

BIOMIMICRY RESEARCH AS AN ARCHITECTURAL DESIGN METHOD IN  
RENAISSANCE UTOPIAS



by  
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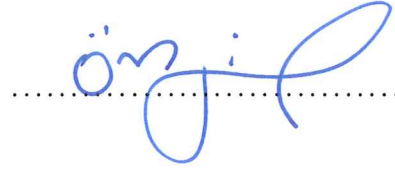
BIOMIMICRY RESEARCH AS AN ARCHITECTURAL DESIGN METHOD IN  
RENAISSANCE UTOPIAS

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## **ABSTRACT**

### **BIOMIMICRY RESEARCH AS AN ARCHITECTURAL DESIGN METHOD IN RENAISSANCE UTOPIAS**

Utopias that have been designed intellectually and literary throughout history have reached the level of spatial construct in Renaissance period. As a period when Scholastic notion has declined and Platonist logos started to become prevalent, humanism emerged during Renaissance. With humanism, human intellect has gained importance and was dignified. Human body was considered as a microcosmic representation of macrocosmos and as to harbor ideal ratios, and designs that resemble human body was made. During Renaissance, works have been made and utopias have been designed in so many areas with the desire to reach the ideal.

Renaissance intellectuals have inclined to natural sciences, thinking that nature needs to be observed for scientific development. They have laid the foundations of modern science, and produced works on scientific empiricism and observation. They believed that the more they reached information on nature, the more they would develop. As it was seen throughout history, social developments have influenced the design of utopias. Within this context, it is likely that the scientific innovations in Renaissance have had an influence on utopia designs.

As a design method based on scientific observation, biomimicry suggests examination of organisms in nature and mimicking the design strategies of nature. Having been existed for 3.8 billion years, nature has a sustainable system which it developed through evolution. When biomimicry is implemented as a design method, nature offers solutions to many design problems by being utilized as a reference book.

As a definition that belongs to today, the concept of biomimicry is a design method that suggests reaching ideal designs through the observation of nature. Foresights on the likeliness of the usage of this method on utopias that were created during Renaissance which is a period when the foundations of modern science has been laid are examined in this thesis, and the obtained findings are presented.



## ÖZET

### **RÖNESANS DÖNEMİ ÜTOPYALARINDA MİMARİ BİR TASARIM YÖNTEMİ OLARAK BİYOMİMİKRI ARAŞTIRMASI**

Tarihte, düşünsel ve yazınsal olarak tasarlanan ütopyalar, Rönesans döneminde mekansal kurgu boyutuna ulaşmıştır. Skolastik yapının yıkılarak, Platoncu logosun etkin olmaya başladığı Rönesans döneminde, hümanizm akımı doğmuştur. İnsancılık olarak tanımlanan hümanizm ile insan aklı önem kazanmış ve yüceltilmiştir. Bu dönemde, insan bedeni, makrokozmosun mikrokozmetik bir temsili olarak kabul edilmiş, insan vücuduna benzeyen tasarımlar yapılmış, ideal oranları barındırdığı düşünülerek bir çok ütopya tasarlanmıştır.

Rönesans aydınları, bilimsel gelişme için doğanın gözlemlenmesi gerektiğini düşünerek, doğa bilimlerine yönelmişlerdir. Modern bilimin temelini oluşturarak, bilimsel deneycilik ve gözlem üzerine çalışmalar yapmışlardır. Doğa hakkında ne kadar fazla bilgiye ulaşırlarsa o kadar çok geliştireceklerine inanmışlardır.

Rönesans döneminde doğa gözlemi yapılarak bilimin ilerlemesi ile bir çok yenilik yaşanmıştır. Tarihte görüldüğü üzere, toplumsal olaylar, bilimsel çalışmalar, kültürel yenilikler, değişimler ve gelişmeler, ütopyaların tasarımını etkilemektedir. Bu bağlamda, Rönesans döneminde yaşanan bilimsel yeniliklerin, ütopya tasarımlarını etkilemiş olması muhtemeldir.

Bilimsel gözleme dayalı bir tasarım yöntemi olan biyomimikri, doğadaki organizmaları inceleyerek, doğanın tasarım stratejilerini taklit etmeyi önermektedir. 3.8 milyar yıldır varolan doğanın, evrilerek geliştirdiği sürdürülebilir bir sistemi vardır. Biyomimikri bir tasarım yöntemi olarak uygulandığında; doğa, bir kaynak kitap gibi kullanılarak bir çok tasarım problemine çözüm sunmaktadır.

Günümüze ait bir tanım olan biyomimikri kavramı, doğayı gözlemleyerek ideal tasarımlara ulaşmayı öneren bir tasarım yöntemidir. Bu yöntemin, modern bilimin temellerinin atıldığı Rönesans döneminde yaratılan ütopyalarda kullanılmış olabileceğine dair önseziler, tez çalışmasında araştırılmış ve edinilen bulgular sunulmuştur.

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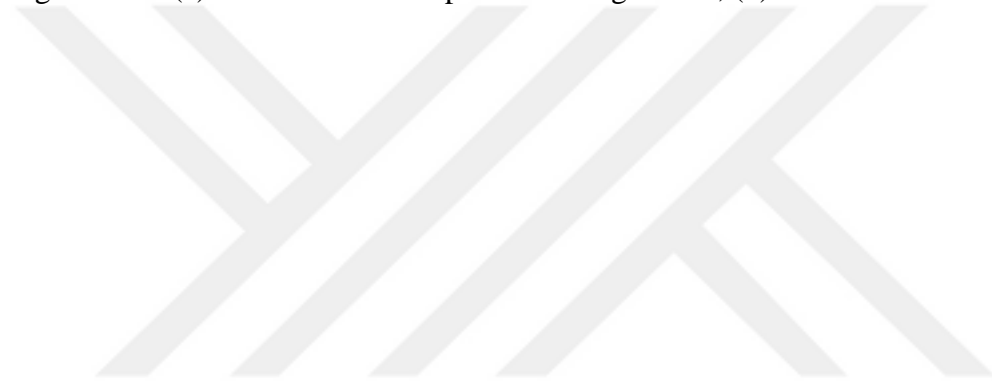
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## 1. INTRODUCTION

The world has a cyclic system that it has created the ideal by evolving, progressing and changing from the day it started to exist. Every system in the world has a sustainable design in itself, without a need for an external intervention. All living things are in a relation with their environment and are shaped by it. The designs in nature maintain themselves in the ideal way based on the existing environment and state. They evolve as the conditions of life change. Life forms that adapt themselves to its environment are seen, rather than changing its environment and transforming it according to their lifestyle. As a part of the nature, humans' habitat are the cities. However, cities are artifices that are formed by human intelligence, not by nature itself.

Every single one of the architectural designs that form the cities can be considered as a habitat that represents the human living space. Today, cities and structures are designed so as to make the environment conform with human life, instead of conforming with the environment. In many architectural design approaches, solutions are found by ignoring the element of ecological environment. During the processes of construction material production, construction stage of buildings, and the utilization of structures, the interest of built environment is valued above ecological environment. Ecological solutions for architectural problems can undoubtedly be found in the nature; where there is a habitat solution for every single living thing. Derived from bios (life) and mimikos (mimicking) in Greek, the concept of biomimicry adopts learning nature through observation as a principle, and can be applied for contemporary architectural problems as a design method. Biomimicry is an innovative approach that finds design solutions through inspiration from nature, and that tells us that we can reach to optimum solutions by learning from it. Today, while biomimicry in biotechnology is a common discipline (such as prosthetic legs, artificial organs etc.), the implementations in architecture and built environment cannot realize their potentials.

An incline to nature has always been seen in history. The relation between nature and humankind has been scrutinized differently in every period. In this thesis, the influence of nature perception that was formed in Renaissance as a period when the foundations of

modern scientific approach were laid, on the concept of ideal city and the methods of architectural design methods is examined.

With the retrogression of the scholastic structure in Renaissance, human intelligence has gained importance and humanity has started to progress and to make researches. Owing to empiricism which was founded in this period, science and technology has progressed until today. Observation of nature has developed. While nature was being observed, the resources it provides us were also discovered and started to be utilized. As a result of this, the state that human designs have become was dependent on natural sources. All systems in nature are cyclical. No system has existed as to break down others' chain. One living thing's death is the life source of another. As the cycle continues, system perpetuates itself. Contemporary design and consumption systems are created with linear systems. Today, as there is no closed cycle, there is more consumption than production. All human-centered production brings this result with itself. In nature, there is optimization. No living thing is superior to another. There is no living thing that is to be placed in the center. As a result of the anthropocentric designs, natural sources are depleted, and the damage on the environment is ignored. In long term, as nature is harmed, humanity has started to suffer from it. Biomimicry suggests observing nature, and being inspired by it, as a method of design. Using nature as a reference book, adapting the knowledge in them to human life, transforming the developing technologies and built environment towards this direction can be regarded as a solution for ecological problems.

Throughout history, humans have inclined to the natural, while searching for the ideal and the right. The fact that the ideal and the truth are in nature has been accepted by most. From a Platonist point of view, ideal community means utopia. In other words, the search for the ideal is also related with utopias. The fantasies of ideal life have existed from the day humankind started to exist. Being the cornerstone of utopia, the ideal life has been deeply adopted especially during Renaissance.

The word Renaissance etymologically means rebirth. It can be interpreted as resurfacing of the vanished ideas. During Renaissance, ancient era works of art that were forgotten in the middle ages had been the focus again; and with the downfall of scholastic structure, humankind leaned on their intelligence more and there was progress in almost every area such as art, literature, philosophy, architecture, and science. Natural sciences were developed, the nature was observed, geometry and mathematics progressed, the perception

of perspective was developed, and the mysticism and closed mindedness of the middle ages was left behind completely by putting intellect (logos) in the center. As intelligence was emphasized, intelligent human was dignified and humanism had emerged. Humanism argues that the ideal is within the human, and everything is for humankind, putting humans in the center. Anthropomorphic approach has been adopted in this period and the human body has been the criterion for ideality. By being mimicked morphologically, human body has been applied to areas such as mathematics, geometry, art, and architecture.

In many utopias where ideal is sought, life standards based on natural sciences were created through inspiration from nature. Utopias and nature resemble each other, as they harbour the ideal within themselves. Both create their own sustainable systems. Their difference is that nature being the ideal system existing in the real world. Utopia is an imaginary, theoretically perfect place. It makes humans question the flaws and deficiencies in the existing situation. Renaissance utopians have developed empirical sciences, while observing the nature and learning from it. So much so that, they thought that nature had all answers and the more they understand it, the more they would progress in science. In Renaissance utopias that reflect the fantasies of the period, science and nature have been observed and mimicked in most of the created ideal communities, and utopias where technology had progressed were created.

The thesis consists of five chapters including the introduction. The aim, scope and the method of the study are described in the introduction. In the second chapter, the concept of utopia is identified and utopias were described historically through examples. In the third chapter, the examples chosen among Renaissance period utopias which are the focal point of the thesis are examined in detail. In the fourth chapter, main approaches on the concept of mimicry are described and supported with examples. The relation between biomimicry and design, and the concepts of biomimicry and design are identified. At the end of the fourth chapter, the findings of Renaissance period which are examined in the third chapter are put forth. The findings are conveyed by tables, conceptual data are interpreted and concretized by numeric data. The fifth chapter is the result where assessments through the data in this thesis are made.

The concepts of utopia and biomimicry, on which there are many studies in the literature independent from each other, are linked with each other in this thesis. With the effect of multilayered structure of utopias, studies were made on utopia in many disciplines, including

architecture. Being a more contemporary concept than utopia, there are also many biomimicry researches that require interdisciplinary studies. Biomimicry is developing as an innovative area of study which new methods can be developed through the observation and interpretation of nature. In this thesis, utopias which humans designed during the pursuit of the ideal and biomimicry which suggests benefiting from the data of nature that they follow during the pursuit of the right are researched. This research is limited with Renaissance period. The reason for the selection of Renaissance period is the fact that it represents the starting point of the period when human intelligence gained importance, ideal life constructs have been designed in spatial dimension, scientific developments emerged in order to reach the knowledge of nature, in short, the period when the foundation of the present modern world were laid and modern science and humankind has started to evolve.

In this thesis, the situations where the concept of biomimicry that is directly related with natural sciences intersects with the concept of utopia are examined for Renaissance period which can be considered as the beginning of modern human. As a result of the literature research, no study in which the concepts of biomimicry and utopia are related with each other could be found. Within this context, it is thought that the thesis will make a new and genuine contribution to this area.

### **1.1. AIM OF THE STUDY**

Along with Humanism, during Renaissance as a period when humankind has gained importance and scientific progression with a rationalist approach was experienced, it is known that nature was observed and studies on natural sciences were made. With the purpose of reaching the ideal, de facto rights, and universal knowledge, Renaissance intellectuals made designs on the level of spatial construct in the utopias they had designed, unlike older utopias. Utopias are fantasies of ideal life that unravel the problems and deficiencies of the period they were created and that offer solutions to those problems. Within this context, it is possible that the scientific innovations and the transformed social structure in Renaissance may had an effect on the design of utopias.

During Renaissance period when scientific developments have increased, it is a known fact that deep-seated social changes and transformations occurred. The direction of the change in the design approaches of utopias that were created in a period like Renaissance, is the

main research question of the thesis. This establishes another question: Has the development of the innovations of Renaissance, namely humanism, empiricism, and observationism influenced the designs of utopias that were started to be fantasized spatially?

Containing ideal designs, nature has been examined more extensively during Renaissance as a period when scientific researches thrived. Being a design method which adopts using the knowledge of nature as a source of inspiration, biomimicry was first used as a concept in 1962. However, Renaissance is the period when the coercion of the church has been removed and rationalist thought became prevalent, and there has been many researches that focused on nature. As a period when nature has been the subject of close attention and many discoveries were made, seeing the traces of nature in fantasized ideal lives is not a remote possibility. Reaching the foresights and findings about the possibility of a relation between the nature that contains the ideal and utopias as the life fantasy of humans constitutes the aim of this thesis. It can be argued that humanity as a part of nature will imitate nature the time it discovers its intelligence, and want to mimic nature by considering it ideal. Within this context, the research question directed at this thesis are as follows:

- Even though biomimicry which means mimicking the nature is a contemporary term, has it been used in Renaissance as a period when the foundations of modern science was laid?
- Is there a link between the pursuit of ideal in Renaissance and the ideal that nature contains?
- Has a biomimetic design approach been adopted while Renaissance utopias were constructed?

Nature has been evolving for billions of years, developing ideal designs within her fabric. Humankind has also fantasized and constructed ideal life throughout history. Intellectuals of Renaissance have also thought that they will find the ideal and the right by observing the knowledge in nature. The fantasy of ideal life means utopia. Utopias and nature contain the ideal. Nature contains the ideal designs that exist in reality; utopia is an alliance of ideal designs fantasized by humans. Nature reaches the ideal by developing itself by evolutionary processes. Utopias are fantasy realms where no problems in the lives of humans exist and the ideal life is maintained.

Biomimicry is a design method directly related with natural sciences. During Renaissance, the period of first extensive researches of natural sciences in history, revealing the mysteries of nature has been quite important. Renaissance was also a period when de facto truthfulness and universality is sought and rationalist approach gained importance.

In this thesis, it is argued that there may be traces of the usage of biomimicry as a design method in Renaissance utopias, as a result of the developed nature observations. Making researches towards this foresights and reaching findings about the three research question that is asked above is the main aim of the thesis.

## 1.2. SCOPE OF THE THESIS

This thesis aims to reach findings on the usage of biomimicry as a design method in Renaissance utopias. Design methodology is a contemporary saying so meaning of the design method in Renaissance period mainly determines a design approach. Within the scope of the thesis, utopias are examined with a historical method and the foundations of utopianism is described. Architectural utopias from the 16<sup>th</sup> century to the 20<sup>th</sup> century are scrutinized. The concepts of architecture and utopia are described by being associated with each other. During the study on utopias, *Utopianism* by Krishan Kumar, *The Book of Legendary Lands* by Umberto Eco, and *The Story of Utopias* by Lewis Mumford have been the main references. For more extensive studies on utopias, Üstün Alsaç's essay in METU Faculty of Architecture Journal, *Düşünsel Mimarlık: Rönesans Ütopyaları Aracılığıyla Örnekleme* and Doğan Hasol's essay in Yapı Journal, *Mimarlıkta Ütopya* have been secondary references.

With the historical examination of utopian design approach, the influence of the innovations of every period on created utopia constructs are emphasized. Among the historically examined utopias, Renaissance period when the foundations of modern science have been laid is selected for the pursuit of biomimicry traces. The reason for Renaissance to be selected is the fact that the discovery and development of rationalist thought, scientific observation and empiricism is first seen during Renaissance. Being a design method directly related with nature, researching the findings of biomimicry in this period constitutes the general frame of the thesis. Although utopias are historically described within the scope of



the thesis, the research on the findings of biomimicry are limited with Renaissance as a period that marks the start of modern science.

Accordingly, Renaissance utopias are examined in detail. As the pioneers of Renaissance, four architects and three literary utopias that creates a vision for their successors are chosen. Utopian designs of the chosen architects and literary utopias and ideal city designs are detailed with an extensive study. The works of these four architects that are examined in this thesis are as follows: *De re Aedificatoria* by Leon Battista Alberti, *T'rattao d'architettura* by Filarete, *Trattati di architettura ingegneria e arte militare* by Francesco di Giorgio Martini, *Codex Atlanticus* by Leonardo Da Vinci, *Utopia* by Thomas More, *New Atlantis* by Francis Bacon, and *The City of the Sun* by Tommaso Campanella.

The concept of biomimicry is primarily examined independently from utopias. *Biomimicry in Architecture* by Michael Pawlyn, *Innovation Inspired by Nature* by Janine Benyus, and *Biomimetics in Architecture* by Gruber Petra have been used as the main references in the description of biomimicry. It is known that nature harbors ideal designs.

In the thesis, it is emphasized that biomimicry is a method that harbors ideal designs and imitates nature. The relationship between biomimicry and idealty can be interpreted as reaching the ideal by imitating the designs in nature. As a period when Platonist logos started to prevail, and natural sciences and scientific observations gained importance, seeing the traces of biomimesis in utopian designs that were created to reach the ideal is probable in Renaissance. Within this context, the question of how biomimicry is used as a design method in Renaissance utopias determined the thesis's scope of research.

