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INDUSTRIAL REVOLUTION AND THE BIRTH OF MODERN ARCHITECTURE

Levent Menga, page 105-122

ABSTRACT

Many factors have been effective in the emergence of modern architecture. The Industrial Revolution, which started with the steam engine found by James Watt in the late 1800s, played an important role in this. The industrial revolution, which started in European countries such as England and France, spread to the whole world in a concise time. With the industrial revolution, there have been radical changes not only in the field of architecture but also in all areas of human life. With mechanization, material access and processing became easier. Due to the need for labor that emerged with the industrial revolution, many people from rural areas flocked to the industrial zones. Although it is positive in terms of job opportunities, the unhealthy living environment of the employees and the extremely dense settlement in the industrial zones have created a chaotic environment in urban areas. To solve this, new solutions were required and the concept of apartment housing started during this period.

The industrial revolution has had many positive aspects in terms of architecture. It has become very easy to transport, process, and uses heavy metals. Apart from the use of new materials, new construction techniques have also improved, which has brought many innovations to the understanding of architecture in the world. Developing technological opportunities and the competition between countries has turned into a competition in architecture. With the use of new possibilities, materials such as metal, concrete, and glass, the architects of the period went to create a new trend of architecture and founded the modern architecture was born.

"Architecture manifests itself through mass and surface. Mass and surface are determined by plan. The creator is the plan. Shame on those without imagination! "
(Jeanneret, Towards a New Architecture, 1923)

The modern architectural movement did not appear out of nowhere. The development of new technologies and the use of new materials played a major role in this. In order to understand the factors in the creation of modern architecture, it is necessary to go back to the Industrial Revolution. This period has changed not only the architectural aspects but also the social aspects of people's daily lives. The process that started with the invention of the steam engine, the construction of railways, and the easy processing of materials that could only be processed in primitive ways for centuries, such as the iron, have changed human life. Everything that affects people physically and sociologically has also directly affected architecture. A new architectural trend has been created in line with the needs of people. We can say that the biggest factor in the creation of modern architecture is the Industrial Revolution.

Keywords: Industrial revolution, architecture, modernism, Le Corbusier, matherials, modern architecture

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The Birth of Modern Architecture

Industrial Revolution

The Industrial Revolution, which emerged as a result of the effect of new inventions on production and the emergence of steam-powered machines in Europe in the 18th and 19th centuries, gave birth to mechanized industry and these developments increased capital accumulation in Europe. The industrial revolution is defined as "a radical change and development in many areas with the development of technology, industrial production and transportation facilities". The use of machines in production has brought with it the concept of mass production and standardization, and this has led to significant changes in the field of production. These changes resulted in a radical restructuring of the European economy. The development of the factory system in production has completely changed the economic system with the emergence of new technologies; In a sense, this created an autonomous economic system. These developments herald a new economic system in which all trade restrictions are lifted and production and trade are completely dependent on supply-demand relations. (BİROL, 1996)

The industrial revolution has led to significant changes and the emergence of new approaches in many subjects (technology, production, culture, economy, social structure of society, art and architecture). The use of steam engines, invented by James Watt in 1765, started the industrialization process. The railroads intensifying after 1830 caused the places they passed to become new industrial zones. As a result of the concentration of industrial zones in certain places, rapidly developing new cities were established. As a result, there has been a massive influx of population into these cities. On the other hand, the use of machinery in agriculture, the increase in productivity and the need for less and less labor in this field have been another reason for rapid and intense migration from rural areas to cities.(Benevolo, 1976)

