HISTORICAL CORRELATION BETWEEN PANDEMICS, ARCHITECTURE AND URBAN PLANNING

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ABSTRACT

The history of mankind has been characterized by dozens of epidemics and pandemics caused by unknown viruses, mostly of animal origin (zoonoses). In some cases, these emerged from the close coexistence of people and farm animals, later spreading through large urban agglomerations with high population density. The architecture and urban design of cities are witnesses of this process. Modern urbanism had to address the problems of cities in the late 19th century: tuberculosis, cholera, and all the other epidemics linked to overcrowding, promiscuity, and poor sanitary conditions, resulting from the economic and social transformations produced by the Industrial Revolution.
The challenges posed by the coronavirus require a reflection on its effects both at the residential and urban levels. In this respect, this work aims to study the connection between pandemics, architecture, and urban form throughout history to comprehend their interaction and develop strategies for the future.

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Figure 1. Benedetto Bordone, Map of Venice, 1528, Isolario.

Introduction

The COVID-19 pandemic had significant repercussions on all aspects of our daily lives, altering the previous use of spaces, both residential and urban. With the declaration of a state of emergency, governments implemented urgent measures to contain the spread of the pandemic, based on strict social distancing measures. Faced with this previously unknown disease, the first strategy put into practice was lockdown, leading to a drastic and sudden change in our daily routine. Forced coexistence in often inadequate spaces for carrying out everyday activities, has brought to light both physical and psychological discomforts, underscoring the need to rethink the configuration of our living spaces.

Nevertheless, the current challenges we face are not unprecedented in human history. Throughout the ages, humanity has confronted various pandemics and epidemics that have resulted in millions of casualties. Among these, diseases like plague, cholera, and tuberculosis have altered the course of human history and had far-reaching social, political, and economic effects (González Toapanta, 2021).

Research objectives

The overall objective of this work is to examine the repercussions of pandemics on urban environments and

how they affected architecture and urbanism. This analysis represents a starting point for reflection on the reconfiguration and adaptation of residential and urban spaces, resulting from the new demands arising during the pandemic.

Experts and scholars are presently contemplating the challenges posed to architecture and urban planning by the ongoing coronavirus pandemic. Conversations are centred around exploring novel approaches through which buildings can play a role in mitigating the spread of future epidemics. These discussions span various design scales, encompassing considerations for interior design, public spaces, and surface coverings. However, the overarching scenario is intricate. While there is a growing public need for air quality, open spaces, and social gathering places, it is getting harder to create solutions for a highly individualistic culture in which even intermediary institutions are losing their relevance (Nigrelli, 2021).

Based on the acquired findings, the intention is to formulate potential solutions and strategies for the future. This involves considering the imperative for social distancing and lockdown measures in the event of a pandemic, to devise effective and adaptable approaches to address similar challenges that may arise.

Methodology

The research consists of a first theoretical and documentary study phase aimed at identifying the various connections that have manifested over the centuries between pandemics, architecture, and urbanism. This initial process facilitated a comprehensive exploration of how pandemics have influenced cities and how they have responded and adapted to emerging health and social requirements, taking into account their distinct characteristics.

A review of the bibliography helped identify the relevant information sources. The most appropriate sources were obtained from research featured in books, publications, articles, and documents on the subject.

The second phase is based on the quantitative methodology to identify historical periods that experienced significant impact from major pandemics, such as the plague, cholera, and tuberculosis. Within each identified period, the research focused on delineating the contributing factors that facilitated the spread of these epidemics and subsequently documented the measures authorities undertook to curb their dissemination. This approach provides a structured analysis of historical contexts, enabling a systematic understanding of the challenges posed by pandemics and the corresponding

responses implemented by governing bodies. The reading of the past will make it possible to identify methods and strategies to deal with the current COVID-19 pandemic.

Plague

Between the 14th and 18th centuries, the plague periodically manifested in Asia and Europe through different epidemic waves. However, the second pandemic famously referred to as the "Black Plague" or "Black Death", stands out as the most extensive and fatal outbreak in history, reaching its peak between 1347 and 1353 (Pasini, 2015b).

Although the methods of transmission remained unknown and were only elucidated in the 19th century, preventive measures drew inspiration from the miasmatic humoral theory, which explained the origin of the disease through the spread in the air of poisonous particles and the so-called "miasmas", transmissible through contact with the sick. Disease control practices were based on the isolation of people, ports, and entire cities (Urquía, 2019).