### **1.3. METHOD OF THE STUDY**

In order to make a research on the usage of biomimicry as a design method in Renaissance utopias, which is the purpose at the start of this thesis, the relation between utopianism, architecture, and utopia was primarily scrutinized. In the thesis, qualitative research is determined as the main method, in addition to that, methods that contain quantitative techniques are used in the findings at the historical research and result chapters.

In the thesis, a brief history of utopias is conveyed with a chronological method, starting from the antiquity, and is supported with examples. As specified in the scope of the study, biomimicry research is not made for historical periods other than Renaissance.

As specified in the aim of the study, it was assumed that design approaches which are influenced by the scientific innovations and methods of the nature is imitated may have been developed during the creation of Renaissance utopias which have constituted the foundation of nature observation and scientific empiricism. Following these foresights, Renaissance period utopias are examined and the research is made with an interpretative method. In this chapter, Renaissance utopias are extensively conveyed and supported with images.

Primarily for the biomimicry method that was sought in Renaissance utopias, a conceptual approach is adopted for the usage of biomimicry as a design method. As scholars who have conducted extensive studies on biomimicry, works of Janine Benyus, Steven Vogel, Michael Pawlyn, Ken yeang and Pederson Zari are analyzed. The relation between biomimetic design and architecture is described with examples of architectural projects.

After the conceptual approach on the description of biomimicry, biomimetic findings from Renaissance utopias which constitute the aim of the study are supported with charts and reduced to concrete data. The findings of Renaissance utopias are placed on a matrix that is prepared for determining the intersection points of two concepts. This matrix is prepared by reason of associating the examples with an interpretative method and conveying the conceptual relations.

In addition to the tabulation through matrix order, the table that Pedersen Zari has created about the implementation methods of biomimicry in his essay *Biomimetic Approaches to Architectural Design for Increased Sustainability* is adapted to Renaissance period utopias (Zari's table system can be found in chapter 4.1 of the thesis). From the table system of Zari which was used as a base, data on the usage of biomimicry as a preference for design strategies in Renaissance utopias is obtained. These obtained data is assessed and the number of biomimetic findings in each utopia is identified. By this, qualitative data is transformed to quantitative data, and biomimetic findings in utopias are classified according to their numbers. In the conclusion part of the thesis, the conclusion that was drawn in the light of the obtained data is conveyed.

In this thesis where the traces of biomimetic design in Renaissance utopias are sought, utopias are conveyed through architecture discipline with a chronological method. The utopias in the determined date interval are exemplified with an interpretative method as the conclusion of the literature review. For the biomimetic findings in utopian designs, a conceptual approach is primarily adopted, and the design strategy in the relation between biomimicry and architecture is conveyed via examples. As a result, the traces that are found in Renaissance utopias are reduced to concrete data. Based on these findings, the obtained data are turned into quantitative data. Thus, results on the existence of biomimicry as a design method in Renaissance utopias are obtained and classified.



## 2. A BRIEF HISTORY OF UTOPIAS

The word *utopia* was first used in a book written in 1516 by Sir Thomas More. Utopia etymologically means *no place*. As the first syllable of the word, “u” has a pronunciation that is close to Greek “eu”, “*eutopia*” is also perceived as “good place” or “perfect place”. In his work, Utopia, as Thomas More describes an imaginary country as ideal and good, there are also interpretations which regard this as a wordplay by creating a binary meaning [1]. More’s descriptions of perfect place or a place that is too good to exist have introduced the concept of ideal life. The concept of ideal life have emerged in Plato’s Republic and its aftermath, but Thomas More is the first thinker to speak of development and environment in a utopia, to describe and fictionalise “place” in his book Utopia [1]. Considering ideal life and ideal community, cities as places where life happens shape fiction. Topos, that is the concept of place, is a necessity for life to happen. Therefore, how “place” is designed is directly related with social life.

Utopias have come to existence throughout history. Systems that bring forth the needs of the society from specific eras can be perceived as the reaction of society. Social events, times of depression, catastrophes and innovations have incited the occurrence of utopias. Ideal life and ideal communities are shaped in accordance with the features of that specific era. At the time when Plato wrote Republic, the society was in a state of despair because of the Peloponnesian War. In Utopia, Thomas More created an imaginary society as a solution to the period when society was in a state of violence and disarray. Utopia has served as a bridge that stretches from the old and closed order of the Middle Ages to the innovative Renaissance [2]. In this regard, it can be suggested that utopias evidentially emphasize the problems of society, and contain visionary opinions on what is best for society.

Utopianism feeds itself from various sources. There is a Golden Era legend in every society that is assumed as the time of origin - a time when mankind lived happily. In that era, a self-sufficient life where desires are limited and requirements are few is led [3]. According to the Adam and Eve myth of the religions, Adam and Eve were debearred from the blithe life, that is the Golden Age, that they have led in heaven because they ate the forbidden apple, and were sent to the earth. The idea of regaining the Paradise Lost has been one of the sources of utopianism[4]. According to another interpretation, the Golden Age is the

mythologization of the yearning of the lower layers to old egalitarian past at the transition from primitive egalitarian society to class society [5].



Figure 2.1. The Golden Age by Jean Auguste Dominique Ingres, 1862 [6]

The search for the Golden Age was seen at various periods in history at various areas. When Christopher Columbus first discovered the New World (1492), he believed that he found the Garden of Eden and maintained the tradition of the search for the Garden of Eden in Christianity [3]. In 1862, Jean Auguste Dominique Ingres described the existence of mankind in a utopic life, upon the narratives of ancient period poets about the mythical Golden Age. By using the discourse “A heap of beautiful sloths!” in his work, Ingres has interpreted the utopic myth of the beautiful and wealthy place where working is not necessary [6].

Another pursuit of paradise is the Land of Cockayne which is described as the paradise of the poor. It is imagined as a life based on extravagance and immoderation. This life harbors a freedom of prosperity and leisure where people earn as much as they sleep and cooked

skylarks fly into people's mouth [3]. In his painting which he depicted the Land of Cockayne (1567), Pieter Brueghel has reflected a hedonist community where the rooftops of the city are made of cakes, and delicious morsels of food fall into the mouths of people lying on the ground [3].



Figure 2.2. The Land of Cockaigne by Pieter Brueghel, 1567 [7]

The millennium belief that Jesus Christ will establish a millennial paradise after his resurrection is also considered as a new approach to paradise myth [3]. This belief of Christianity that is seen as the paradise of the past and the future has made a contribution to the foundation of the notion of ideal society [3]. In ancient myths, an earthly paradise of plentitude and abundance where men do not have to work was imagined. Imaginary countries that does not exist or cannot be reached are associated with religions. Pagan belief as another interpretation of the millennia belief in Christianity has also had an effect on utopianism. The concept of Ideal City originated from pagan beliefs [3]. There are old approaches that link with the city form, and that embrace quality life and perfect republics. Ancient city is considered a work of art and consecrated to god. After the function of the city has organized not the material life but the moral aspect of the relationship between mankind

and universe, the city itself has become ideal and was turned into an earthly paradise [3]. Kumar describes the ideal city as “the microcosmic reflection of the macrocosmic system in divine order”. The perception and duly practice of this divine order should be ensured by intelligence - natural privilege of mankind. Cities that fulfil the possibility of good life are prone to degeneration, if not controlled by rational administration, rational planning and regulation [3]. The importance and philosophical perception of rational administration take an important place in the formation process and maintaining the continuity of the ideal city.

The abovementioned myths made a great contribution to the foundation of utopia. The Land of Cockayne feeds the element of desire in utopia with the hedonist community it reflects. Paradise and Golden Age belief has introduced the element of balance and harmony between nature and mankind, the Millennium belief which Jesus Christ will establish an earthly paradise has introduced the element of hope, and Ideal City has introduced the element of design with the deductions of philosophers [8]. Although it can't be suggested that Utopias consist of all of these elements, myths are feeding the utopian thought. The element of design has united values such as desire, hope and harmony and helped imaginations to reach the dimension of fiction.

Although the shaping of the utopian thought has been influenced by the narratives of myths and legends, utopias and dystopias are described as the history of now in *Utopia/Dystopia: Conditions of Historical Possibility* edited by Michael d. Gordin, Helen Tilley and Gyan Prakash. They argue that a foresight about a better life in the future more clearly reveals the contemporary problems [9]. Utopias are ideal system suggestions where old is completely broken down and new is built due to the inefficiency and negativity of the existing order. However, as utopias are founded so as to be at “nowhere” contrary to a viable future such as futurism suggestions, they are not necessarily implemented. According to Kumar, *the* value of Utopia is not at its viability, but at its relationship with a possible future, and utopia gains strength with its impracticability [3]. The impracticability of utopias does not make them independent from place. On the contrary, it is the place that is imagined as existent but does not exist. If place did not exist, its absence wouldn't exist. Therefore utopias are by definition related with place [10]. The construct of utopia is shaped together with place. Utopia cannot be constructed independent from place. Cities that ideal life takes place are important in terms of utopias. So much so that, according to Lewis Mumford, first utopia is the city itself



[3]. Imaginations and fantasies about cities go back to ancient times. It can be said that every city has a bit of utopia in its essence.

The concept of city is interpreted in utopias in many different ways. Some supposed that the ideal form of the city shapes society, and it is a means of achieving the ideal. Others assumed that ideal society creates its own ideal place [8]. In both arguments, there is a concern on the ideality of the city, even though the process is different. Ideal life and ideal city have always been related with each other.

In Plato's Republic where ideal state is described, society is classified as the guardians, the auxiliaries, and the producers. Guardians are rulers and philosopher-kings. Auxiliaries consist of the military class who maintains the order and provides the defense. Producers are citizens who are responsible from the material foundation of society [11]. Classification are seen in so many Platonist utopia [3].

The hierarchical order in the state has influenced Platonist Renaissance era urban planners, and these planners have tried to create the Republic's classified social order in centralized and circular planned cities [3]. The rationalist thought and the pursuit for ideality that was introduced with Renaissance were based on ancient artworks. The effort to reach the ideal has caused so many utopias to emerge. The importance of rationalist thought has redounded on a lot of areas. In the aftermath of humanism movement, people with intellect were extolled. Based upon the fact that mankind is in the center of everything, human body was seen as a criterion for the ideal. Designers such as Leonardo Da Vinci and Francesco di Giorgio Martini have made their designs according to the body ratios, deeming the geometrical order created by human body as ideal. Platonist philosopher Tommaso Campanella has researched the laws of nature and published essays about them. With Francis Bacon came the empiricism, and the answers for designs have started to be found via the observation of nature. The thinkers of Renaissance era have developed lots of utopias that can be referred as Platonist in order to break down the scholastic structure of the Middle Ages and as a reaction to the obscurity of the period.

Platonist classification can also be seen in dystopias that are the obverse of utopia. Etymologically derived from the Greek words "dus" and "topos", dystopia means challenging/formidable place [12]. Although implying the exact opposite of utopia with its meaning, for a dystopia there needs to be a society that is planned so as to be horrific.



However, in contrast to this fact, dystopias are classified as utopias that are good for a certain part of the society, or utopias that completely went astray. Therefore, utopias actually come with the dystopia that they imply [9]. For example, in his dystopian novel *Brave New World* (1932), Aldous Huxley has classified the society as Alpha, Beta, Gamma and Epsilon by creating a caste system in order to criticize the assortative perception [13]. The word “dystopia” was first used by John Stuart Mill in 1868 in the meaning of “a bad place” or “the worst system that can be imagined”. Mill describes dystopia that is a symptom of the intertwinedness of utopia and dystopia as “the utopia that one needs to be very careful when wishing it to come true” [14]. While utopias blame the present and jump over the reality to carry the society into the future, dystopias leave the society right in the middle of the reality [9]. Utopias and dystopias, by definition, aims to fundamentally and systematically change the existing system.

In this part of the thesis study, a part of the architectural utopias created from 16th century to the end of 20th century is discussed historically over examples. In the remaining part of the study, Renaissance period utopias will be analyzed in more detail.

## **2.1. 16<sup>TH</sup> AND 17<sup>TH</sup> CENTURY UTOPIAS**

Utopias are ideal and imaginary societies where all negative effects in human nature and daily life end, people work altogether without personal profit, and where there is peace and harmony. Utopian imaginations have been fantasized throughout history, but utopia as a concept is unfamiliar for the Middle Ages where Christian *logos* is prevalent. This concept has emerged in Renaissance period. The imaginary countries that constitute utopianism in history and the right of laziness that are verbalized in anonymous folk poetry such as *Cockayne Tale* or *Candy Mountains* don't appear in Renaissance utopias [15]. Renaissance utopias produce constructed ideal life systems instead of a lazy life fantasy.

Renaissance is a breakthrough period when sciences gain independence from scholastic thought, human mind and body is recognized, happiness is pursued in this world, Greek is learned in addition to Latin which is the prevalent language in the Middle Ages, and therefore the ancient philosophy is profoundly examined and a new human model is introduced. In this period, Plato has replaced Aristoteles, and human and nature have started to be examined. Throughout the Middle Ages, human has been deemed “an organ of a big

organism” and intelligence has been oppressed by Christian theology [5]. With Renaissance, intelligence escaped religious oppression and started to emancipate. In this period, most of the cities have had to protect their freedom from absolutist princes. A lot of theorist have presented their utopian plans which they designed for a new city planning to the princes and tyrants who wanted to break down the democratic order of urban management. Renaissance period urban planning has been scientific and theoretical, instead of the experimental and organic orientation of the middle Ages. Designs were made by the blending of general humanistic demands, centralization of pryncedom, aesthetic morphology, cosmic symbols and new defense techniques with the ideal examples. General urban schema was made via geometrical abstractions [16].

Innovations in Renaissance have supported intellectual liberation. The establishment of the first printing house in England by William Caxton in 1477 has paved the way for the distribution of knowledge. With the new countries learned through the geographical discoveries and the journeys have broaden Renaissance people’s horizon, and a new idea of the possibility of other communities apart from the society that they live in has emerged [17].

In 1516, Thomas More’s book *Utopia* was printed in Basel, with the map drawn by the famous German painter Hans Holbein and under the supervision of Erasmus. With this book, the “utopia” concept that can universally be used in ideal life projections was introduced [5].

In his book, More tells a story about a traveler who take long journeys with Amerigo Vespucci, the explorer who claims to have found America long before Columbus, and after parting from him, continues his journeys and eventually arrives at Utopia [17]. In Utopia island, there is an imaginary city called Amaurote, and he tells how people of Amaurote lives via the narration of the traveler. At Amaurote, there is a life that no one acquires possession, earns money over jobs and possession, and social equality is provided [17].

According to Mina Urgan, More may have read and be influenced from *Mundus Novus*, the book that Amerigo Vespucci wrote his journey memories. In his memoir, Vespucci tells of communities that, although not civilized as Utopians, do not care about gold despite having it in their country, share everything, and live freely without a king [17]. The fact that More tells of a neverland in other realms can be interpreted as another point of view and a reaction to the lifestyle of the period rather than the applicability of his ideas.

In addition to the effects of geographical discoveries, complete access to all knowledge of the antique age also enables the humanists of the period to, in the words of Mina Urgan, found a “Republic of Knowledge” in Europe, with the help of culture and knowledge exchange. Erasmus from Holland, Thomas More from England, and Guillaume Bude are deemed as the principal representatives of this republic [5].

Italy is regarded as the homeland of Renaissance [5]. Rome, the capital of the Roman Empire, along with the cities such as Florence, Genoa and Venice, resembles the old Greek polis cities. Beginning from mid-15<sup>th</sup> century, new designs started to be made in architecture and painting. Geometrical, rational and functional ideal urban landscapes are worked, and urban plans of Renaissance utopias have been influenced by these works.

Ideational architecture products and applied architectural works have progressed interconnectedly throughout the historical development process of architecture. Described as ideational and literary, ideal city fantasies have first been seen as formal design in Renaissance era [18]. Architects and painters in Florence have started to create a new symmetrical and geometrical ideal city instead of Gothic art.

In his work *De Re Aedificatoria* (On Architecture), Florentine architect Leon Battista Alberti describes the principles of Renaissance urban development that is connected with linear perspective and planimetry. “*Alberti’s thoughts on the Classical World’s forms, ratios and decoration suppose that the ideal and non-temporal beauty of the universe have been discovered by the Antiquity, and the artist should use the forms of the Ancient World as an example and starting point in order to reach this beauty,*” says Robert Stern about Alberti [19]. Collaterally with Renaissance thought, urban designs where microcosmos and macrocosmos interconnects. As in the polis example of the Antiquity, the sacred circle approach is used as the preferred geometrical form. Ideal cities are designed with the aim of connecting nature with universe [5]. Empirical point of view shows itself not only in architecture but in every area. Deemed as a part of sorcery and religion until Renaissance, science emancipated from sorcery and religion. Lifestyle of the Middle Ages that could not be detached from in the beginning of Renaissance was left behind in 17<sup>th</sup> century with the maturing of Renaissance, and lots of new ideal city samples were designed. As science emancipated, technological and scientific utopias have emerged. New utopias that use science and technique, such as The City of the Sun, Christianopolis, and New Atlantis can be given as an example to this period.

On the third chapter of this thesis study, Renaissance period theorists' works on ideal city concept are examined. The ideal urban designs that Leon Battista Alberti wrote in *On the Art of Building* and the design methods he obtained with Vitruvius researches; Sforzinda ideal city that Filarete designed in *The Treatise on Architecture* and the symbolic meanings he emphasized about urban design; visualizations of the ideal architectural ratios and the ideal design criterion that Francesco di Giorgio Martini discussed in *The Treatise on Architecture Engineering and Military Art*; the ideal urban design of Leonardo da Vinci and the designs that he made based on the ideal ratios he has created inspired by Vitruvius are all examined in architectural context. The aim in choosing these theorists is the fact that they have produced architectural products in which the reflection of Renaissance rationalism, humanism, orientation to nature and the concept of ideality on architecture and urban life can be clearly perceived.