Reasons for the Industrial Revolution

The population of Europe started to increase from the 16th century. This increase accelerated with the industrial revolution. The increasing population has led to an increase in consumer demand, and the revival of trade and economy. Some of the increasing population in the rural areas migrated to the cities, thus creating a large workforce ready to work in industrial production. Advances in technology have reduced the need for the population in this sector, causing this population to migrate to cities. The standard of living has risen, and goods such as sugar, coffee, and tea, which were considered luxuries in the past, have now become a natural necessity for the middle class and lower classes. This indirectly increased the demand for consumer goods and large-scale looting became the most important financial source of the Industrial Revolution. Both the Central American gold plundered by the Spaniards and the British ships that struck the Spanish ships and plundered the plunderers carried tons of gold to Europe. All this supported the processes that led to the Industrial Revolution in the 16th and 17th centuries. The British (Battle of Plessey), who defeated the French troops on the battlefield on June 23, 1753 in India, confiscated the enormous treasures of the Mughal emperors. It can be said that the money and financial opportunities that emerged in the economy of this country with the transfer of this treasure to England, and all technical inventions related to weaving and steam machines, were the main arguments in explaining that between 1758-1791. (Benevolo, 1976)

Colonialism: European countries created new colonies and started to use the goods they brought from here in industry and started to sell these goods to the colonies again. The importance of the banking and insurance sectors has increased.

Capitalism: In parallel with the enrichment process of the middle class, capital accumulation began to occur. Thus, new investment areas began to be sought. Laying the foundations of a political structure suitable for industrial society through the French Revolution is shown as the main reason for the emergence of the industrial revolution. Developments in transportation and technology are one of the most important reasons for the emergence of the industrial revolution. Countries that use the

industrial revolution positively have made significant developments. Karl Marx talks about this in Capital:

"Being the most advanced country in the sector, the country only gives an idea of its future to the countries that follow it in this field."(Marx, 1867)

The Development of the Industrial Revolution

One of the most important developments of the Industrial Revolution is the invention of the steam engine. In 1763, James Watt invented the steam-powered machine in Scotland. The advanced form of this machine constitutes the true starting point of the machine age.

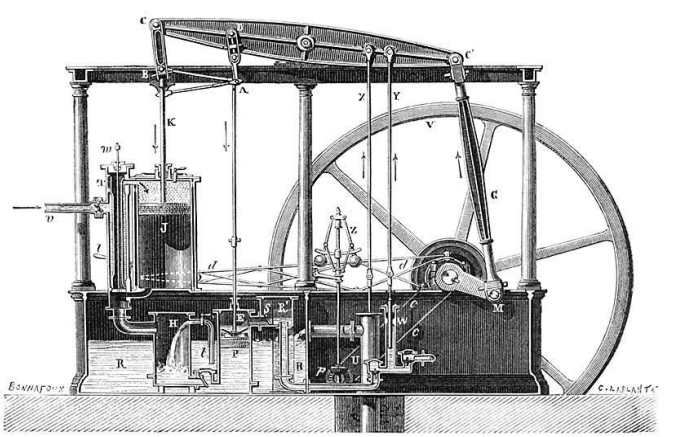


Fig. 59. — Machine à balancier de Watt.

e, Tuyau de prise de vapeur; *T*, tiroir; J, cylindre; H, condenseur; PE pompe d'épuisement; WY pompe alimentaire de la chaudière UX pompe d'alimentation de la bâche B; *p* Z régulateur; *ddd* excentrique; ABCD parallélogramme; GM bielle et manivelle; V volant.

JAMES WATT'S STEAM ENGINE 1973 URL1

The steam engine was first used in coal mines and textile workshops. Later, the steam engine was developed and trains and ships emerged. Another important technical development is the development of production processes that ensure the production of high quality and large volumes of steel. Steel, which has been used in raw form for years, has started to be processed more easily thanks to machines. With the

development of steel production, mechanization has increased. With the development of textile machinery, mass production and factories began to appear.(BİROL, 1996)

This period is called the Age of Enlightenment, as there were great developments in the field of science and technology in Europe in the 18th century. Some historians call the first stage of industrialization the First Industrial Revolution, in which the steam engine, coal, steel and textile industries were at the forefront.