Due to its strategic location and significant commercial activities, the city of Venice in Italy served as a crucial intersection for Mediterranean trade routes. The particular geographical layout inspired the establishment of the first public hospital for plague victims on the island of Santa Maria di Nazareth in 1423, named Lazzaretto (Fig. 1). The name possibly originated from the combination of the words Nazareth and Lazarus, the protector associated with leprosy and contagious diseases (Malagnini, 2021).

Very soon the Lazzaretto proved insufficient for a health policy that sought to differentiate between treatment and prevention. Therefore, in 1468, another hospital was instituted on another island. The Lazzaretto "Novo" (thus named to distinguish it from the first one) was destined to welcome those who, having recovered from the plague, had to complete a period of isolation before returning to the community. It was also used to segregate people and goods coming from infected places or those who had had contact with infected people and objects during a period called "quarantine".

Since the main objective of the lazarettes was to prevent the import of epidemics through temporary isolation, some common general characteristics can be identified. The quarantine facility had to be sealed off, resembling a fortress, to guarantee the prevention of any contact between the interior and exterior. Special consideration was given to the organization and ventilation of the rooms. A stringent segregation of individuals and goods was also implemented

within the confines. The objective was to prevent the mingling of patients at various stages of quarantine (Bonastra, 2010).
In addition, the authorities needed access to up-to-date data on the health status of the neighboring populations in order to ensure the timely adoption of preventive measures. Consequently, the first Health Passports appeared. The Fede di sanità (Pasini, 2015a) allowed holders to travel by land, confirming that they had completed the quarantine period or were not infectious, while the Patente di sanità allowed sea travel.
The empirical confirmation of the existence of an incubation period led to the abolition of a defense based on the total closure of communications of territorial units, replacing it with protection that imposed a temporary barrier to the traffic of people and goods, intended to delay rather than to ban entry (Bonastra, 2010).

Cholera

Starting from 1820, when it initially surfaced in the Mediterranean, cholera manifested cyclically, presenting in numerous seasonal waves for approximately 100 years.
The industrial cities of the late 19th century were the result of the economic and social transformations brought about by the Industrial Revolution, which gave them a new spatial configuration. They were composed by the centre, the oldest segment housing bourgeois residences and their associated services, and the expansive periphery, dominated by factories and working-class dwellings, marked by overcrowding and substandard sanitary conditions. The residential structures, typically semi-detached, were small and piled up, positioned in close proximity to the factories, which emitted dust that covered the houses and polluted the canals with hazardous fumes (Engels, 1845).
Even though the method of disease transmission was unknown, a connection was identified between the proliferation of cholera and the unsatisfactory sanitary and hygienic conditions prevalent in the poorer living environments.
Violent epidemics that significantly reduced the European population prompted extensive urban transformations (Sánchez de Juan, 2000), which were facilitated by crucial technological revolutions. These included the construction of sewerage and water supply networks; the expansion of streets and squares; a new zoning of urban territory; the definition of the performance that individual living environments should guarantee and a more specialized sanitary infrastructure (Nigrelli, 2021).

When cholera reached France in 1832, Paris was a medieval city characterized by narrow streets, crowded houses, and unsatisfactory sanitary conditions, perpetually plagued by epidemics and unrest. Emperor Napoleon III championed an urban renewal initiative known as Grands Travaux and entrusted its coordination to the Prefect of the Seine, Baron Haussmann.

Implemented continuously from 1852 to 1870, the plan involved the dismantling of the dense fabric of the ancient city and the construction of new wide, straight, tree-lined streets conducive to troop movements (Fig. 2). The old neighbourhoods were demolished and the population reallocated in the suburbs; many public and private buildings were built; water and sewerage networks were implemented. The plan resulted in a massive and radical urban modernization driven by hygienic, social, strategic, and economic considerations, making it one of the most significant urban developments of the 19th century. Even though it was criticized for the scale of its interventions, it significantly improved the quality of life in Paris. Major epidemics, excluding tuberculosis, ceased, and the quality of new buildings and road traffic saw improvements (Quijano Ramos, 2011). Barcelona, too, experienced various epidemics, with three notable waves of cholera occurring around 1850.

Figure 2. Louis Froissart, Paris, opening of the Rue Impériale, 1856.

The city was characterized by narrow streets, lacking adequate sunlight, being damp and poorly ventilated. Issues of overcrowding and public health were prevalent. As it was a walled city with a high population density, it became an ideal breeding ground for any kind of epidemic.