On the later chapters of the thesis, Thomas More's *Utopia*, Tommaso Campanella's *The City of Sun*, and Sir Francis Bacon's *New Atlantis* as examples of fictionalized utopias in which ideal life is described are thoroughly examined in architectural context. Chosen in addition to the selection of architecture theorists, these three novels are preferred because of the fact that they reflect the features of Renaissance period in different ways. The utopian thought of Renaissance period which aims to achieve the ideal with the help of scientific empiricism and observation is considered as a reflection of the multilayered structure of utopia as it can not develop independently from architecture, and examined through architectural discipline.

Many theoretical studies on architecture were done in Renaissance period. Along with the abovementioned utopias, other ideal cities were designed as well.

After Italy, the birthplace of Renaissance, the most ideal city design is seen in Germany. Vitruvius' first German translation was published with the title "Vitruvius deutsch" by Walther Ryff in Nurnberg. In his book *Etliche Underrieht zur Befestigung der Stett und Flecken*, the Renaissance artist Albrecht Dürer (1471-1528) has displayed his designs. It is a known fact that German theorists have read the Italian or Latin copy of old books before they were translated to German and were informed about the ideal city designs of Italy [18]. For this reason, the fact that the German designers were inspired by the theoretical works in Italy is considered natural.

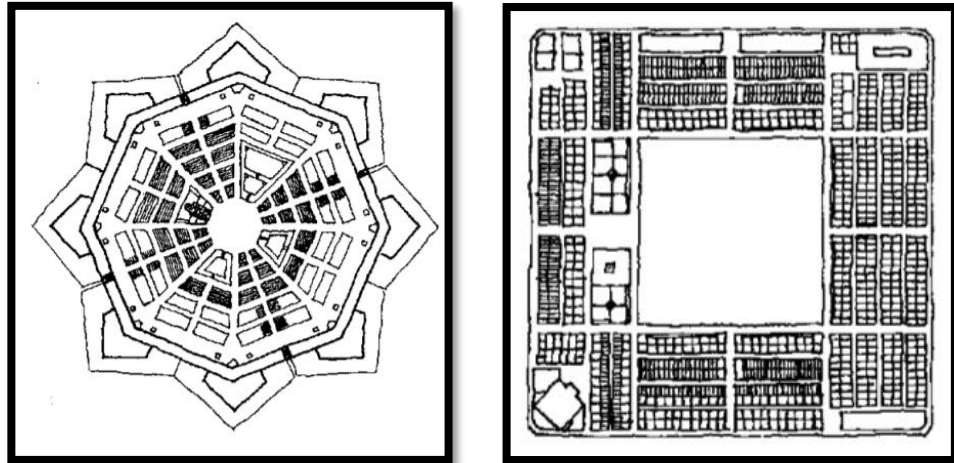


Figure 2.3. Albrecht Dürer's Ideal City designs [18]

Albrecht Dürer have designed two ideal cities in his book. One of these proposes an octagonal planned, concentric-radial road network transportation. Again an octagonal concourse is created in the city center. The other ideal city is designed as a square plan with sides of 734 meters. The city was territorialized according to their functions and located accordingly. While doing this, environmental conditions like the direction of the prevalent wind was taken into consideration. For example, locations of the foundries were preferred so as to prevent unpleasant smells and smoke to penetrate the city. The city square in both designs are, unlike their Italian counterparts, were left empty, being octagonal in the former, and square in the latter. In Italian designs, this area were allocated to the church or another important function [18].

Italian architect Andrea Palladio (1508-1580) is also considered as one of the theorists of architecture. In 1570, Palladio wrote his renowned work *I Quattro libri dell'architettura* which treats the same subject with Alberti's *De re Aedificatoria* (which will be discussed in detail on chapter 3.1 of this thesis). As it is written a hundred years after Alberti's book, the subjects that focus on the content because of the influences of the era have changed. Unlike Alberti, subjects such as clean water and sewer system were less dwelled on. Instead, formal problems of city planning are prioritized and the way the fountains and sculptures in the middle of avenues establish a relationship with squares is discussed in detail. As a result of these transfusions, baroque city image has emerged. According to Üstün Alsaç, this work is considered as the beginning and the precursor of baroque urban design [18].

In 1619, in the beginning of Thirty Years War, Christianopolis was written by theologian Johann Valentin Andreae as a 17th century utopia. The ideal urban design that reflects the Renaissance city was fantasized on an imagination of a Christian society [8].

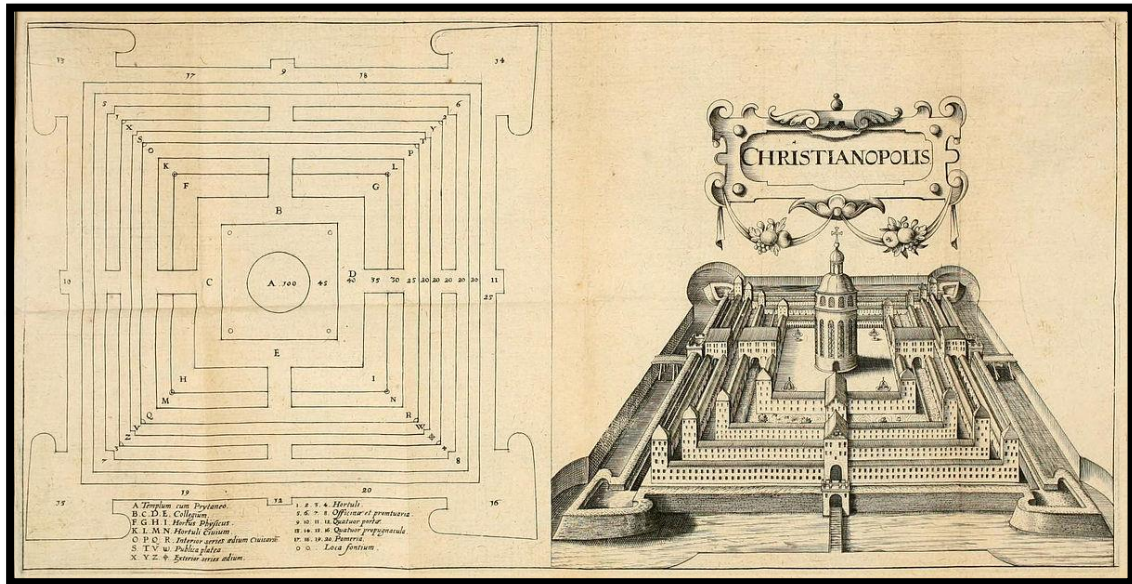


Figure 2.4. Christianopolis plan [20]

As can be understood from the city plan, the tower at the center of the city is at equal distance to all corners of the city. Geometrical equality is reflected on social equality as well. In Andreae's utopia, the administrator of the church is also the administrator of the city. Property belongs to the public, but is under the supervision of the administrator [21]. The city of Christianopolis is square shaped, and one side of the square is 215 meters long. The periphery of the city is surrounded by walls and it has four towers. There is a circular religious structure that has a perimeter of 90 meters and a height of 21 meters at the city center. The religious ceremonies are mostly conducted at the city center where the temple is [22]. The buildings other than the temple are two-storey. The city is zoned based on functions, and similar functions are gathered together [8].

While religion is the key element and the regime of the city, it places important on empiricism and education. There are separate laboratories at medicine provision houses, anatomic research areas and nature observations. At these workplaces, scientific researches are being made to find cures for diseases, to analyze the characteristics and development of

all life forms through the observation of nature. Also, it is an ideal city design where studies are being made in areas such as mathematics, literature, geometry, medicine, theology, foreign languages, painting, art, music, metaphysics, astronomy, and astrology [22].

Mumford suggests that Christianopolis utopia has influenced the 20<sup>th</sup> century utopia, the Garden Cities, and the primary idea was the association between city and agriculture [2]. According to Kumar, Christianopolis utopia makes a contribution to utopianism, owing to the fact that it is a utopia that centralizes science, like the City of the Sun or New Atlantis [8].

With the innovations of Renaissance period, people's mindset has changed, and with this enlightenment, new ideas have emerged. Platonist thought is adopted and the relationship that mankind established with microcosmos and the universe was reflected on its relationship with architecture. Thus, utopias that represent universe was designed. The oppression of religion has been replaced by science and intellect. The harmony of religion and science has started to be seen in utopias. As Renaissance matured in 17<sup>th</sup> century, utopias have emerged where empiricism and scientific research is in harmony with religion, and the importance of natural science is emphasized. The Age of Enlightenment in late 17<sup>th</sup> century is an era when the innovations of Renaissance has developed, the effect of the concept of religion on ideal life has eased off with the abolishment of the oppression of religion, and utopias that value science was created.

## **2.2. 18<sup>TH</sup> CENTURY UTOPIAS**

The change and renewal in the beliefs and thoughts of the Western civilization in the Middle Ages, and people's discovery of access to knowledge with intellect first happened in Renaissance period. Its seeds sown during Renaissance, the period that bore its fruits as the continuation of questioning with intelligence has been called The Age of Enlightenment. Beginning with the 1688 British Revolution and peaking with 1789 French Revolution, the ideas of Renaissance have matured in the Age of Enlightenment and a rational progression has started in this direction. As modern thought has improved, its implementations have started to be seen in every area [23]. There have been many progressions in urban design and architecture as well. The desire to pursue the ideal which exists since the beginning of humanity also continued throughout the Age of Enlightenment. As the oppression of the

church has decreased, structures other than churches and castles have superseded the works of designers. Etienne Louis Boullée (1728-1799), one of the theorists and architects of the Age of Enlightenment, has produced monumental, imaginary works which he named “talking architecture” (“architecture parlante”) and that are imaginary rather than applicable [24]. By using forms other than human scale, he preferred to draw cultural structures like utopian castles, rampart designs for imaginary cities, monumental designs for Newton, museums, operas and theatres.

Boullée has finished the Cenotaph project which is a monumental utopian design in 1784. Designed for Newton whom he is an admirer of, this monument is an empty sphere that represents the universal gravity law which holds together everything in the universe [24]. As can be seen in its cross section, when looked from outside, only the upper half of the sphere is perceived. The lower half is embedded in a square shaped mass with cypress trees on top. In the lowest elevation, there is a sphere shaped sarcophagus with Newton’s tomb, reached through a long, dark tunnel. It can be suggested that the dark tunnel that goes to the sarcophagus represents the transition between life and death. By Ali Artun, Cenotaph for Newton project is considered sublimer than both Solomon’s Palace and Harian’s Pantheon in Rome (127 A.C.) and described as the magnum opus of utopias about museum architecture [25]. According to Artun, Boullée’s sphere forms the most austere, most imaginative and utopian architectural expression of this ideal form of cosmic perfection and celestial harmony, creating a sacred effect with the beams of the sunlight infiltrating from the holes on its surface [25].

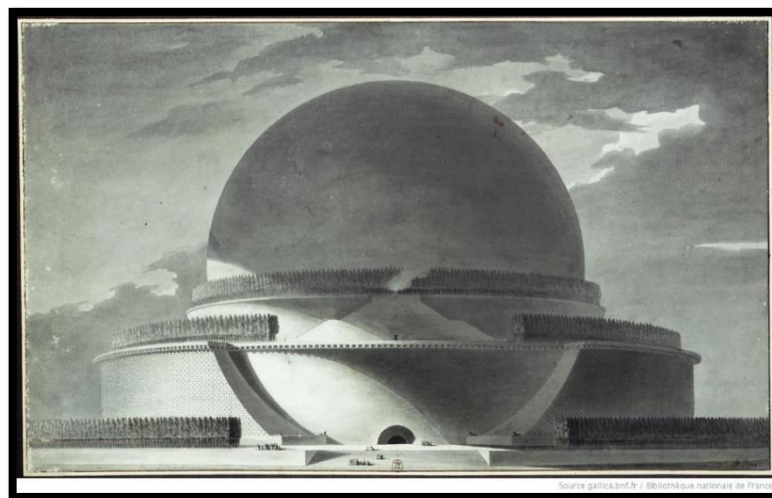


Figure 2.5. Cenotaph project for Newton elevation [26]



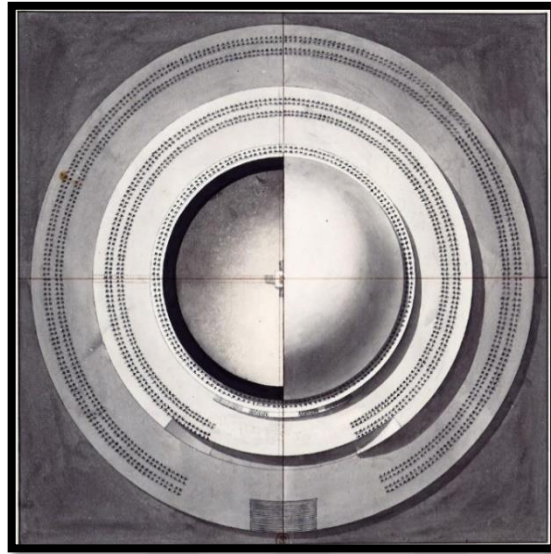


Figure 2.6. Cenotaph project for Newton plan [26]

The aim of the monument that Boullée design with the pursuit of aesthetic sublimity is to “place Newton to the sky” [27]. Boullée has designed an imaginary “ideal museum” in his designs based on gigantic geometries. In the development of museum architecture, Boullée’s works have been guiding in 19<sup>th</sup> century - known as “The Golden Age of the Museum”. World Museum (1929) design of Le Corbusier, who has a lot of utopian design which will be discussed later on this thesis, is the stylistically interpreted version of Boullée’s sphere [25].

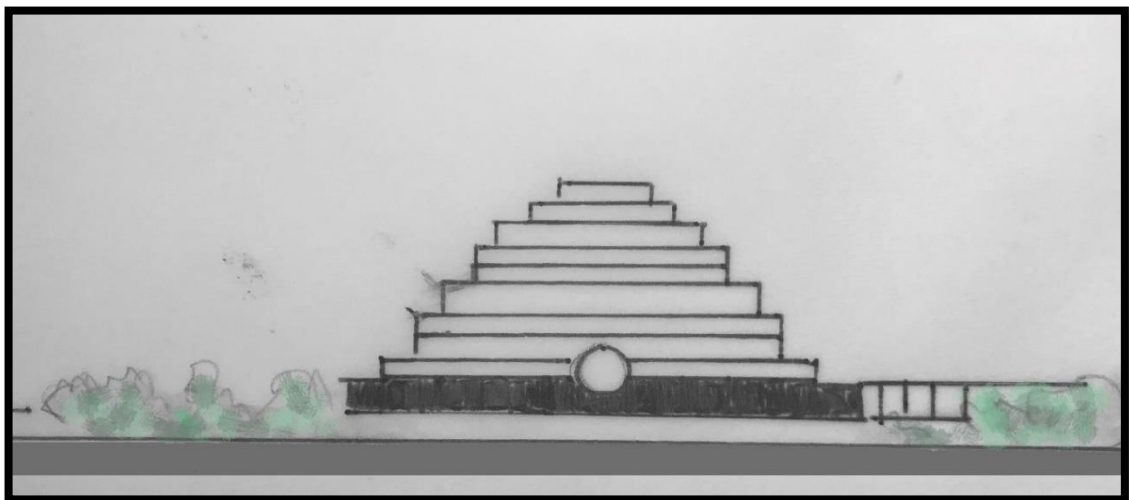


Figure 2.7. Le Corbusier World Museum sketch (sketch by thesis author)

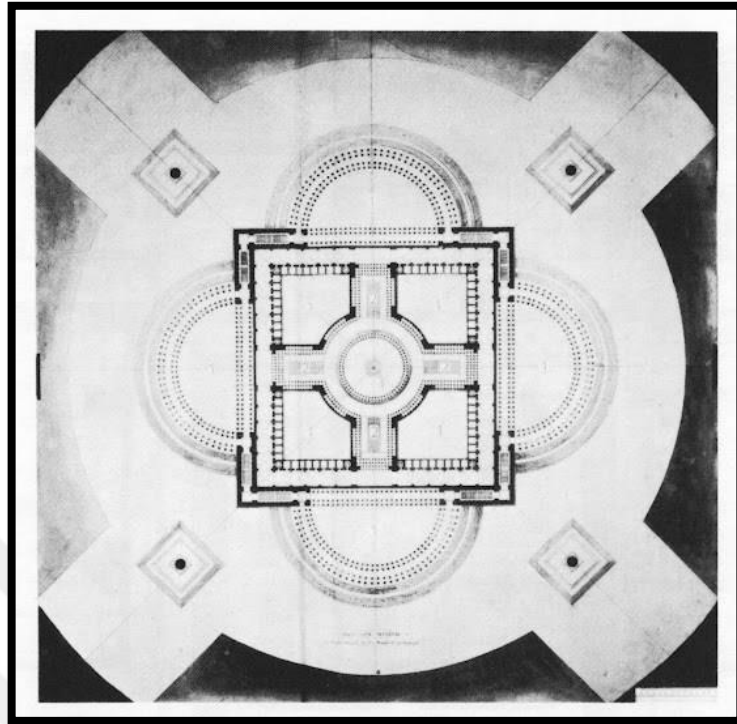


Figure 2.8. Boullée's Ideal Museum plan [28]

In Boullée's "Ideal Museum" design, as can be seen from its plan, its design is made so as to develop on a Greek cross plan type. The center of the structure is the scaled up version of Pantheon in Rome. It creates a square shape with large hallways surrounded by columns. Domed spaces are designed on four sides of the square [28].

Boullée's contemporary, architect Claude-Nicolas Ledoux has preferred to design by using plain geometrical forms in the utopian works of Palladio Style. With forms like pyramid, cylinder, sphere, he has found fantastic solutions. With his unique designs and writings, he has laid the foundations of modern architecture. In 1789, at the time of French Revolution, he designed Chaux Ideal City utopia. The starting point of the utopia design was the industry city at Arc-et-Senans, built for the Royal Saltworks and conceptualized for the project between 1775-1779, 20 years before the Revolution [29]. The Age of Enlightenment, the church was at the center of designs, whereas in Ledoux's industrial city design, the house of the administrator was at the center. There were 10 buildings with different functions that surround the semicircle plan. Every building has one façade facing the square, and, in order to provide privacy, a façade opening to the backyard where the wet bulk were placed. The main entrance were from the central alignment of the semicircle. The administrator's house at the center was emphasized with Doric columns so as to be perceived from afar.