In the 19th century, industrialization reached a new stage as a result of advances such as the use of electrical energy and fuel resources such as oil and natural gas, the development of electric and gasoline engines, the invention of automobiles, airplanes and similar vehicles. This development is called the Second Industrial Revolution. The emergence of the private sector has created a safe and stable environment in terms of industrial and commercial activities and has been very effective in the development of the industry. (Ragon, 1986)

Social and Architectural Consequences of the Industrial Revolution

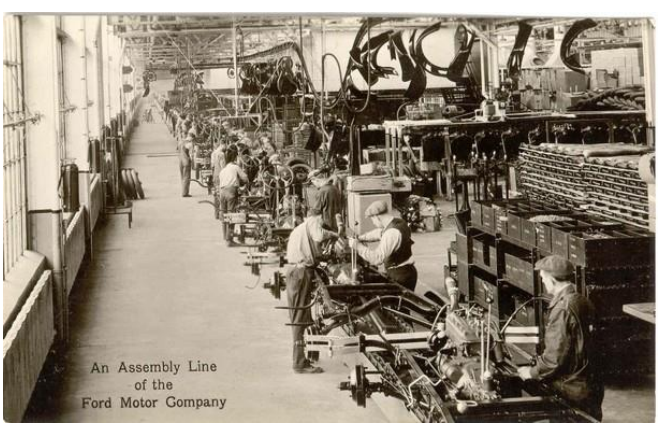
The Industrial Revolution has had consequences that deeply affect not only production and economic structure, but also all areas of human life. With the growth of the industrial sector, the worker population increased and very intense labor exploitation emerged in the early periods. As the working and living conditions of the workers were very bad, children at an early age were employed as workers. This situation led to the emergence of workers' struggle. This development and social injustices gradually led to the emergence of socialism and communism movements.

CHILD LABOR IN THE INDUSTRIAL REVOLUTION - ENGLAND EARLY 1900 URL2

A CHILD LABORER IN THE INDUSTRIAL REVOLUTION - ENGLAND EARLY 1900 URL3

With the industrial revolution, the need for raw materials for production and the market for manufactured goods increased, and colonial lands became both a raw material source and a market for industrializing countries. In addition, the difference in development and technology between Western countries and the rest of the world has widened. They made inventions parallel to the military and economic superiority of the West. Facilitating transportation by train and steamships facilitated military and political control of colonial lands. All these reasons unfortunately led to the spread of colonialism. (BİROL, 1996) The search for raw materials and markets led to the emergence of a colonial race among industrializing countries. For this reason, it is thought that conflict and competition are one of the most important factors preparing for the

First World War. With industrialization, the consumption of fossil fuels in factories and motor vehicles has increased environmental pollution. The destruction of forests, agricultural lands and similar natural resources has accelerated. In addition to the negative effects of the Industrial Revolution on the working class and colonial peoples, it also had positive effects on all people in the long run. As a result of the developments in the field of health, diseases such as plague, fever and malaria that caused the death of millions of people in the previous periods have disappeared, and the average human lifespan has extended. The general welfare level of large sections of the population has improved compared to previous periods. Social and economic rights emerged as a result of working class struggles. (Benevolo, 1976) With the Industrial Revolution, the role of scientific and technical developments in economic development and enrichment has increased, and this has led states and companies to invest much more in scientific research. Thus, scientific and technical developments accelerated. In the 19th century, scientific and technological inventions exploded.



A PHOTO FROM THE FORD VEHICLE FACTORY, EARLY 1900S URL4

In addition to the social consequences of the Industrial Revolution, it also had positive and negative consequences in terms of architecture and urbanism. The use of machines in production has brought with it the concept of mass production and standardization, and this has led to significant changes in the field of production.