Following the demolition of the walls in 1854, the Ministry of Public Works entrusted the formulation of an urban expansion plan to the engineer Ildefonso Cerdá. The Plan Cerdá was a reform and expansion plan, featuring a layout structured on a geometric grid pattern (Sennett, 2019) and inspired by the principles of hygiene and an equitable territorial policy (Fig. 3). The grid of square blocks measured 113.3 meters, with the notable innovation of 45º chamfers on the corners to enhance visibility. The city was structured into neighbourhoods (comprising 25 blocks, one school, one church, and one barracks), districts (consisting of four neighbourhoods and one market), and sectors (encompassing four districts, two urban parks, one hospital, administrative buildings, and industries). Unlike Haussmann, Cerdá focused more on buildings than on public space.

According to Sánchez de Juan (2000), Cerdá stated that «the opening of great roads through the ancient City, according to the directions of the healthiest winds, would provide wide passage to light, air, men and goods, and would bring wholesomeness, well-being and wealth to the entire population». Originally, the building capacity was intended

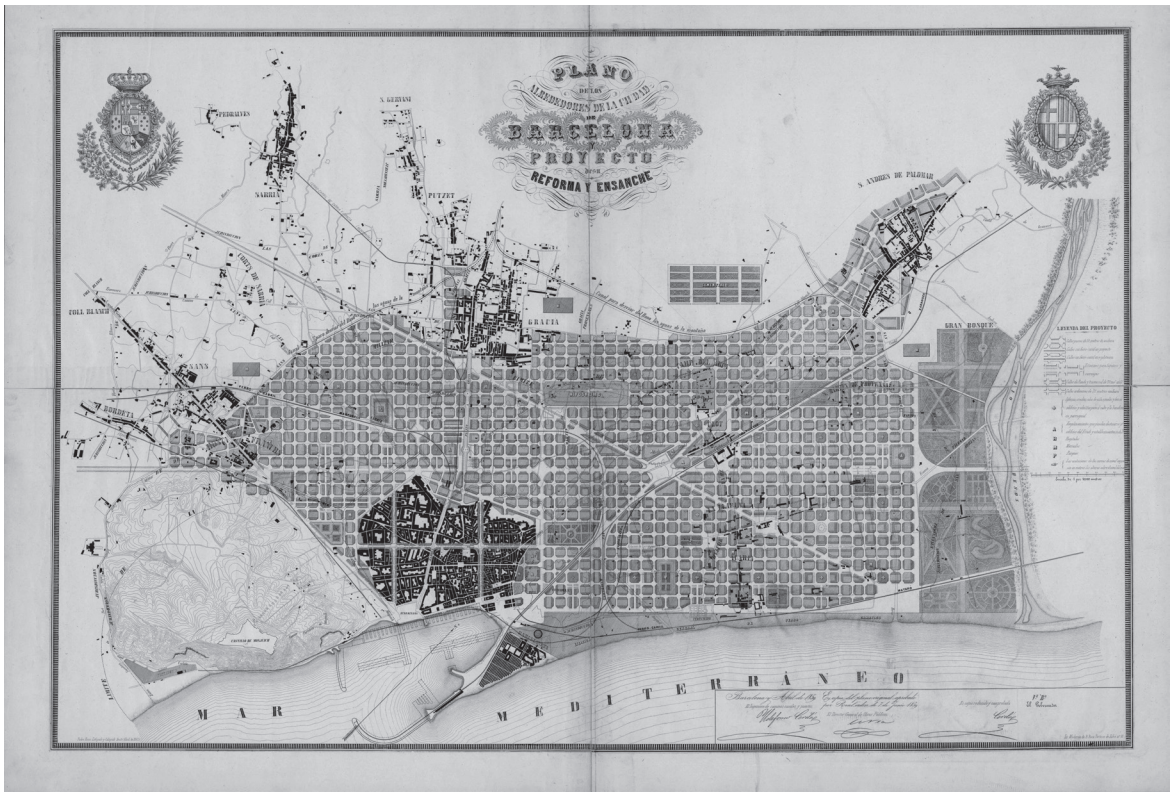

Figure 3. Ildefons Cerdà, Barcelona, Plan Cerdá, 1859, Museu d'Historia de la Ciutat, Barcelona.

to be used in a variety of ways on two sides of the block. However, as speculation and landowner interests perverted the Cerdá plan, it experienced several alterations throughout time and many of its rules were not followed (García-Ayllón Veintimilla, 2014). Thus, the goal of creating a more egalitarian city could not be realized under the plan.