Reinterpreting classical architecture, Ledoux has preferred to use rustic columns and roofs. Also used to preserve food, salt was very important at that time. In order to describe mankind's observation and perception of nature, decorations which morphologically mimic salt mines were made. Ledoux's industrial city were shut down after the French Revolution in 1790 [30].



Figure 2.9. Artificial salt mine [31]

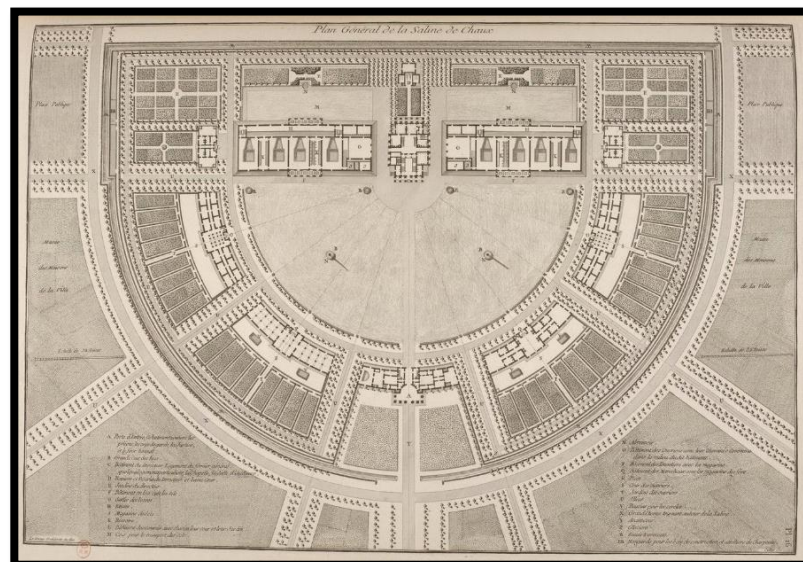


Figure 2.10. Royal Saltworks plan [30]





Figure 2.11. Royal Saltworks [30]

Considered as the first modern factory, the royal saltworks which has been the starting point of the plan design of Chaux Ideal City. With the industrial urbanization, the semicircle plan of the salt factory has evolved to full circle. To the factory complex consisting of ten buildings, a lot of annexes has been added and each building's function was described with the help of visuals. These drawings were published in his book *Treaty of Architecture*. On the city plan, entrances and exits are made on two main axis. The avenue that stretches from the forest to the river and the other avenue that intersects at the city center are the transportation axis of the city. By creating open spaces, Ledoux wanted to create public areas (*res publica*) at the city center. He wanted to provide a balanced and harmonious habitat. When the perspective drawing is examined, the wish to make the impression that there is production in the city by emphasizing the smoke on the factory, and that there is life by drawing strolling people at the square can be seen. Older structures like churches or farms were interpreted by blending them with new structures at places that are closer to the countryside. The fact that he turned the salt factory into a utopic city design shows similarity with this visionary approach [32].

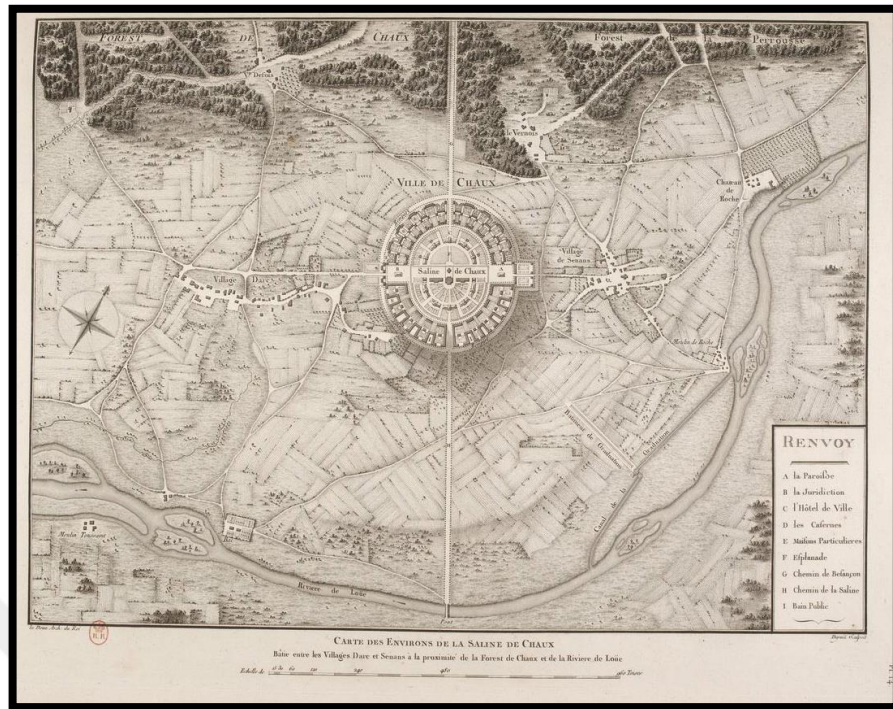


Figure 2.12. Ideal city of Chaux plan [30]



Figure 2.13. Ideal city of Chaux perspective [30]

As can be seen from the examples, there were monumental structures and designs in 18<sup>th</sup> century utopias where utopian geometrical shapes (cubes, spheres, pyramids etc) are used in respect of their sizes. Another remark is that the structure complex that was designed for another function has evolved into ideal city. For example, a factory that was once used as a salt factory was turned into an ideal city design. There is a geometrical symmetrical planning in both the factory design and the ideal city design.

Placed in the center of the city in pre-Enlightenment utopias, the church has left its place to the house of the factory administrator. With industrialization, factories have influenced social life. Ledoux's reinterpretation of a factory and the redesigning of the ideal city as an industry city can be considered as an indicator of the fact that social life is now industry-centered.

### **2.3. 19<sup>TH</sup> CENTURY UTOPIAS**

In late 18<sup>th</sup> century, migration from rural to urban has started. Beginning in Britain and gaining momentum in entire Europe, this population movement has continued in 19<sup>th</sup> century too. Whereas the population of London was under 1 million and Paris' population was 500.000 in 1800's, the population of London has increased to 4,3 million and of Paris to 2,5 million in 1900's. In America, the urban growth has been so much faster. New York has been the second crowded city of the world after London, with an increase from 63.000 in 1800's to 2,8 million in 1900's [33]. With an intense increase in population, city infrastructures have become unable to carry the population load. During this period, a lot of utopia has been developed as a reaction to industrialization. As the utopias of this period have an egalitarian and prosperous aim, they show a similarity with Thomas More's utopia.

A lot of utopia has been designed with a main purpose of solving the problem of dense population and unhealthy living conditions in the cities. The utopian, monumental and cultural designs of the Age of Enlightenment with their geometry and size have been replaced by egalitarian, economical solution oriented small cities and communal housing utopias founded at rural areas where production and consumption is structured as a result of the emergence of the working class with industrialization. With the aim of changing the adverse working conditions of the working class and creating a happy society of industry, Robert Owen (1771-1858) has founded a community called New Lanark (1800-1824) in



Britain. In this project where working, education and village units are solved together, a communal life where workers live happily in healthy conditions is imagined. Brought into being in Britain, New Lanark project is used as a museum today. Owen's New Harmony project (1825-1827) which he designed with an absolute equality principle but failed to actualize was designed as a suggestion of a rural small city. Owen imagined an isolated communal life where areas such as prayer places or kitchens are at the city center, and the dormitory rooms are placed on the rectangle that surrounds the center.

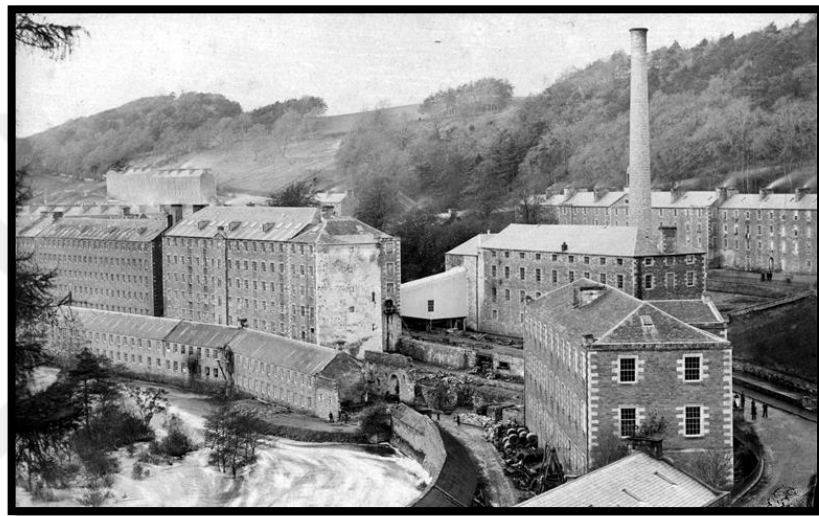


Figure 2.14. New Lanark [36]

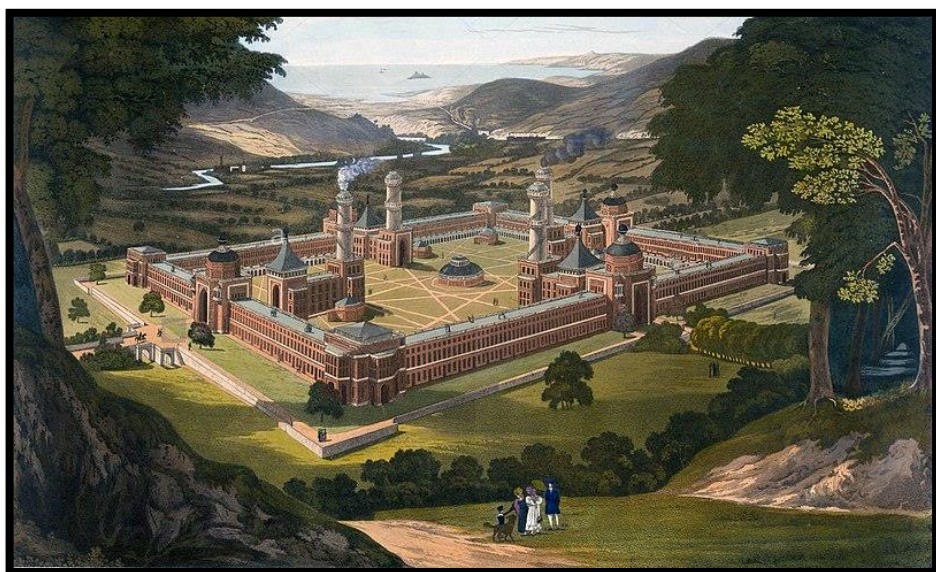


Figure 2.15. New Harmony [37]

Owen's contemporary, Charles Fourier (1772-1837), and after him, Jean-Baptiste Andre Godin (1817-1888) have proposed utopian designs for the industrial society. Fourier has designed Falanster project (1834) as a reaction to the concept of industrial city [38]. Unlike Owen's utopia, all activities are gathered in one structure in the utopia that Fourier suggested. The structure was planned as to accommodate 1620 people, and it is designed as a building where all tools and equipment are shared, and where elder people live on the first floor, children on the second and adults on the third. France wanted to found a Falanster in Algeria but failed to do this. After 1848 Revolution, large buildings that are divided into rooms and designed in accordance with Fourier principles were built for 400 worker family in all neighborhoods of Paris. Between 1841-1859, 28 Fourierian colony were founded in USA [38].

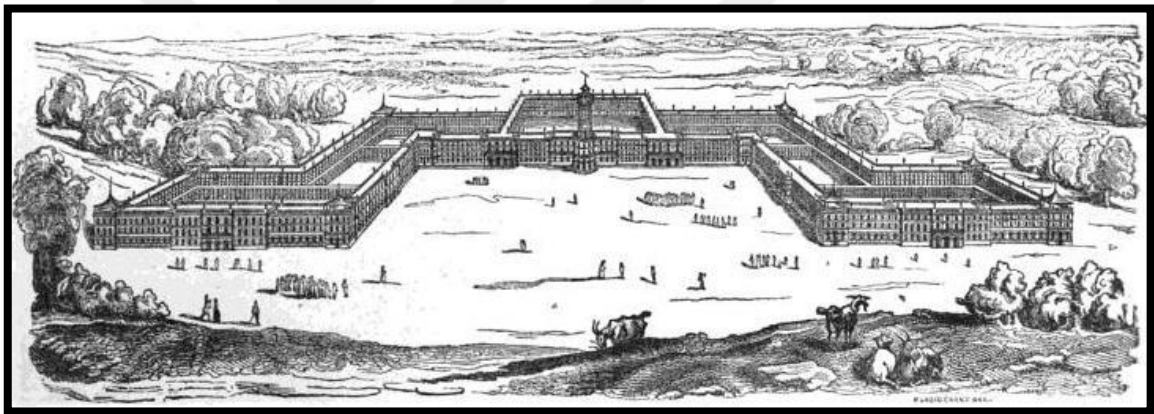


Figure 2.16. Phalanstere [39]

Reinterpreting Falanster utopia, Jean-Baptiste Andre Godin has proposed the collective life project called “Familister” which is integrated with industrial structure, and which opens to a shared yard [38]. Different from Falanster, Godin wanted to establish a sense of belonging by preserving the concept of family, providing each family a house, instead of communal life [40]. Three big housing structures were designed as to be connected to each other, and hospital, children's playground, school, theater, launderette, service and storehouse areas were in the same structure. Inner courts were designed as to be sheltered by a glass roof. Familister was successfully applied and used as a producer cooperative after Godin's death. As one of the first efforts of social housing, Familister is used as a museum today.





Figure 2.17. Familistère courtyard [41]

In 19<sup>th</sup> century utopias, the effects of the industrial revolution can be seen. Ideal cities based on collective life has been designed. There are examples of communal life integrated with industrial life. Projects were designed that are able to handle the dense population in the cities caused by the increase in the migration, and it was imagined that communal life can constitute an example for this. Unlike utopias' structure based on impracticability and imagination, there were efforts to actualize utopias in this period. Owen's New Lanark project and Godin's Familister project are actualized examples in this respect.

With the industrial cities that were founded in 19<sup>th</sup> century, a period when industry has placed itself in the center of everyday life, the foundations of mass production-oriented modern city of the 20<sup>th</sup> century has been laid. Due to the dense population in the cities, city life had to carry on under tough conditions. Life became disconnected from nature, technology started to progress, and a consumption-oriented lifestyle has started. With the changing social structure in this period, different interpretations of utopia have emerged. The concept of technotopia which consists of dystopia which is set against utopia, the concept of nostalgic and reactionary utopia which criticizes the current lifestyle, and the combination of emerging technologies and utopia has first emerged in late 19<sup>th</sup> century and continued in 20<sup>th</sup> century.

## 2.4. 20<sup>TH</sup> CENTURY UTOPIAS

With the industrialization in the 19<sup>th</sup> century, modern cities have started to emerge and maintained their existence until the 20<sup>th</sup> century. Rural areas have become empty and cities have gradually gotten bigger. The population that is too dense for the bearing capacity of cities have started to impair life quality. In order to solve urban problems, in 1898, Ebenezer Howard proposed the garden city which is integrated with nature. The aim of this garden-city was to create a synthesis of the advantages of the rural and the urban [42]. Howard's ideas were to "turn the people back to the land", which was also the course of the utopians. Howard used a metaphor on the urbanization of this period, describing all cities as a magnet, and all people as a needle. For the more useful and equal distribution of the urban population, he claimed that a magnet stronger than the attraction force of the city needs to be created [42]. Within this context, it can be suggested that the density in the city centers can only be homogeneously dispersed to rural areas by integrating the functions and employment opportunities of the modern cities with the healthy aspect of the rural life.

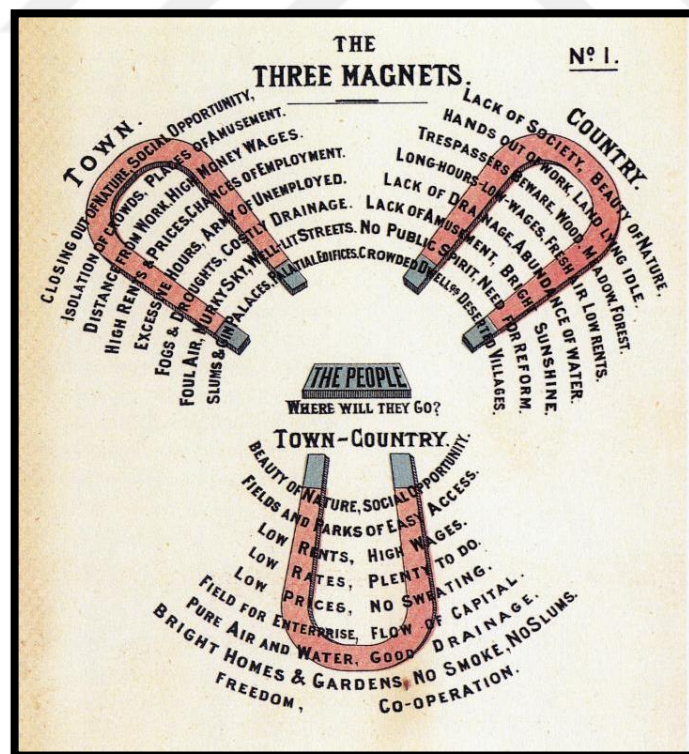


Figure 2.18. Howard defined three "magnet" locations: Town, Country, and Town-Country

Garden city was designed with a radioconcentrical plan and 400 hectare of an area of 2400 hectare was reserved for construction. Remaining areas were shaped as green belts. In the center, commercial and administrative functions were located, and the housings were located on five different circles surrounding the city center [42].