These changes led to a radical restructuring of the European economy. The development of the factory system in production completely changed

the economic system; it is, in a sense, an autonomous economic system. These developments heralded a new economic system in which all trade restrictions were lifted and production and trade were completely dependent on supply-demand relations. An economic system in which the self-interest of the producer would contribute to the achievement of general welfare led to the emergence of capitalism in its purest form.(BİROL, 1996) As a result of the progress of industry and the development of trade, it caused the slow collapse of the medieval cities and the emergence of the urban working class. The factory owners started to employ the poor in rural areas in order to find workers for the large factories formed with the development of the industry, and for this reason, many groups of people flocked from the countryside to the cities. As a result of the agglomeration of factories and workers in the cities, man has been cut off from nature. Homeowners in cities took advantage of this, and the more people they fit in their homes, the more money they made. The landlords in the cities benefiting from this density started to keep the rent prices high because they knew that they could always find tenants for their homes, and therefore the settlements in some neighborhoods in the cities reached unprecedented densities.

A REGION DOMINATED BY THE WORKING CLASS DURING THE INDUSTRIAL REVOLUTION URL5

The stages up to this process did not occur suddenly. Stages in the process leading up to the development of industry: the Renaissance, which virtually destroyed Christian cities, Protestantism, which gave priority to the Christians' banking and profit in business, and the 1789 revolution that led to the transfer of power to the state. French bourgeoisie. The progress of industry and the development of trade, XIX. It formed the cornerstones of capitalist society in the twentieth century. (Ragon, 1986) These two developments, as well as their positive aspects, also acted in parallel with the disasters in terms of settlement and urbanism.

WORKING PEOPLE'S LIVES IN UNHEALTHY AREAS, LATE 1800S CHICAGO URL6

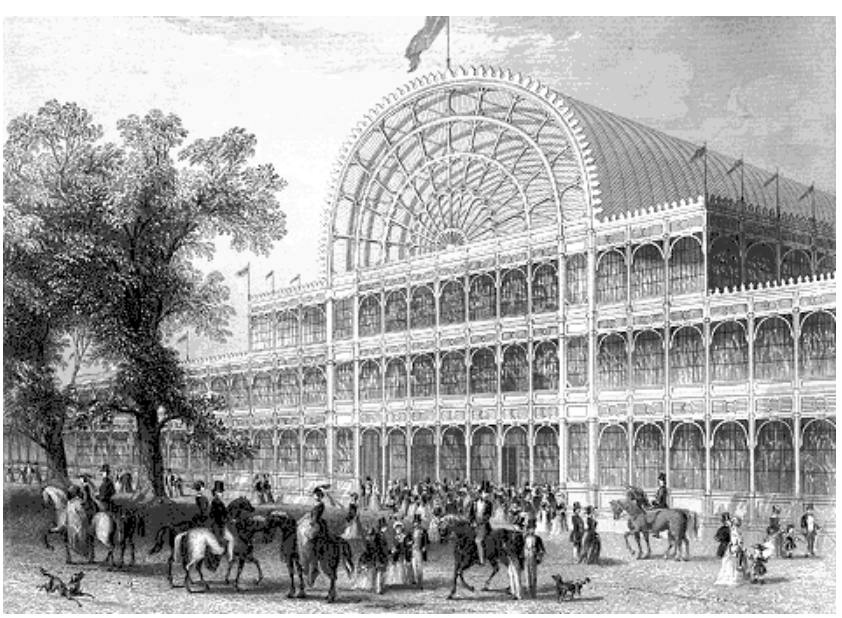
From the beginning of human history to the XVIII. The period up to the 19th century is called the "tool period". Later, a new form of civilization, the machine civilization, was passed. It also means commercial civilization. Industrial civilization is undoubtedly XIXThe establishment of the spinning mills dates back to 1785, and in the previous century, the number of workers in Colbert's mills amounted to 1700. Traders and trading methods XIV and XV. It emerged in the 19th century, right after the collapse of Christian cities founded on completely different values. These merchants are the ancestors of modern capitalists.(Ragon, 1986)

On the other hand, the rapid development of the industry and with it the technology has caused the shift of the most basic production and creation field from philosophy and art to technology since the end of the 19th century and especially in the 20th century.