In the summer of 1858, London experienced a combination of heatwave and drought that drained the River Thames, where all sorts of waste were dumped. The episode of the "Great Stink", during which the unbearable smell of untreated sewage discharged permeated the central area of the city, highlighted the need for swift interventions in the sewer system (Bryson, 2014). Considering that water for domestic and food use was drawn from the surroundings, with wells lacking proper filtration, contamination was assured, and the epidemic became inevitable. With no cure for the epidemic, the subsequent creation of a colossal sewage and waterworks system, designed by Joseph Balzagette (1819-1891), chief engineer of the Metropolitan Board of Works in London, saved the city's inhabitants, allowing them to stay and continue living in it (Del Cueto, 2021). The engineer's solution was the construction of kilometres of brick sewer tunnels parallel to the river to intercept the discharge of domestic sewage and those flowing freely through the streets (Fig. 4). The establishment of this sanitation network, that still works, marked the beginning of the cleaning of the River

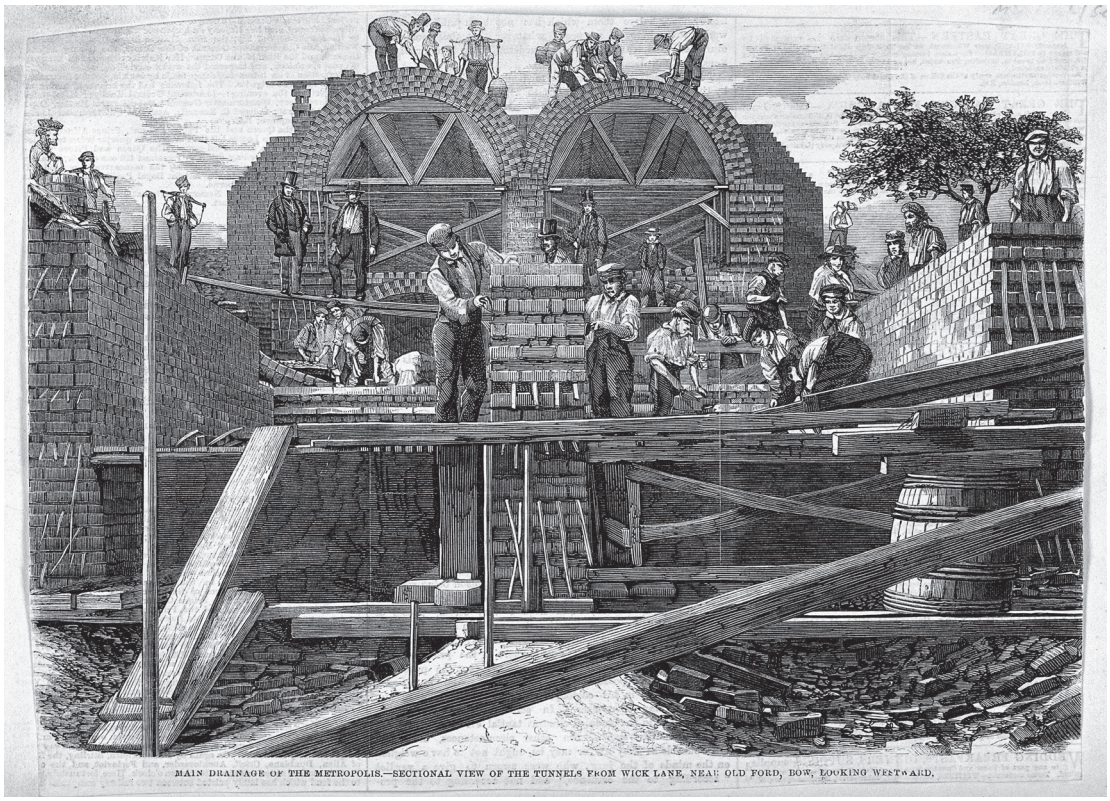

Figure 4. Main Drainage of the Metropolis, 1859. Illustrated London News, 27 Aug. 1859: 203.

Thames and was crucial in putting an end to the recurrent cholera epidemics that plagued the English capital.