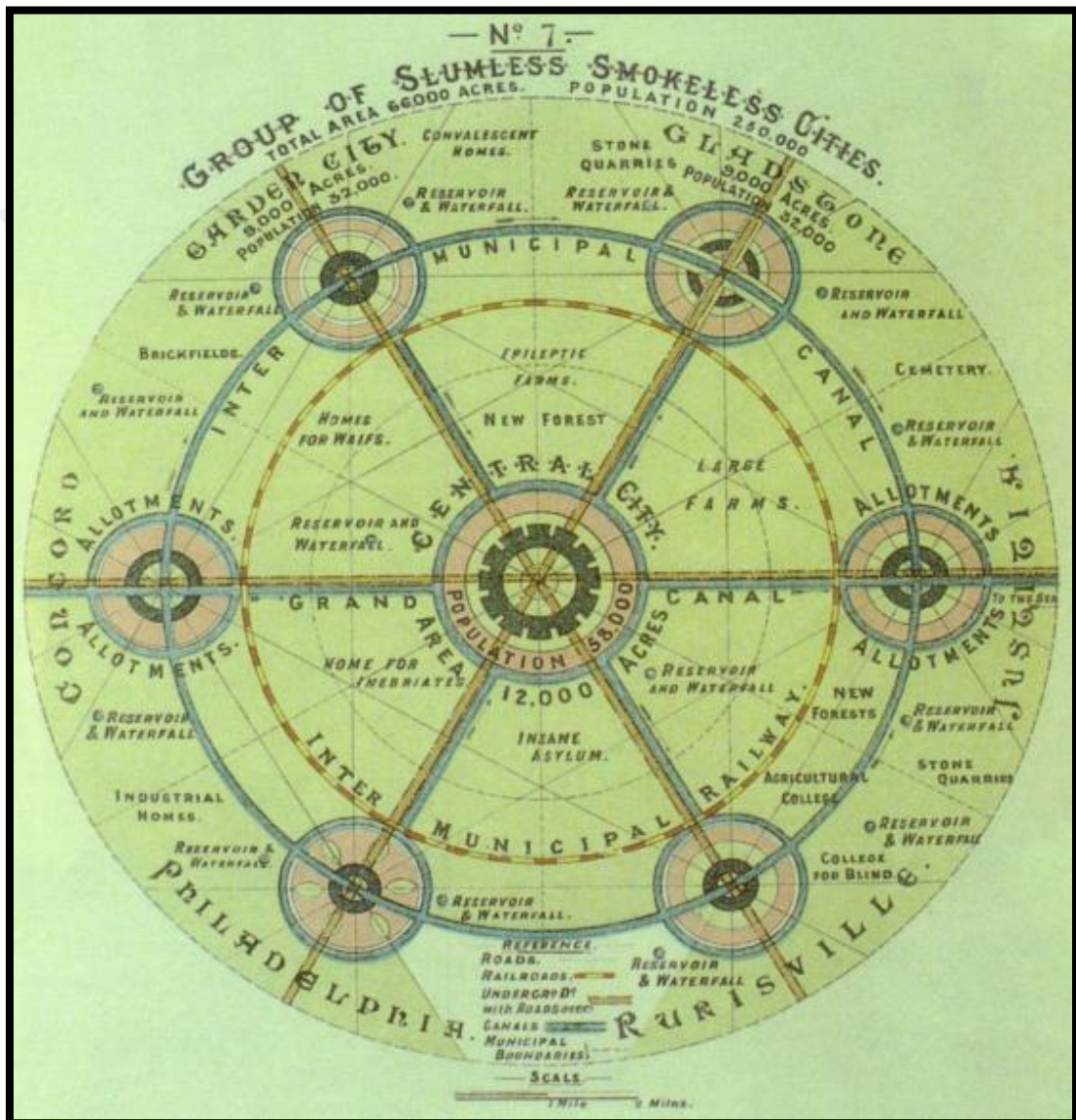


Figure 2.19. Garden City plan scheme [43]



The first example to be applied was Letchworth city in England in 1903. Built as a garden-city model, the city could only reach a population of 16,000 in 1936, although it had a capacity of 35,000 people [42].

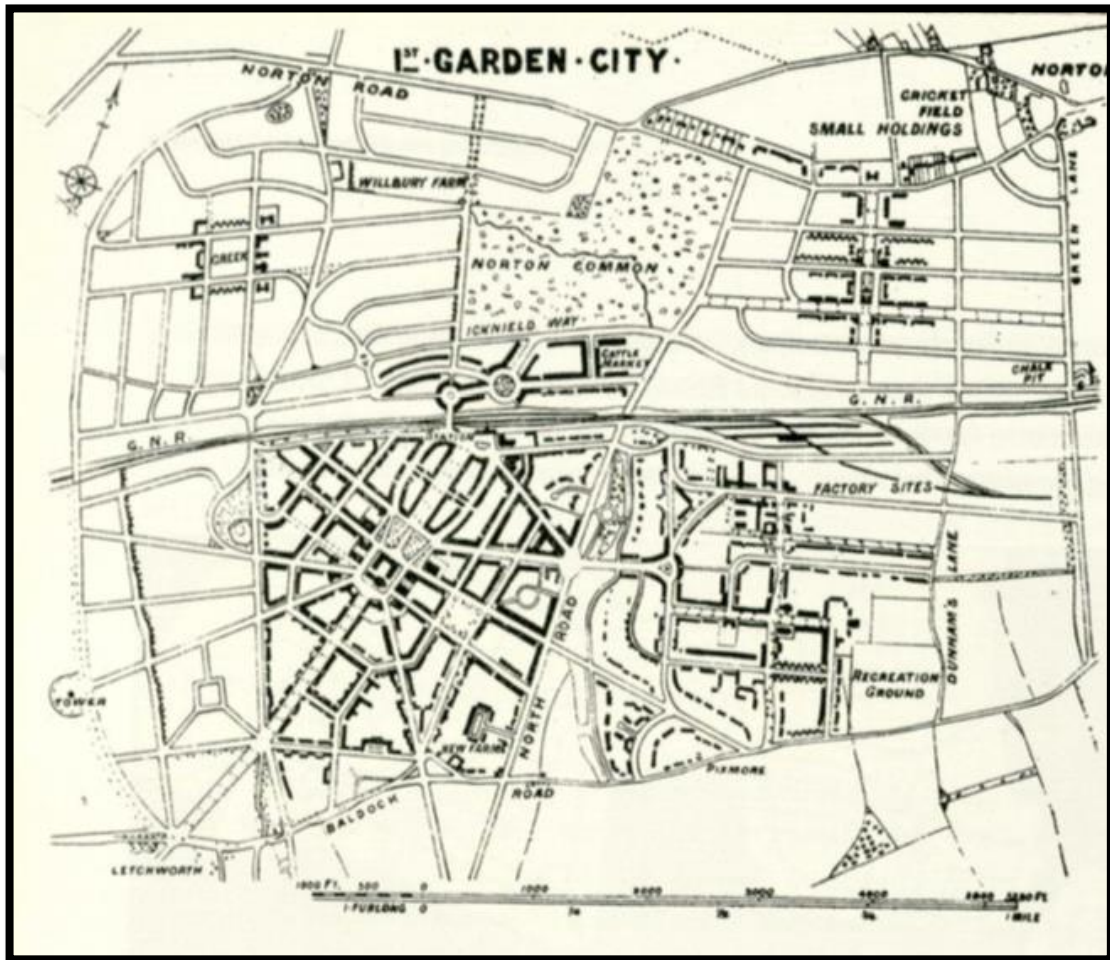


Figure 2.20. Letchworth Garden City's original plan, by Barry Parker and Robert Unwin [44]

As a result of the urbanization in the 19<sup>th</sup> century, most of the society, especially the newly migrated people, lived in ribbon buildings that face the factories and railways, and receive almost no sunlight, due to the disproportionate increase in population at the city center. In 1900's Berlin, half of the families lived in rental houses that consist of a small room and a small kitchen, and the other half in two rooms and a kitchen [45]. Unhealthy conditions in city centers prompted a lot of architect to create an ideal city design.

In times when society needs hope, utopias have increased. Wars had an effect on the emergence of utopias. Near the end of the World War I (1918-1919), Bruno Taut described himself as an “*imaginary architect*” in a letter he wrote to Karl Ernst Osthaus, and started to make utopian designs for the future societies to have a better life [46].

In 1914, Taut preferred to use Glashaus (Glass House) which he designed for *Werkbund* exhibition as the structure at the center of the utopian city design that he mentioned in *Die Stadtkrone* (Crown of the City, 1919) and named as *Alpine Architektur* (Alpine Architecture, 1917) [47]. According to Taut, as a result of industry revolution, the cities that face extinction became a source of boredom. He thought that he could overcome this boredom with the transparent structures that he had proposed [48].

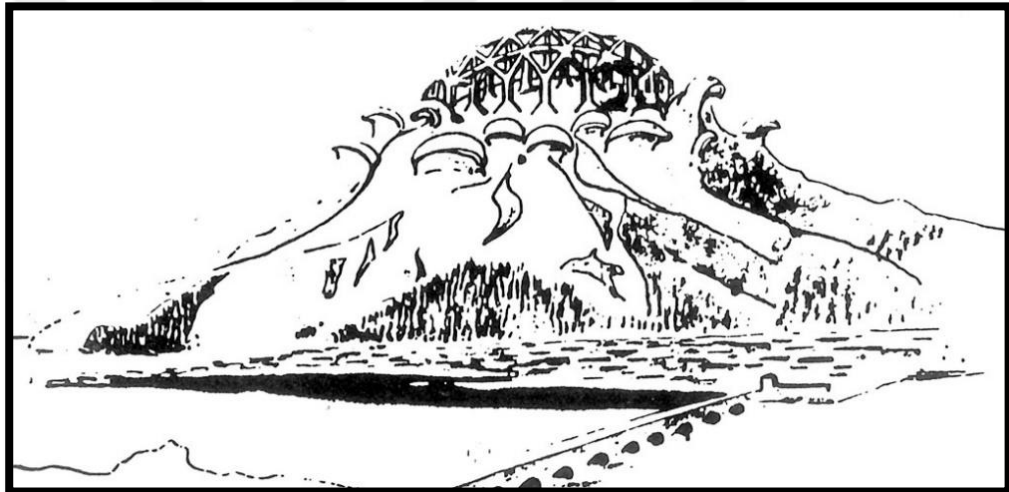


Figure 2.21. Alpine Architektur sketch [38]

The cities that were designed in 20<sup>th</sup> century are being influenced by the technological and scientific developments of the period. Production through land has been replaced by production through industry. Therefore, population has tended from rural towards urban. As current conditions in the cities (transportation, housing etc) are designed with regard to the capacity and functions of medieval city, physical conditions could not meet the requirements of the period [49].

Based on the speed, dynamism and functionality that industrialization and new technologies have introduced to daily life, healthy physical environments where the chaos of the cities does not exist is being designed. Between 1910-1933, modern architecture was on the rise

as a solution to the chaos of industrial cities. In this period, utopias have progressed in two main paths. One is to change the society by making use of the production potential that develops with industry, create “new human” model; and the other is the dominance of architecture over all other design disciplines [38]. Le Corbusier was one of the pioneers of Modernism Movement, and has reacted to the city life that was created by industrialization. Corbusier has determined four main functions that form ideal city model and made designs in that direction. According to him, dwelling, working, recreation, and transportation are main functions that must exist in cities [50]. Corbusier argues that existing environmental plan must be renewed by using new industrialization techniques, and the industrial society that live in unhealthy conditions should be transformed so as to improve the life quality [50]. Corbusier argues that architects have much bigger responsibilities than to just build structures. According to him, architects should be the leader and the pioneer of social development [49].

In accordance with this ideology, for the aftermath of World War I, Corbusier set forth *Contemporary City (Ville Contemporaine)* project in 1922, as a solution offer for the chaos of industrial cities [51]. With a capacity of 3 million people, the city was designed based on the discourse “there must be skyscrapers in the center of a big city” [8]. Such that, it can be said that he foresaw the cities of today with this project.

Le Corbusier used the skyscraper as a kind of vertical avenue, a “hovering avenue”, and with this method he wanted to transform the “dull avenues” of the old city into thoroughfares [45]. With *Contemporary City* design, Le Corbusier made a design that offers a solution to security issues and prevents the physical environment from the damages of industry. He placed 24 sixty storied skyscrapers made from steel and glass at the center of the city. There is a green belt of 300 ha that surrounds the skyscraper [8]. The area allocated for the green belt has been one of the main aspects of Le Corbusier’s urban theory. A huge part of the city is allocated for lawn, gardens, tennis courts, boulevards and parks. Le Corbusier described parks as the lungs of the city, since they are the places to breathe [51]. He stressed on the situation that cities were in at late 19<sup>th</sup> century, and argued that the cities that are in touch with nature instead of the ones with air pollution due to industry are like a paradise to enjoy leisure time [51].

Le Corbusier proposed a system in which fetid and pestiferous areas of 1920’s Paris are demolished for the solution of the overwhelming and erratic traffic axis, and housing areas

and avenues are separated with trees and hierarchical traffic solutions are introduced instead. Using a medical metaphor, he described the current situation of the cities as exsecting the cancerous limb [51].

In his *Contemporary City* proposal, Le Corbusier envisaged these building complexes as places for 20-50 thousand people each, and where society's business services are provided. Housing units are designed as 6 storied luxury buildings and grid planned houses with gardens for workers who work 8 hours per day [52]. He planned housings and workplaces close to each other. Taking a holistic approach for environmental design, Corbusier aimed to reflect the architectural revolution on the evolution process of the city with this method [8].

Collaterally with Ebenezer Howard, Corbusier provided a planning with a housing design that protects the privacy of the family, and in which he distributed the social services and commercial functions to the city. It can be said that the concepts of collective order and individual freedom are two main concepts that describe the *Contemporary City* [53].

Using the technologies of the period has been a starting point in design for Le Corbusier. The concept of speed is very important for him. With an influence by the design of automobiles, Corbusier used discourses such as "Housings are machines to live in" [33]. Corbusier's utopian perception was one to claim that technology has the power to enable the reintegration of humankind with natural harmony, provided that it is used duly [51].

*Contemporary City* project is a suggestion which Corbusier designed independently from space. His second modern city proposal was *Voisin Plan* in which he reorganized Paris city center in 1925 [51]. He wanted to use the skyscraper design of the *Contemporary City* here too. When the city plan is examined, it can be seen that, as a designer who attaches importance to automobiles, Corbusier has tried to offer a solution to traffic problem, which is an important issue in industrial cities

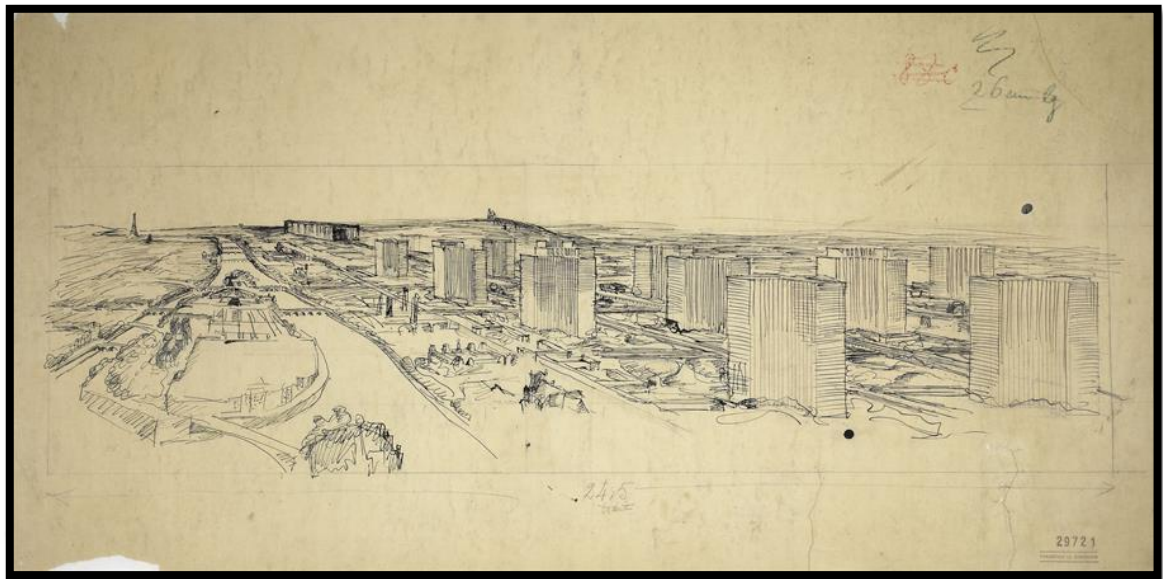


Figure 2.22. Plan Voisin perspective, Le Corbusier [54]

As his Voisin Plan he foresaw for Paris did not attract enough attention due to the economic depression of 1929, in 1933, he proposed the ideal city which he named Radiant City - a city with a more authoritarian design. Corbusier argues that for a modern society, modern city should be built [50]. In the project where he reflects the principles of Contemporary City, unlike Ebenezer Howard's Garden City, he tried to find a solution in the city, instead of a settlement that is created outside the city. With "Towers in the Park" discourse, he tried to create the modern city, organizing the chaos within the industrial city with parks and skyscrapers [50].