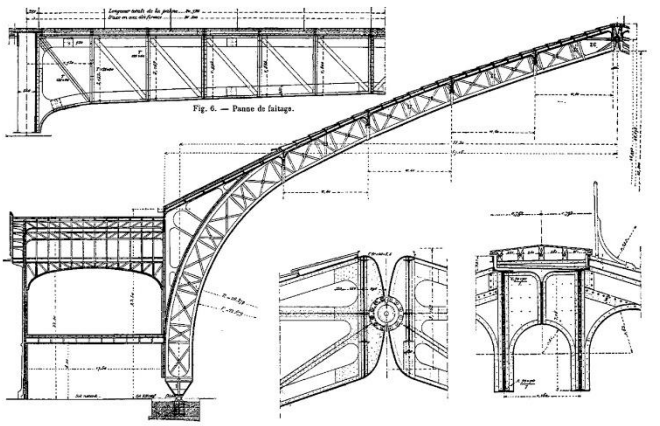
In the 19th century, steam power started to be used in the operation of machines and especially in railways, and the products obtained brought new energy sources. In the middle of the century, developments in science and technology accelerated. Nuclear energy has come to the fore and developments in the field of chemistry have led to the emergence of new industries. The metal material, which has been used for about 4000 years but can be composed for the first time in this period, became one of the most important new products in this period. On the other hand, in addition to the use of new building materials in building production, new construction methods have also developed, and this has led to the emergence of important innovations in the world of architecture, and the foundations of modern architecture were laid in this period.(BİROL, 1996)

MARSHALL FIELD MALL CHICAGO 1897 URL7

The socio-economic developments that took place in the period following the Industrial Revolution had a profound effect on the field of architectural production. It has led to the emergence of new building types on the one hand, and a new understanding of creating space and form on the other. The use of new building materials and construction methods in building products in the 19th century and the competition between countries in the field of technology led to the introduction of a new building type called "fair buildings" to the agenda of the architectural world. (BİROL, 1996) The Crystal Palace, which represented England at the first world fair opened in London in 1851, is of great importance as it is a structure shaped by technology, where cast iron and glass were used together as a building material for the first time. With this structure, the thick walls between the interior and the exterior are eliminated and thus the interior space is freed from all kinds of weight, which has become the pioneer of a new space understanding. The most important world exhibition after the first is the 5th world exhibition opened in Paris in 1889. In this exhibition, the Eiffel Tower, which was built by engineer Gustave Eiffel to create an icon for France and Paris, and the Gallery of Machines (Galerie des Machines), representing France, are examples of buildings where technology directs architectural form.



CRYSTAL PALACE, JOSEPH PAXTON, 1851 URL8



MACHINE GALLERY USE OF STEEL MATERIAL 1889 FRANCE URL9

MACHINERY GALLERY, FERDINAND DUTENT, 1889 FRANCE URL10

The understanding of construction brought to the agenda by Christal Palace showed itself in the United States in the following years. Along with the Chicago School movement, multi-storey structures were built

using new materials such as steel, reinforced concrete and glass. The use of the steam elevator in 1857, the hydraulic elevator in 1870 and the electric elevator in 1887 accelerated the production process of multi-storey buildings. New materials and construction methods have been fully used in the field of architecture. These innovations paved the way for the emergence of many new approaches based on the developing industry, new materials and construction methods in the 20th century architecture. (Benevolo, 1976) Thus, a new architectural trend began to emerge in parallel with the new technology.

The Birth of Modern Architecture

Modernism, which is used synonymously with modern architecture and Functionalism, is basically an architecture school that adopts the plain use of form and the purification of decoration from architecture. Changing needs and rapidly increasing population inevitably led to the emergence of simpler and faster structures. The architects who had an impact on the emergence of this new school were mainly architects such as Le Corbusier, Frank Lloyd Wright, Van Der Rohe, Philip Johnson, Peter Eisenman. The school became popular in a short time by being adopted by many respected architects and educators of the world. However, in the first half of the century, it is seen that a small number of buildings representing this trend were implemented. The differences adopted by each of the pioneering architects in their approaches to the aforementioned school emerged at the beginning of the 20th century. This school has been one of the most preferred architectural styles in the world for the construction of both institutional and commercial buildings in the first 30 years of the post-World War II period. According to many authors, Modern Architecture is seen as an architectural movement that emerged as a result of social developments that emerged in every society due to Modernity and Enlightenment. According to them, this style emerged as a natural result of the social and political developments of a certain period. According to other authors, Modern Architecture emerged as a style realized with the contribution of new materials such as iron, steel and glass, whose mass production became possible with the industrial revolution that emerged as a result of technological and engineering