Tuberculosis

Cholera was not the only disease that afflicted industrial cities. By the end of the 19th century, tuberculosis affected all social classes, with no distinction between proletarians, bourgeoisie, and nobility.
Regarding the mode of transmission, the prevailing belief was based on the miasmatic theory that asserted the disease spread through contact with that bad air. Therefore, the primary recommendation was to go to the mountains and receive treatment outdoors.
In 1859, the German physician Hermann Brehmer (1826-1889) built the first sanatorium dedicated to the hospitalization and isolation of the sick, the Kurhaus, located in Göbersdorf (Silesia) in a wooded valley at an altitude of about 560 meters (Del Curto, 2010).
The discovery of the bacillus that causes tuberculosis, by the physician Robert Koch (1843-1910) in 1882, revealed that the disease was contagious and thrived in dark and dusty environment. Therefore, exposure to sunlight, clean air, and rest emerged as crucial factors in improving the health of patients (Mumford, 2012). This understanding had a profound impact on the architecture of the early 20th century,

Figure 5. Matilde Caruso, The Paimio Sanatorium, 2019.

initiating a significant collaboration between architects and physicians in the design of sanatoriums (Colomina, 2021a).
The architects started to design hospitals with larger windows, sanatoriums with huge terraces, bathrooms covered with tiles and aerodynamic furniture where dust could not be hidden.
The first open-air schools appeared in Germany and Belgium in 1904, with huge windows or folding walls to prevent and combat the pandemic. Their success, marked by the absence of tuberculosis cases among children, allowed the concept to spread to other parts of the world in the following decades. Concrete and glass became the key materials of these new structures (Del Cueto, 2021).
The Paimio Sanatorium (1929-1933) by Alvar Aalto (1898-1976) became the true icon of the first half of the 20th century, blending modern design with functional requirements (Fig. 5). The sanatorium featured rooms with straightforward, unadorned lines. Its design was specifically influenced by the necessity for patients to remain in bed, showcasing an innovative and thoughtful approach to both aesthetics and the practical needs of healthcare architecture. The structure, emblematic of Finnish functionalism, was built using reinforced concrete, with white-painted facades modulated by the presence of large sliding windows to emphasize its horizontal character (Campbell, 2005). The color palette was carefully chosen based on the sensations they conveyed. The roof terrace allowed patients to be exposed to the benefit of fresh air and sunlight.
The impact of medical thought on architecture led to a radical change in living spaces. The creation of healthier

Figure 6. David Morocho-Jaramillo, Ville Savoye, 2016.

environments, a constant emphasis on ventilation, sunlight, and hygiene became a concern for architects. The result was the creation of buildings with white walls, flat roofs, large windows, terraces for sunbathing or exercise, hygienic bathrooms with tiled surfaces, and minimalist furniture. Lightweight, washable materials, and aerodynamic shapes became prevalent. At the same time, 19th-century architecture was demonized, being labeled as rife with diseases, particularly tuberculosis. Decoration was treated as an infection, and the purging of decorative elements was seen as a purification operation (Colomina, 2021b). Essentially, the characteristic elements of sanatoriums became distinctive features of Modern Movement housing (Colomina, 2021a).

Adolf Loos (1870-1933) was a fervent advocate for the abolition of ornamentation, considered as a physiological reaction of modern man (Loos, 1972).

Villa Savoye (1929-1931) by Le Corbusier (1887-1965) became the paradigm of the Modern Movement. The house was elevating from the ground using pilotis to avoid the potential breeding ground for disease in wet soil, featuring full-length windows, and a terrace garden (Figs. 6-7).

Richard Neutra (1892-1970) designed Lovell House (1927-1929), in collaboration with the doctor Philip Lovell. He believed that the purpose of a house extended beyond providing physical health; it should also contribute to psychological well-being (Cassinello, 1965).

Mies Van der Rohe (1886-1969) designed Tugendhat House between 1929 and 1930. Its value lies in the application of the compositional principles of modern and functionalist architecture, where the emphasis was not solely on form but on functionality. When form served functionality, beauty emerged (Frampton, 1993).

Conclusions

In the past, urban planning successfully improved the life expectancy of the city's inhabitants and limited the spread of epidemics. The architecture and urban design of cities are witnesses to this process.

The historical responses to plague, cholera, and tuberculosis have indeed shaped aspects of architecture and urban planning. While efforts during the plague era focused on isolation, prevention, disinfection, and information, cholera prompted changes in city planning to address sanitation issues, leading to the modern road networks we see today. Tuberculosis shifted attention to housing design, considering both physical and psychological well-being.

As for the impact of COVID-19 on architecture and urbanism, the challenges are significant. Immediate transformations of buildings and cities to meet emerging health requirements are impractical. The pandemic calls for a more balanced and flexible urban design, fostering a new relationship between space and time, public and private spheres. This rethinking should extend to privacy, community, equality, mobility, technology, energy, work, and climate. The post-COVID-19 architectural and urban landscape will likely require innovative solutions that integrate health, sustainability, and adaptability.

Figure 7. David Morocho-Jaramillo, Ville Savoye, 2016.

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