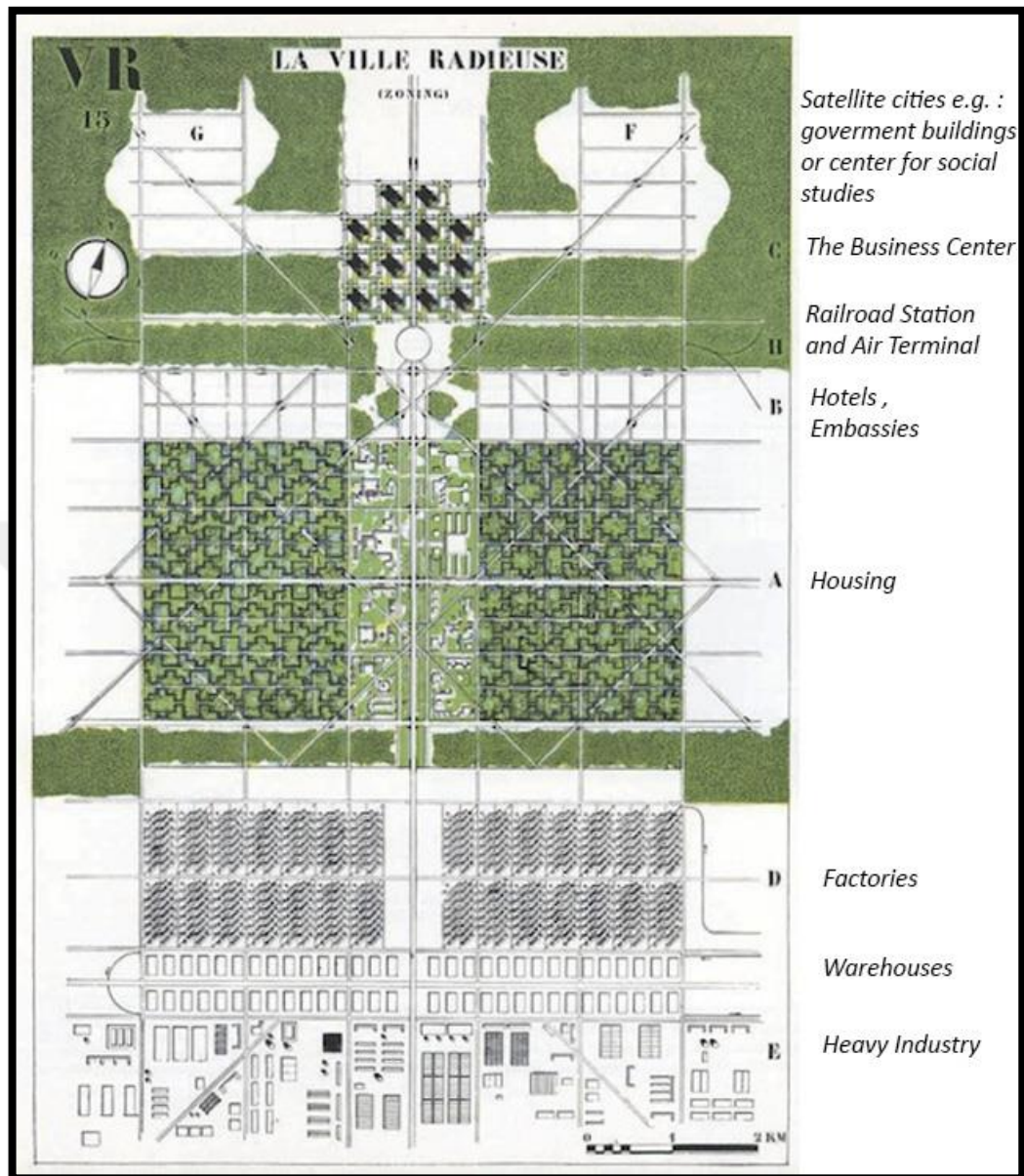


Figure 2.23. The Radiant City, 1933 [56]

As can be seen on the plan, Corbusier sorted out the ideal city construct geometrically and symmetrically by dividing it into zones according to their functions. He located heavy industry, factories and storehouses outside the city, and separated this area and residential district with a green belt. Dwelling houses are located among parks and are divided by symmetrical avenues. Subsequent to dwelling houses, there are embassies and hotels, and subsequent to them, there are transportation centers like airports and railroad stations. On the other side of the transportation centers, there are skyscrapers with the function of business centers, and subsequent to them, there are suburbs.

Although Le Corbusier's utopias could not be brought into being, they have been guiding for a lot of modernist designs. Corbusier himself has used these utopias for proposals which he designed for European cities like Paris, Antwerp and Moscow, and Northern African countries such as Morocco and Algeria. In 1949, he proposed and applied the zoned geometrical design in Punjab, India [57].

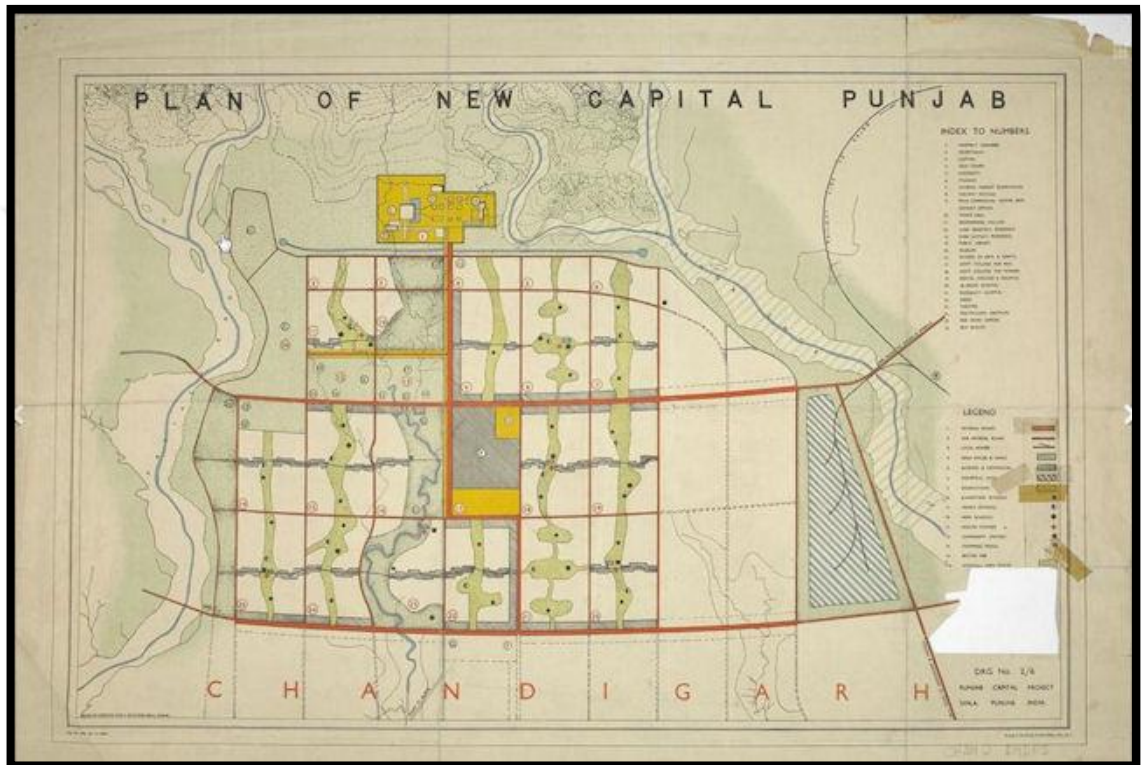


Figure 2.24. Plan of Punjab [57]

In parallel with Le Corbusier's designs with standardization, flawless geometrical regularity, and symmetry, Lucio Costa designed Brasilia city and Oscar Niemeyer. In this urban plan which is strictly divided according to its functions, there is a perfect geometrical

regularity and identical housing units. In this way, Le Corbusier's principles were followed and social equality was sought with standardization [58].

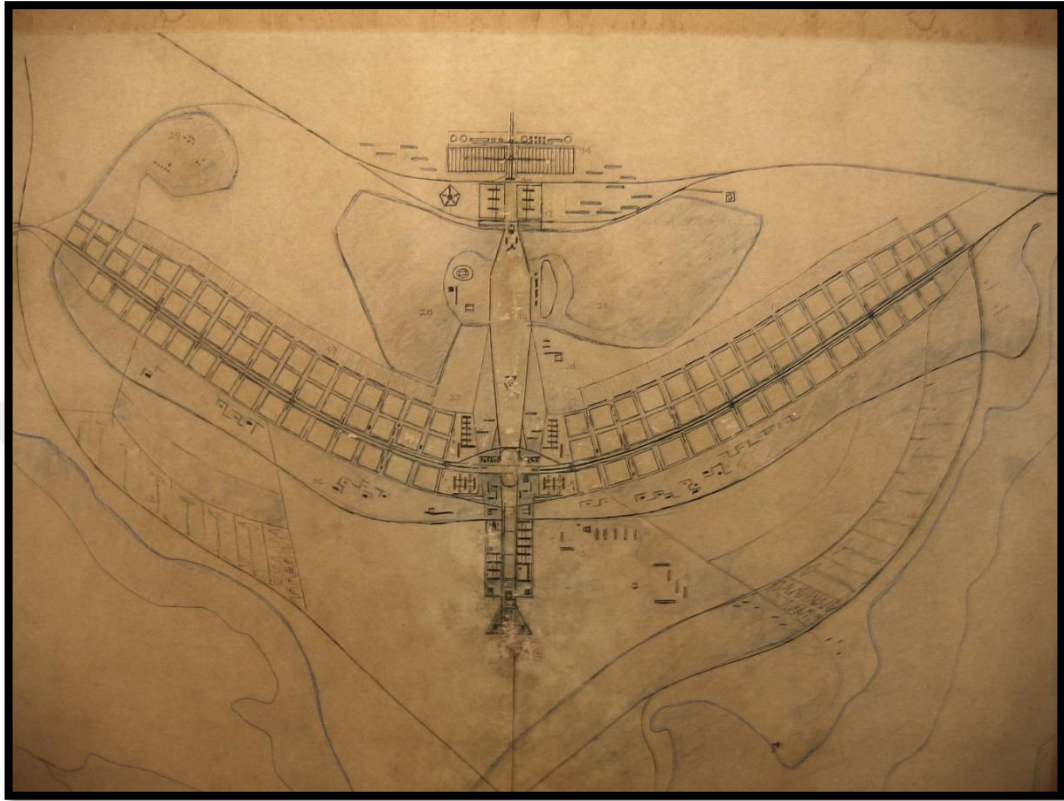


Figure 2.25. The original plot plan of Brasil [59]

Minoru Yamasaki, who is a modernist architect influenced from Le Corbusier, has designed Pruitt-Igoe housings as a post-war reconstruction in 1954. Pruitt-Igoe housings which 13,000 people live in 33 buildings with 11 stories each have been applied in St Louis in 1954. At the area where the population has decreased after business centers have been gradually moved to suburbs, vandalism and illegal deeds have emerged. After such a period, the housing has been demolished with TNT, and that day was described by Charles Jenks as the day that modern architecture has died [60]. There are several arguments about the demolition of the housing, but essentially it is perceived that individuals, regardless of their income bracket, need a sense of belonging [60]. On the basis of this example, it can be argued that solutions that work on paper owing to the holistic design approach of modern architecture may not be always the same when it comes to implementation.





Figure 2.26. Pruitt Igoe housing [61]

After World War II (1939-1945), 20th century utopias have increased rapidly. The world order imagined for 2000's in 1900's was a futuristic life where flying cars fly overhead, climatized clothes are worn, food is taken in form of pills, therefore there is no need for a kitchen in houses [38].

The aftermath of World War II can be referred as the second wave of the 20th century. In this period, in 1960's, Japanese Metabolism movement, English Archigram group, and Coop Himmelblau in Vienna have produced utopian architectural works [38].

The atom bomb that was dropped on Hiroshima and Nagazaki in 1945 not only destroyed the city and killed most of its habitants, but also wiped out the cultural identity of Japanese architecture. In the rapidly growing and globalizing world, cultural homogeneity has been effaced, and Japanese people had to recreate themselves in a state of tabula rasa after what happened [62]. Japanese Metabolist movement is the architectural group consisting of Kenzo Tange, Noboru Kawazoe, Masato Otaka, Kiyonori Kikutake, Kisho Kurokawa, Kenji Ekuan and Kiyoshi Awazu. Starting in 1960, Metabolism has been the description of the architectural movement created by imitating the metabolism of biological living things. Architecture is identified with a growing metabolism. The aim is to reunite by arguing that

everything is interrelated. This relation includes the coexistence of animals, humans, plants and minerals [63]. The effort of reuniting in Metabolism movement and the progression of architecture in this direction can be related with the reconstruction effort of a ruined culture.

In 1960, Kisho Kurokawa designed the *agricultural city* utopia for the agriculture cities which were devastated with the tropical storm in 1959. In this project, he proposed a living complex for 2000 people, consisting of 300 housings of 500 meters [64]. Owing to its structure, the project has a structure that can enlarge organically.

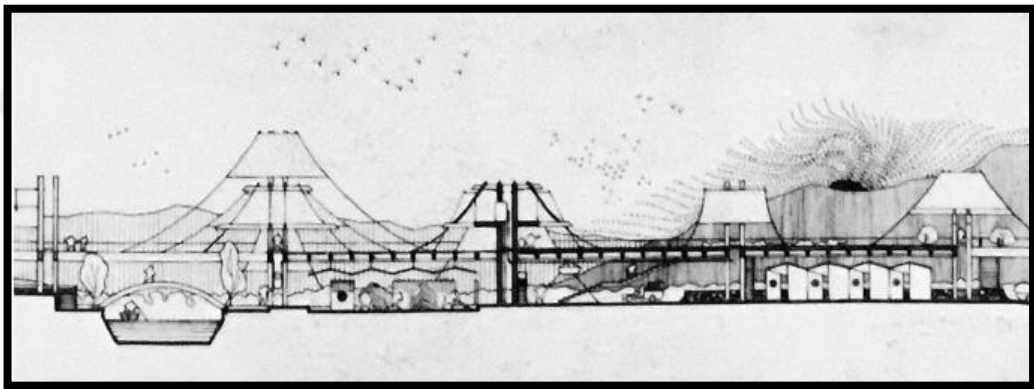


Figure 2.27. Section through Kurokawa's Agricultural City , showing artificial land and living space suspended above the earth [65]

Kenzo Tange's A Plan for Tokyo project is also the improvable version of the centralized urban planning which was transformed into a linear city plan.

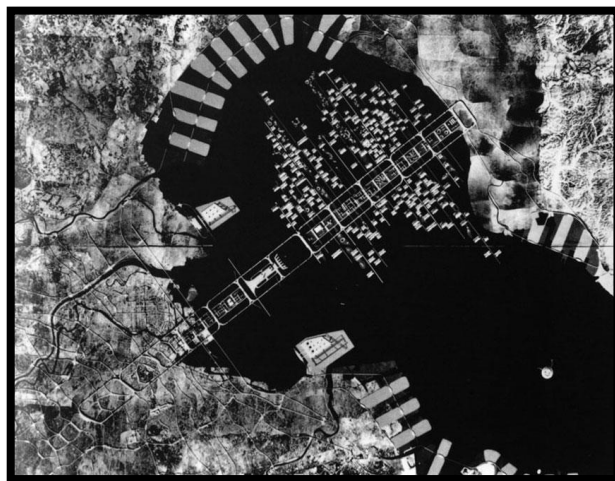


Figure 2.28. Plan for Tokyo, Kenzo Tange [66]

Designed by Kisho Kurokawa for Tokyo in 1961, Helix City project can structurally develop both horizontally and vertically, and has an aim of enabling data transmission similar to the spiral structure of DNA [63].

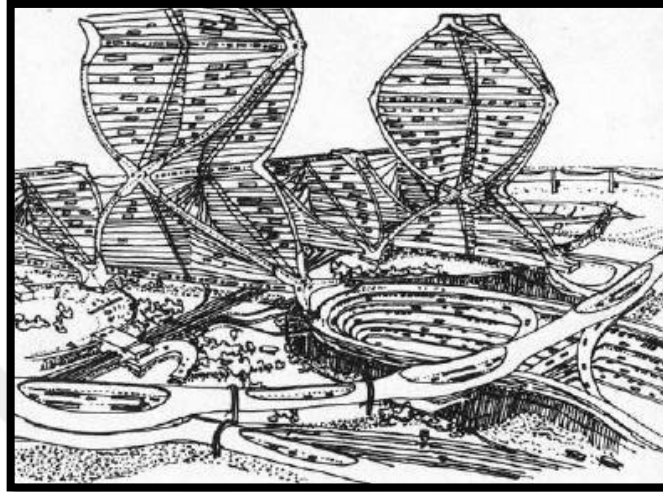


Figure 2.29. Helix City, Kisho Kurokawa [67]

The floating city project which Kasumiguara designed for his hometown in the same year was designed as a housing project that floats on the lake. Its design was considered in relation with Narita's Tokyo airport. The structure of the design is vertical. It provides the transmission between the roof and the lake. With its spiral structure, it resembles both the helix city of Metabolist movement and also the chromosomes that biologically convey the genetic information [63].

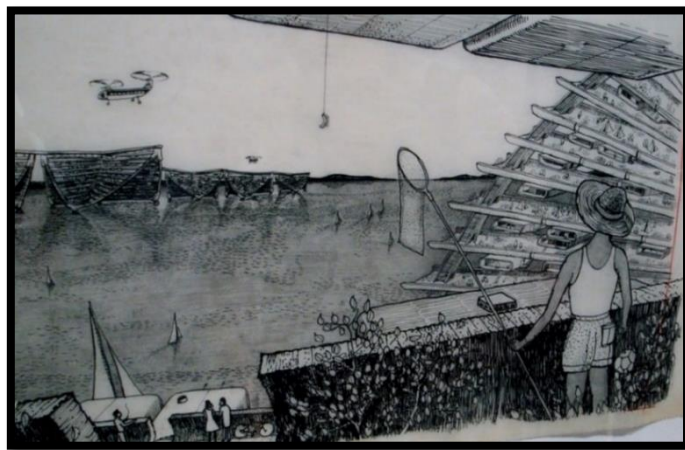


Figure 2.30. Floating City, Kisho Kurokawa [68]



Before the war, the architecture of the Japanese cities consisted of demountable wooden structures. As a traditional application style of Japanese culture, prefabrication has influenced Metabolist movement too. Kurokawa's Capsule Tower project which is an applied example of Metabolist architecture can be considered as an interpretation of prefabrication in Metabolism. It has a mobile and prefabricated design with its capsule living units that can be integrated to the main frame at the center. Kurokawa describes his approach on this matter with these words: "*Nakagin Capsule Tower is not only an architectural vision of a building, but also the accommodation of 144 people in their 144 units.*" [69].



Figure 2.31. Capsul Tower drawing [70]



Figure 2.32. Capsul Tower [71]

In 1961, as the English contemporary of Japanese Metabolism movement, Archigram was founded by Michael Webb, Warren Chalk, Peter Cook, Dennis Crompton, David Greene and Ron Herron. Brought into being as a reaction to post-war developments, this group has also founded a journal with the same name (Archigram) and started to publish their ideas [72].

