued rules and guidelines intended to curb the worst practices, but the lack of a comprehensive plan to tackle industrial and environmental pollution meant that their efforts were hindered from the start and the effectiveness of them was ultimately limited.

Further complicating efforts to make the city a more comfortable, livable place were frequent outbreaks of diseases such as smallpox, tuberculosis, typhoid fever, and cholera. Tuberculosis was by far the deadliest disease in the city, but urban administrators were largely helpless in the fight against tuberculosis given the lack of effective medicines against it and a
nascent understanding of the biological science underpinning germ theory and transmission of
the disease. Unlike tuberculosis, physicians had an effective preventative tool for smallpox in the
form of a vaccine. Despite the clear difference in death rates between states that mandated
vaccination during this period and those that did not, Austria never implemented such a program.
Instead, vaccine advocates relied on coercion where they could and encouragement where they
had to – a strategy which still left much of the population vulnerable to the disease. Physicians
did not have a vaccine for cholera, but their understanding of its method of transmission meant
that preventing the disease was a relatively straightforward matter of ensuring clean drinking
water. Fortunately for the inhabitants of the city, the opening of the First Mountain Spring
Pipeline coincided with the last major outbreak of the disease in Vienna. Although city officials
struggled to overcome a number of other epidemic diseases, they were at largely successful in
banishing one major disease from the city, while actively working to reduce deaths from other
diseases as well.

Each aspect of life in Vienna was inherently connected to the others in some way, making
it impossible to look at just one aspect of the built environment of Vienna during
industrialization and get a comprehensive picture of how people lived. Poor sanitation led to
deteriorating housing conditions and greater risk of outbreaks of disease, as did the cramped,
squalid nature of the homes and apartments themselves. Environmental pollution also greatly
impacted the health of individuals living near factories and other industrial sites, largely by
leeching into housing through the air or the water. The interconnected nature of these problems
should come as no surprise to a modern urban administrator or policy maker, but it is useful to
gain an understanding of how officials in the past developed their understanding of how to tackle
a complex web of problems.
The 1870s was a transformative decade for Vienna, and residents witnessed the 1873 World Exposition, the opening of the First Mountain Spring Pipeline, the transition from biofuel to coal as a primary energy source, the regulation of the Danube River, the Great Panic of 1873, and numerous outbreaks of epidemic disease during this time period. Residents also witnessed another, arguably greater transformation during this period as well: the shift in the municipal government’s understanding of its responsibilities in the public sphere. The numerous challenges that were either created or exacerbated by industrialization forced city officials to assume greater responsibility for the lives and well-being of their residents, which in many cases meant attempting to mitigate the worst effects of industrialization. In situations where the city developed concrete and comprehensive proposals to tackle the problem they were fairly successful in achieving their objectives. For problems that were approached on a case-by-case basis with no overarching vision for how to proceed, their effectiveness was extremely limited. Regardless of the success of these initiatives, however, the increased level of government involvement and interest in what was previously considered private spheres of activity was a profound shift in how the government viewed its relationship to its inhabitants and helped create a city in which the municipality was responsible for basic needs like water, waste disposal, sanitation, and health.
PRIMARY SOURCE BIBLIOGRAPHY


SECONDARY SOURCE BIBLIOGRAPHY


Appendix A

Reported Housing Problems by Year
<table>
<thead>
<tr>
<th>District</th>
<th>Moisture</th>
<th>Over-crowding</th>
<th>Lack of Light and Air, Too Low in Height, etc.</th>
<th>Inhabited subdivisions, mostly vaulted merchant areas between 4.14 and 6.22 feet high</th>
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<th>Cellar Apartments</th>
<th>Cellar workshops (wet, devoid of light and air)</th>
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Innhauser and Nusser, *Jahres Bericht Im Jahr 1875*, 3-4.

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238 Innhauser and Nusser, *Jahres Bericht Im Jahr 1875*, 3-4.
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<thead>
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<th>District</th>
<th>Inhabited Cellar Workshops</th>
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239 Inhauzer and Nusser, *Jahres Bericht Im Jahr 1877*, 3-4.
Appendix B

Vaccination Statistics in Austria by Year
## Vaccination Statistics in Austria by Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Doctors Responsible for Vaccinations (Lower Austria)</th>
<th>Unvaccinated Children (Lower Austria)</th>
<th>Children to be Vaccinated Not Yet Showing Signs of Illness (Lower Austria)</th>
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Vaccination Statistics in Austria by Year

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<td>1880</td>
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<td>1,393</td>
<td>3,404</td>
<td>48,530</td>
<td>13,866</td>
</tr>
<tr>
<td>1881</td>
<td>45,166</td>
<td>1,343</td>
<td>3,738</td>
<td>50,247</td>
<td>15,732</td>
</tr>
</tbody>
</table>

Appendix C

Infectious Disease Deaths in Vienna by Year
### Infectious Disease Deaths in Vienna by Year

<table>
<thead>
<tr>
<th>Disease</th>
<th>1871</th>
<th>1872</th>
<th>1873</th>
<th>1875</th>
<th>1877</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory Tuberculosis</td>
<td>5,185</td>
<td>4,859</td>
<td>4,545</td>
<td>4,646</td>
<td>4,763</td>
</tr>
<tr>
<td>Smallpox</td>
<td>473</td>
<td>3,334</td>
<td>1,410</td>
<td>791</td>
<td>588</td>
</tr>
<tr>
<td>Scarlet Fever</td>
<td>399</td>
<td>497</td>
<td>295</td>
<td>265</td>
<td>238</td>
</tr>
<tr>
<td>Measles</td>
<td>153</td>
<td>136</td>
<td>115</td>
<td>68</td>
<td>55</td>
</tr>
<tr>
<td>Erysipelas</td>
<td>87</td>
<td>100</td>
<td>85</td>
<td>102</td>
<td>71</td>
</tr>
<tr>
<td>Typhoid Fever</td>
<td>953</td>
<td>761</td>
<td>727</td>
<td>351</td>
<td>337</td>
</tr>
<tr>
<td>Epidemic Typhus</td>
<td>196</td>
<td>4</td>
<td>15</td>
<td>151</td>
<td>10</td>
</tr>
<tr>
<td>Diphtheria</td>
<td>185</td>
<td>213</td>
<td>139</td>
<td>237</td>
<td>818</td>
</tr>
<tr>
<td>Dysentery</td>
<td>105</td>
<td>38</td>
<td>53</td>
<td>32</td>
<td>17</td>
</tr>
<tr>
<td>Syphilis</td>
<td>21</td>
<td>36</td>
<td>28</td>
<td>40</td>
<td>42</td>
</tr>
<tr>
<td>Puerperal Fever</td>
<td>51</td>
<td>75</td>
<td>58</td>
<td>63</td>
<td>27</td>
</tr>
<tr>
<td>Whooping Cough</td>
<td>139</td>
<td>171</td>
<td>132</td>
<td>107</td>
<td>114</td>
</tr>
<tr>
<td>Malaria</td>
<td>5</td>
<td>11</td>
<td>2</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Rabies</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Cholera</td>
<td>0</td>
<td>1</td>
<td>2,855</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,958</strong></td>
<td><strong>10,239</strong></td>
<td><strong>10,462</strong></td>
<td><strong>6,863</strong></td>
<td><strong>7,087</strong></td>
</tr>
</tbody>
</table>

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