developments. (Ragon, 1986) The modern architectural movement was first seen in France and England. The fact that France and England were pioneers in terms of architecture and urbanism in the 19th century was due to the economic development of these countries. When countries such as Germany, the USA and Belgium reached their level, these two countries set out to reveal something new in the field of architecture this timeThe effects of the industrial revolution have created new needs in the field of architecture. The founders of the new architectural movement, which was born with the use of new techniques and new materials, could not influence the architects of their time, except for a small minority of private individuals. The development of industry necessitated the introduction of a new architectural trend for the masses immediately.

However, most architects and artists continue to build ostentatious architectural structures, such as museums, churches, and opera houses, without being aware of the new needs of the world and the beginning of a new era. Moreover, the needs of the people, which should have been the priority, were put in the background and more importance was given to the preservation of old works of art. (Ragon, 1986) The rapid population growth of factories and residential areas, which increased with the industrial revolution, led to the emergence of a new architectural style. Leading architects of the period made various studies for the construction of faster and more practical structures. With the development of technology, the use of steel, glass and reinforced concrete became widespread. With the new materials, the architects of the period started to design the buildings within that framework by putting the function in the foreground. With the use of reinforced concrete in the buildings, the load-bearing walls in the buildings are no longer needed. Since there are no load-bearing walls, the structures can be built in a faster time and more flexible designs can be made in the plans. The fact that the plans can be made more flexible in the buildings has had an impact on the facades of the building and thus on the whole design. Architects such as Le Corbusier, Frank Lloyd Wright, Van Der Rohe and Philip Johnson are cited as the founders of modern architecture. With their works, they showed the world that a new movement was born. Frank Lloyd Wright's Fallingwater (waterfall house), Van Der Rohe's Farnsworth House, Philip

Johnson's The Glasshouse, Le Corbusier's La Roche House, Unite Habitation and Villa Savoye are shown as the building blocks of modern architecture. Le Corbusier, one of the most important architects of modern architecture, revealed the principles that he called "The 5 Principles of Modern Architecture" in line with the materials and techniques he used in his buildings. These; Raising structures from the ground by means of columns (pilots). The free plan scheme results from the fact that the buildings are not carried by load-bearing walls. Free facades were formed as a result of the free plan scheme. strip windows and flat roofs and terrace gardens have become the 5 principles of modern architecture. Thus, in line with new needs, new technology and new construction techniques, a new architectural trend has inevitably emerged.

CONCLUSION

The emergence of modern architecture has been due to the use of modern materials and the requirements of modern times. Le Corbusier, one of the leading architects of the period, became one of the founders of modern architecture with the innovative solutions he applied in his buildings. It would be unfair to other prominent architects to say that innovative ideas were implemented only by Le Corbusier during these periods. Together with Le Corbusier, architects such as Frank Lloyd Write, Van Der Rohe, Philiph Johnson, Peter Eisenman, Pierre Koenig, Eilen Gray, Richard Neutra formed the foundations of modern architecture with their works.

Today, in architecture, art and in many areas of life, people tend to be minimal. Even the technologies we use are constantly getting smaller and smaller. As life and technology accelerate, people have started to adopt minimalism in all areas of life because they get bored quicklyIn architecture, simple and flexible structures are described as modern and beautiful. Based on this acceptance; Le Corbusier laid the foundations of today's architecture with its simple and functional structures about a century ago. We can easily say that the application of the plain approach together with the simplicity, functionality and technological development in spatial solutions, which is accepted as a necessity of contemporary life, will be accepted for many years to come.

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