Between 1958-62, Hungarian architect Yona Friedman designed *Ville Spatiale* (Spatial City) as an example of utopia [73] and between 1959-74 Constant Nieuwenhuys designed *New Babylon* project as an anti-capitalist utopia [74].



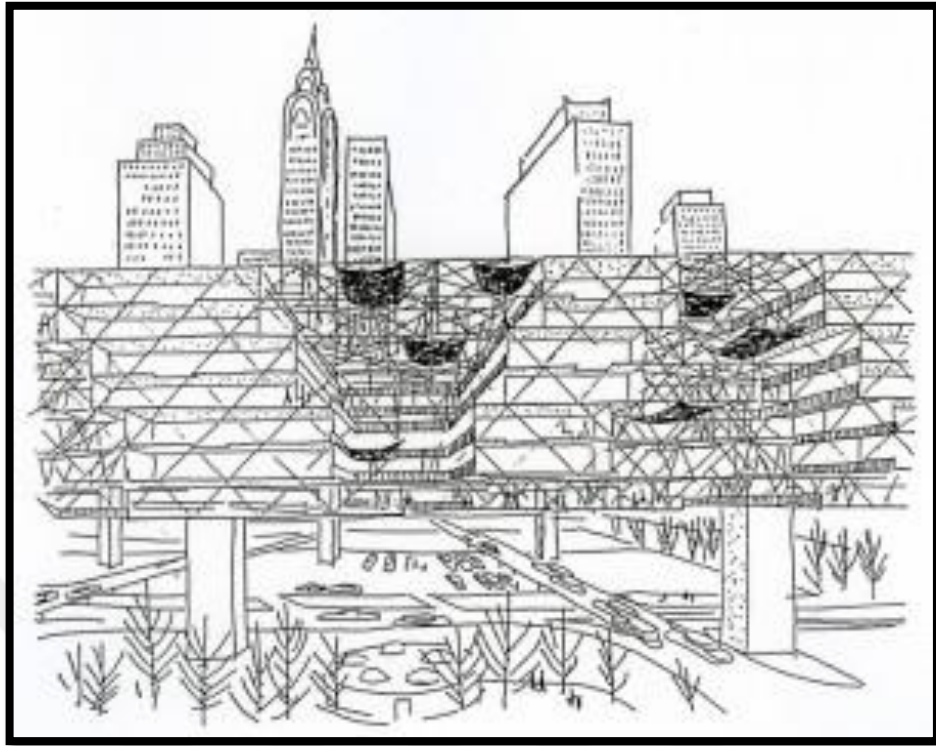


Figure 2.33. Ville Spatiale, Yona Friedman [75]

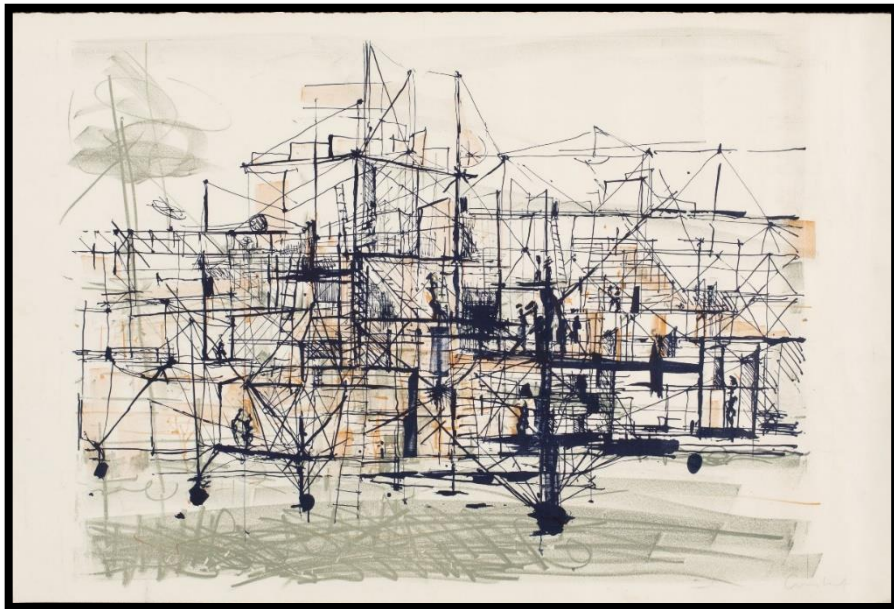


Figure 2.34. New Babylon, Constant Nieuwenhuys [76]

Although Archigram group's most famous project in the long term is Ron Herron's Walking City (1964), the project that reflects the group's early years' design concerns the most is

Peter Cook's Plug-in City [77]. With its scale, Plug-in City is a project that expresses the effect that Archigram group wants to create. Plug-in City has revitalized the avant-garde impulse that inspired first generation modernists. As a mega-structure design with constant circulation, Plug-in City is a design where functions interlace and limits are indeterminate, and has changed the pessimistic point of view towards urban planning [77]. Prominent with its concept of building the future, Plug-in City has reinterpreted two elements of modernism - Megastructure and "build-in-becoming". Build-in-becoming is a design concept which constantly grows, which has fast transportation links, and contains changeable units [77]. This design concept was seen at earlier utopian modernist designs. Soviet linear city plans of 1910-20's and Le Corbusier's Algiers project (1931) can be given as examples to this Karl Ehn's Karl Marx-Hof Project (1927) in Vienna or Le Corbusier's Unité d'Habitation (1947-53) project in Marseille are implemented examples of this concept. Plug-in City project can be seen as a reinterpreted combination of these projects [77].

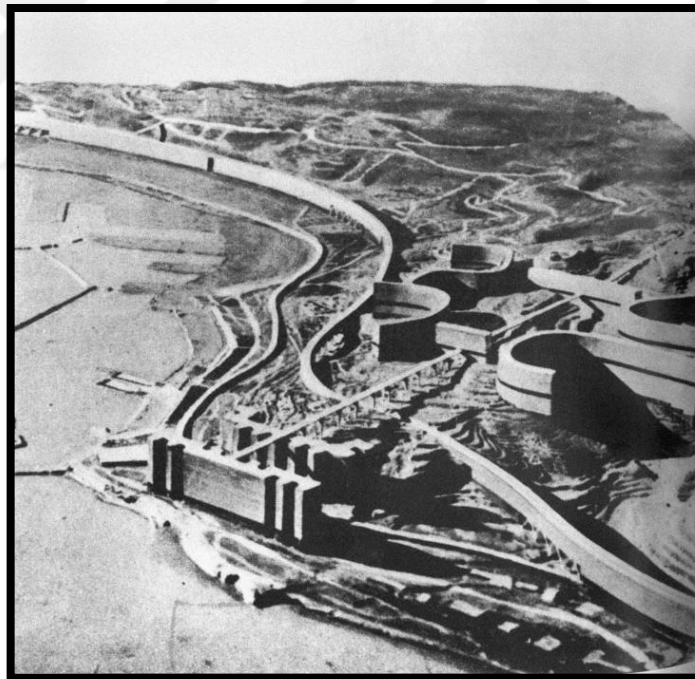


Figure 2.35. The 1933 rendering of Plan Obus for Algiers demonstrates Le Corbusier's superimposition of modern forms: the long arching roadway that includes housing — his viaduct city — connecting central Algiers to its suburbs and the curvilinear complex of housing in the heights that accesses the waterfront business district via an elevated highway bypassing the Casbah [78]

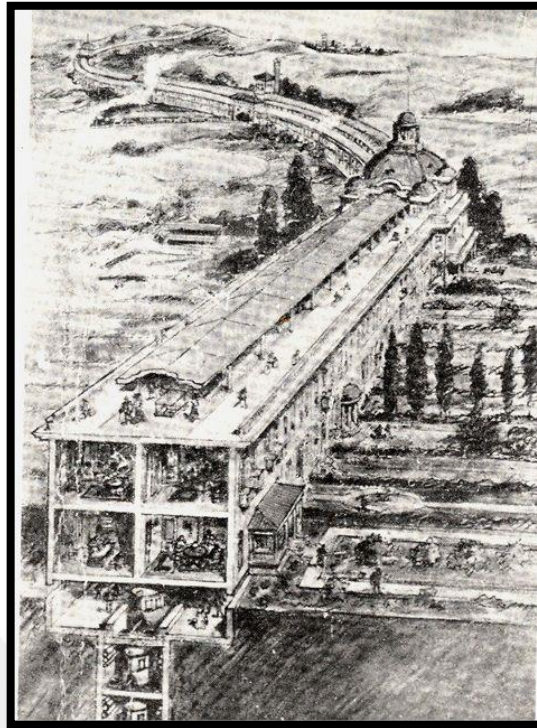


Figure 2.36. Edgar Chambless Roadtown, 1910 [79]



Figure 2.37. Karl Marx-Hof by Karl Ehn 1927 is a municipal tenement complex in Heiligenstadt [80]



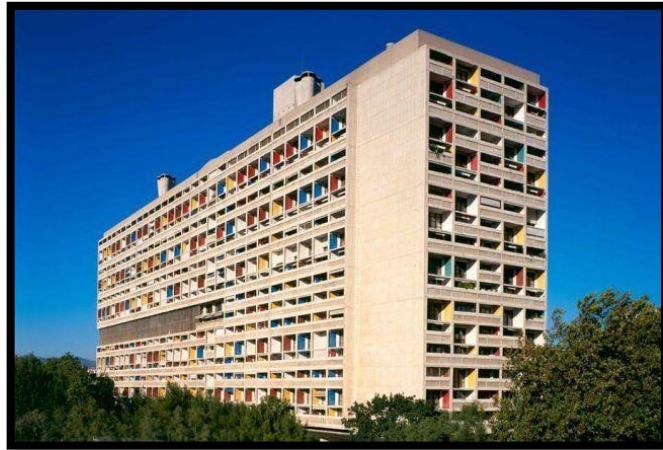


Figure 2.38. Unite d'Habitation, Le Corbusier 1947-53 [81]

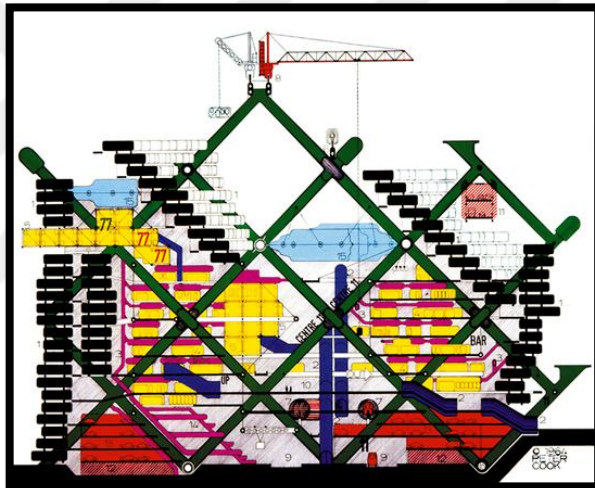


Figure 2.39. Plug-in City project, Peter Cook, 1964 [82]

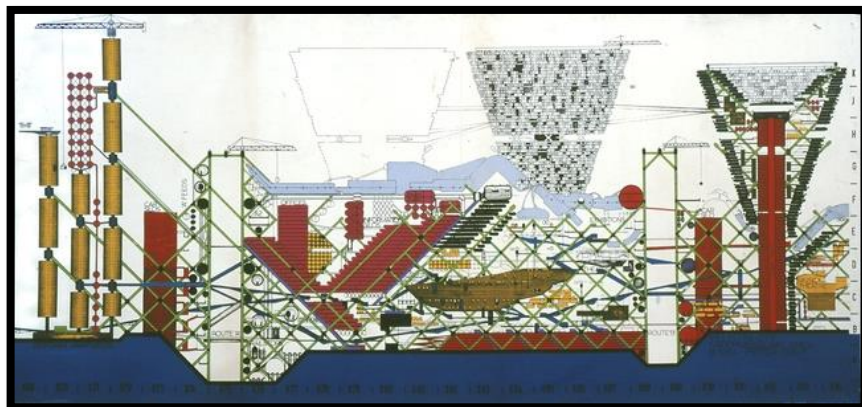


Figure 2.40. Plug-in City project, Peter Cook, 1964 [82]

As a huge scientific progression about the period, Russian cosmonaut Yuri Gagarin went to space and completed his tour around the world's orbit in 1961. Competing with Russia on this subject, USA has made a substantial amount of investment on space explorations and thus the space age has begun. [72]. While going to space was the main agenda topic of the period, astronaut clothes design has made an influence on architecture, and it was interpreted as a shelter, a mini habitat for astronauts. Michael Webb designed *Cushicles* in 1966 and *Suitaloon* in 1968. With this design, people would continue their existence without modern world thanks to this technical equipment on their clothes [72].

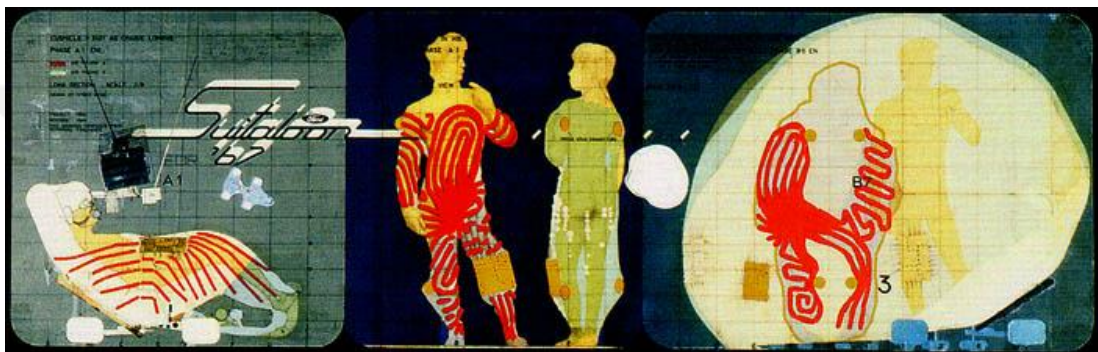


Figure 2.41. Cushicles, Michael Webb, 1966 [83]



Figure 2.42. Suitaloon, Michael Webb, 1968 [83]

In early 20<sup>th</sup> century, a lot of utopian examples have been designed for a solution to the dense population problem arising from industrialization. The multilayered structure of utopias are

clearly seen in this period. The needs of industrial cities could not be met with existing cities and ideal city designs are made where a relation between the rural and the urban can be established. Garden City is an example of proposals where this relation is established and both agricultural and urban areas are integrated. Soviet revolution (1912), the technological progress of the period, and machine aesthetics have formed the new city perception. Production with functional design-oriented machines has introduced standardization, and designs started to be uniform. This period was one when negative utopias (dystopias) were on the rise. Modern architecture has given lots of examples that contain dystopian designs.

Le Corbusier's The Radiant City design or Plan Obus project are dystopian examples. Minoru Yamasaki's Pruitt-Igoe, an implemented design which was made for post-war reconstruction is considered as another example of dystopia.

In the second half of 20th century, with the effects of World War II and the increase in technological developments, utopia designs have evolved on another direction. With the help of advanced technologies such as megastructures, prefabricated and floating cities, many utopias, and as can be described as a layer of utopia, technotopias have been designed. Yona Friedman, Japanese Metabolism, and Archigram group are examples of technotopia.

## **2.5. RESULT OF CHAPTER**

Utopias have been created differently in every period of history. After Plato's Republic, the concept of ideal city has again become a current discussion with the scientific and socio-cultural developments at Renaissance period. In this period, ideal city designs that have spatial setup and were conveyed with drawings were produced. Renaissance theorist who inclined to antiquity had a Platonist approach. The ideal cities they designed had the hierarchical order of the Republic. Mankind that was glorified at a period when humanism has emerged has been the criterion for many design principle. Ideal has been sought with the relation that Ancient period architect Vitruvius established between architectural criteria and human body. Renaissance designers were inclined to design cities with a utopian point of view.

In 1516, with his work Utopia in which an ideal country is being described by using the word "utopia" for the first time, Thomas More has found a new term that describes the ideal life.

The idea of reaching an unknown country with geographical discoveries has influenced the intellectuals of the period, and ideal city designs have continued over island countries as in the example of More's Utopia.

The innovative and scientific thought that was brought by Renaissance period has progressed in 18<sup>th</sup> century. With the enlightenment in the aftermath of English and French revolutions, modern era has started. In this period, owing to the disappearance of church's pressure, monumental utopias with sharp geometry were produced instead of religious structures. Works about the sublimity of the universe have been produced, and designs that are utopian in respect of their size and could not be produced with the technology of the period were made.

In the cities that developed with the Industrial Revolution in the 19<sup>th</sup> century, working class has emerged and migration from the rural to the urban has increased. In this period, collective utopias in which production and life are intertwined were made. An egalitarian and libertarian lifestyle was aimed for the working class.

Industry has settled in the city center in 19<sup>th</sup> century, and there were efforts to detract it from the living environment in the 20<sup>th</sup> century. As a utopian approach, it was aimed to gravitate towards nature again and garden cities started to emerge. After World War I, as a solution offer to the chaos of industrial cities, city designs where there are parks inside the housing areas, avenues are symmetrical and geometrical, buildings are vertical, and that are divided according to its functions with a strict zoning principle were made. It can be argued that there is an inspiration drawn from the theorists of Renaissance period.

Advancing technology has caused the architectural perception turn to machine aesthetics, and structures have become to be regarded as a means. Due to the egalitarian and uniform approach, the standardization in ideal city designs have dulled the individual's sense of belonging, and in this period negative utopias, that is, dystopias have started to be created. After World War II, utopias have started to change with the developing and advancing technology. With the space age, mobile, progressing and growing organic utopias started to emerge.

Utopias are anticipatory and imaginary designs. The architectural utopias of today are made with a longing for the past. An egalitarian life with clean air, clean water, hormone-free food, where nature is used efficiently, no one harms the environment, the ozone layer is not

harmful, there is no nuclear threat, and that is at peace with the nature has become the utopia of today. Contemporary utopian designs which the technology is advancing are seen in the examples of dystopia.





### 3. RENAISSANCE PERIOD UTOPIAS

The word “Renaissance” means rebirth in French [84]. Giorgio Vasari, in his work *Vite de' piu eccelenti Architetti, Pittori, e Scultori Italiani*, also known with its common name, *Vite*, has used the word “*rinascita*”, that is rebirth in Italian, for the period that has started with Alberti [85]. In Renaissance period, the mysticism and scholastic structure of the Middle Ages has collapsed, and Ancient Rome and Roman doctrines were adopted and new points of view have emerged [86]. According to Vasari, art follows the laws of nature. Humankind cannot be reborn but plants shed their leaves in winter and blossom in spring. Vasari describes rebirth as reblooming. He regards rebirth and revival as not just learning from the antiquity but also as regeneration by learning from nature [87]. As a reaction to the obscurity of the Middle Ages, the humanistic thought of ancient Greek doctrines and works has been adopted and an anthropocentric way of thinking has started to emerge.

The humanistic thought that was developed with Homeros in the Ancient Age is an ideal of maximizing human abilities. It is argued that excellence of mankind is only possible with an approach based on intelligence [88]. Socrates, one of the philosophers of the primeval era, has described intelligence and wisdom with these words: “Mankind has got to know itself, because this knowledge is wisdom itself. There is no willpower other than wisdom.” [88]. The antiquity thought that were revived in Renaissance period have reminded the importance of humankind to enlightenment thinkers, and conducted to the revival of humanistic thought. The idea of humanism that was introduced by enlightenment has started to spread to every aspect of life. Humanism means being supportive of humans, according to Turkish Language Association [89]. With a simple point of view, people are individuals who form society. And the places where social life occurs are cities. As the concept of space is directly related with life, cities and architecture have renewed themselves in this context and were influenced by humanism. The search for ideal has started for mankind, and ideas about cities have started to reach a spatial context. Until Renaissance, many intellectual (philosophy) and literary (literature) examples of the concepts of ideal life and ideal city were seen. With ideas parallel with Renaissance, spatial designs have started to emerge as well [86]. In addition to the theoretical approach to the ideal city, drawings were also made to reshape existing urban context in accordance with the principles of humanism. Architecture was included to the cultural innovation that have started in 15th century. However, there wasn't a similar

interaction in the implementation process of urban planning, and the cities developed like an extension of the medieval cities [86].

Theorists of architecture have given place to radical arrangements in their essays and drawings, even though most of them could not be actualized. They made collective living arrangements on how cities will expand, their settlement, creating hygienic and healthy places, production, defense, and representation [86]. These social requirements are discussed in a path of philosophical theories that regard humankind and the world as a reflection of divine order. Therefore, there are generally symbolic meanings in the cities that were designed by theorists. In Renaissance period, as seen in Filippo Brunelleschi's (1377-1446) and Leon Battista Alberti's (1406-1472) works, they developed futuristic looking plans with their advanced perspective knowledge and their compliance to dimension, order and symmetry criteria, compared to real projects [86]. The relation between architecture and cosmological ideas were described better in Renaissance.

Renaissance period artists, adhering to Pythagorous's discourse, "Everything is number," regarded architecture as a mathematics science that deals with spatial units. They used the laws of perspective to be able to scientifically interpret the pieces of the universal space that mathematics create, and argued that the universally valid can be recreated [90]. They believed that the universal harmony cannot self-expose if it does not happen in space by way of architecture, which is regarded as in service of religion [90]. In this period, as the designs were mostly made in city scale, they are collected under "Ideal city designs in Renaissance period" in architecture and urban planning disciplines [18].

Apart from the new ideas on the relationship of humans with humans that was introduced with humanism, the relationship between human and nature have started to transform. The relation between human and nature which was established in the age of enlightenment has perceived nature as existing for humankind and something to be dominated. Regarded as the father of modern science, Galileo has founded scientific empiricism, observing nature as science's subject of examination, and transformed it into the language of mathematics. Galileo and Newton have regarded the purpose of modern science as having a command on nature [91].

In *Novum Organum*, a part of the comprehensive work which is named by Francis Bacon as the Great Instauration, traditional philosophical systems are denied and a "new" scientific

method that will replace the old system is explained. The system of accessing the knowledge that Bacon proposes consists of observing and interpreting nature [92]. Bacon's new method is about finding reality as absolute rationalism evolves towards utopian perfectionism, instead of abstract and supernatural problems. According to Bacon, the history of science is described as improvement and progression. He regards knowledge that is obtained through experience as the background to be used to perceive future. He argues that obtaining knowledge should be the duty of society, and the more knowledge is shared the more it will increase and improve [92]. In the 17th century, the human thought that looks for its method to understand reality has taken the first step towards Enlightenment with Bacon. In his works, Bacon made assessments on finding the right method that would be discussed in the future, and determined that "Nature can only be conquered by being obeyed" [93].

Establishing a relation with nature in Renaissance period has reached the level of spatial construct in literary works. Spatial constructs have contributed to the emergence of utopian city designs. Those utopian designs have continued their influence after the period, some of them was tried to be materialized after many years or have inspired many projects. As for Renaissance period, ancient era works have been inspirational and guiding. As an ancient era architect who inspired many artists who have produced works of art before Francis Bacon, Vitruvius' work *De Architectura* (On Architecture) has been compiled in ten volumes, consisting of the following chapters respectively: *Basic Information on Architecture and Urban Planning; Construction and Building Materials; Temples; Corinthian, Doric and Etruscan Style Temples; Public Buildings; Houses; Decoration; Water; Sundials and Clepsydras; Machines* [94]. According to Vitruvius, all the subjects he compiled are the main source for the human mind to grasp the functioning logic of nature. Nature contains in itself a ratio and symmetry that is the foundation of architecture and design disciplines. Mathematical ratios continue their functions in the physical existence of all living things. If the designer grasps this perfect mechanism in nature, he/she will accurately establish the relationship between the part and the whole that is the foundation of architecture. The parts of nature are designed with a right ratio like the parts of the body such as legs, arms, head, and feet. Similarly, if the architect can establish the relation between the part and the whole correctly, his/her design will be harmonious in itself like a creation of nature. Therefore, Vitruvius argues that the biggest teacher and model of architects is nature itself [94]. Architects of Renaissance period have sought the ideal in their designs, observed

nature to reach function, associated human body with a cosmological design concern and made their architectural construct in this manner. Vitruvius' approach that seeks the ideal in nature has been guiding for many designers of Renaissance period. Prominent ideal city designers of Renaissance are examined in detail in the later chapters of this thesis.

Italian architect Leon Battista Alberti took inspiration from Vitruvius' volumes in his work titled *On the Art of Building* (1452) and has written the first architectural essay of Renaissance period. As the architect who wrote the second architectural essay of the period, Filarete's *T'rattato d'Architettura* (Treatise on Architecture) (1464) which he wrote for the Duke of Milan, Sforza, and in which he designed the first ideal plan of Renaissance, had parallels with Vitruvius' ideas on nature and his ideal geometry he created. This work was also an example of the macrocosmic design approach of Renaissance. Another architect of the period, Francesco di Giorgio Martini's *Architettura Ingegneria e Arte Militare* (Treatise on Architecture, Engineering and Military Art) contains many anthropomorphic ideal designs that was introduced by Vitruvius' ideal human geometry. The human body in the ideal geometry that Renaissance artist and inventor Leonardo Da Vinci has visualized as "Vitruvius Human" was also influential for many anthropomorphic design. Da Vinci has also tried to reach the ideal in his designs by observing nature. He produced his ideal city design in 1487.

Ideal city and life designs are made not only as scientific essays on architecture, but also as novels. In 1516, Thomas More's novel *Utopia* was published. The title of the book is interpreted as non-existent place, or a place too good to be true. Today, this word is not only used as a book title, but also for all ideal city designs that are made as a reaction to the current situation. Similar to Plato's *Republic*, More has presented opinions on an ideal government as well. Unlike *Republic*, in *Utopia*, a place was fantasized and an island was described for the first time. Describing the ideal state with a newly discovered island might have been with the influence of geographical discoveries. In fact, *Utopia* was published twenty four years later from the discovery of America. After Thomas More, Tommaso Campanella, who has spent most of his life in prison, has adopted the philosophy of nature, and wrote the utopian novel *the City of the Sun* (1602). Set on an island like in More's *Utopia*, what is different in this novel is the detailed constructs on urban planning and architecture. After Campanella, Francis Bacon who is one of the founders of scientific empiricism, wrote the utopian novel, *New Atlantis*, in 1624.

All works that are mentioned above can be regarded as products that represent the influence that the scientific approach of Renaissance had on architecture, urban planning, art, and literature.

### **3.1. LEON BATTISTA ALBERTI (1406 - 1472) AND HIS ARCHITECTURAL UTOPIA WORKS**

Italian architect Leon Battista Alberti was one of the pioneer theorists of Renaissance. He studied Vitruvius' works, and presented his remarks on architecture in his work titled *De re Aedificatoria* (On the Art of Building), which he wrote in 1443-52 but was published in 1485. He was influenced from Vitruvius' 10 volume work on architecture and based his work on Vitruvius' doctrines such as durability, convenience, and beauty. As an architect who wrote the first scientific essay on architecture of Renaissance period, Alberti made basic descriptions on architecture in the first of his ten volume work, and defined the word structure as "body form" [95]. He argues that structure, just like human body, consists of both a substance and an idiosyncratic design and reaches beauty in this way. According to Alberti, substance forms a relation with nature, whereas design is related to the mind of architecture [95]. With a Platonist perception, Alberti adopted the concept of idea, and postulated that there is a higher reality than the physical world. As a neoplatonic argument, he discussed that architecture symbolizes superior ideas with universal mathematics laws and harmonic ratios [95]. According to Alberti, beauty is the reasoned harmonious totality of all the limbs of the human body. There is no need for a part to diminish or to be added [95]. In the ninth volume of the book, his thoughts on architectural beauty are elaborated.

Alberti conveyed the words of Vitruvius about ancient cities and his own remarks on medieval settlements. In his essay, he mentioned both social and political realm, and discussed different systems according to their regimes (republic, monarchy, tyranny). He stated his opinions about ideal city morphology as well. For example, he gave information about circular plan layouts consisting of concentric circles. He remarked that they are adaptable to organization system with more than one center that can meet multiple functions. He talked of a city that is harmonious with urban landscapes that are presented through modern art that consists of wide avenues, regular squares and monumental buildings [86].

Most of the humanist architects of the period don't have the theoretical cultivation to completely understand and implement Vitruvius's works, although they are inclined to antiquity. However, Alberti has a solid grasp of both his own era and ancient era. In his work, he used Latin in which Vitruvius has written his book, and used very little illustration and this made his treatise very hard to be understood. Because of this approach, he was criticized by Francesco di Giorgio Martini [96].

Leon Battista Alberti is the first modern historian to research the relationship between human body's proportions with architectural designs [97]. He made a graded drawing of a male body.

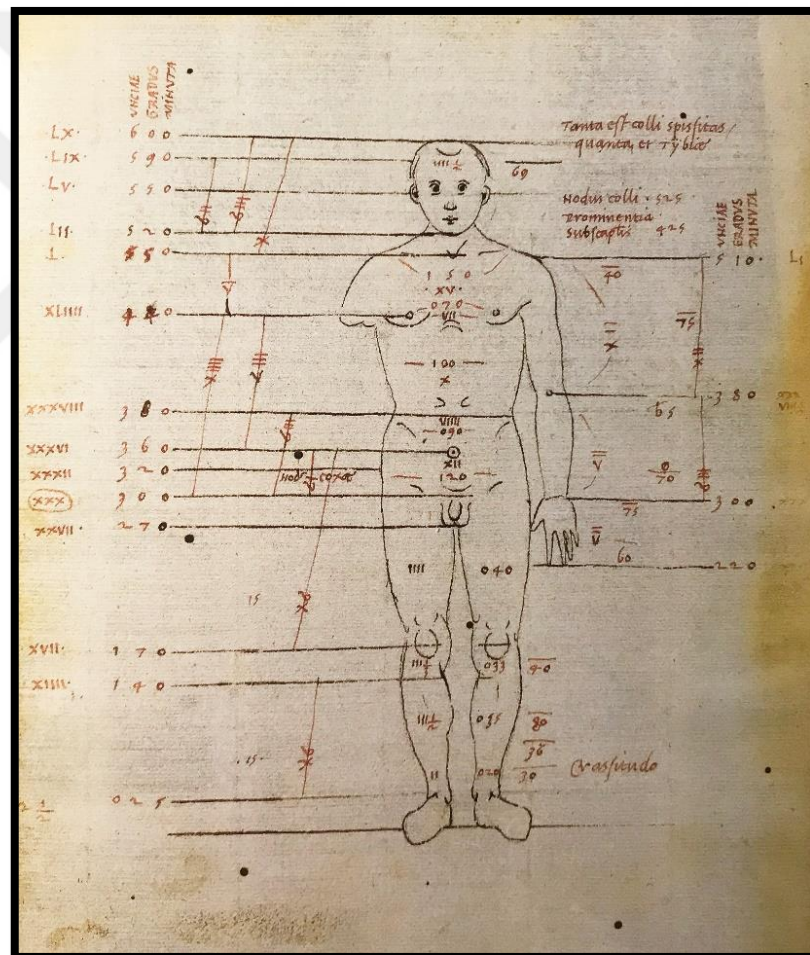


Figure 3.1. Leon Battista Alberti human body proportions drawing, 1450 [97]

Like Vitruvius who he followed his lead, Alberti started his ideal city design by searching for the best location for the city. In his work *De re Aedificatoria*, addressed subjects such as general architecture, city forms, defense plannings, water sources, infrastructure arrangements (sewage system). In his works, along with these subjects, he made many ideal city designs. He generally made stellated designs in his ideal city plans [18].

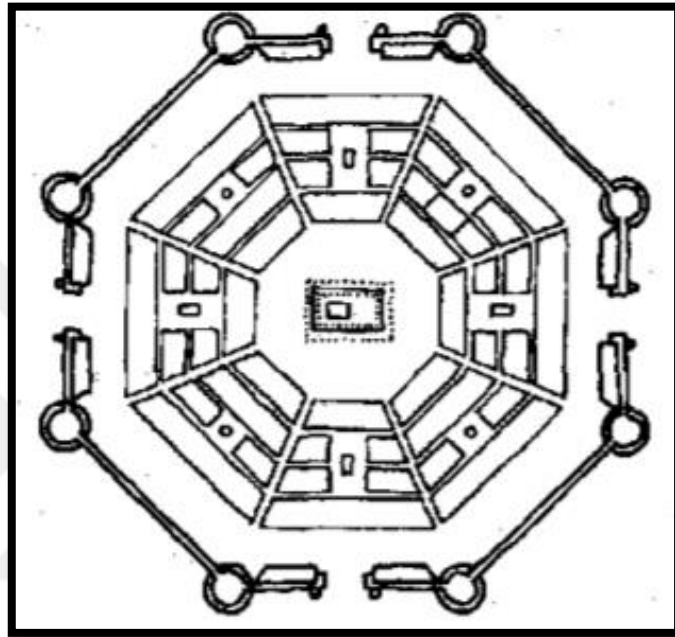


Figure 3.2. M.Vitruvius P. city plan drawn according to his accounts [18]

As Vitruvius' ten volume book on architecture is the only architectural research that was left from ancient period to 15<sup>th</sup> century, its manuscript copy has attracted intensive attention. In this text written in Hellenistic Greek and Latin, it is very hard to understand the parts without illustrations. This enabled architects who studied Vitruvius' works to interpret according to their point of view [97].

### 3.2. FILARETE (1400-1469) AND HIS ARCHITECTURAL UTOPIA WORKS

One of Renaissance period architects who lived in Italy, Antonio di Pietro Averlino (1400-1469), also known as Filarete, which means *Lover of Wisdom* in Greek, has made designs on ideal cities he named Sforzinda after the Duke of Milan, Francesco Sforza, in his work *T'rattato d'architettura* which he wrote between 1461-1464. The book was published



approximately ten years after Leon Battista Alberti's book *On the Art of Building*, and showed similarity in terms of content. There are some points which he differed from Alberti [95]. In his book which he described the ideal city instead of existing social order, he was influenced from Plato's Atlantis and built the social construct in parallel with Atlantis. He dedicated his ideal city to Hippodamus of Miletus, who he saw as a role model [96]. His main purpose in writing this book was to put across to Sforza family that ancient period art is superior to Gothic style - the prevailing art of the period [95].

In the first volume of the book, he wrote about himself and dwelled on architectural proportions and ratios. In the book that consists of a dialogue between the king and the architect, architect conveys his opinions in 3 different chapters. In the first chapter, he discussed the origin of measurement and talked about the sources of structures and how to make them sustainable, in brief, described the requirements to be a "good architect". In second chapter, he explained the selection of location, how buildings, squares, avenues and streets should be in the city environment, and the laws of nature should be obeyed. In the third and the last chapter, he made use of ancient doctrines and talked about building structures in different forms and reusing forgotten classical doctrines [95]. In his book, Filarete regards the body of Adam who is the first human that God created as ideal. The body contains in itself mind, soul, and intelligence. Human exists with them all. The body gains its proportions through its functions. According to Filarete, ideal city should be the same with the human body. All things that give life to human should exist in the construct of the city [98].

Not all humans have the same intelligence, same body, or same soul, and show variability. With the ratios of the body, proportions and measurements form. If Adam's body is deemed as ideal proportion, dwarves represent small, giants represent big ratios, and the units of measurement are defined through human body. Filarete classifies column types via human body. Human head is used as a unit of measurement. The biggest type, Doric style, equals to nine heads. The smallest type, Ionic style, equals to seven heads. The medium type, Corinthian style, equals to eight heads [95]. Matching up with Leon Battista Alberti's ideal city principle, the morphology of the city and political, social and economic aspects are connected to each other. Filarete is the first Renaissance designer who gained acceptance in Renaissance period and used ideal circle form in city planning designs [33]. In its plans rife with astrological and symbolic meanings, Sforza had an octagonal plan that was made by

overlapping two squares that are rotated 45 degrees. Having one each at every outside corner, there were eight towers, and one entrance each on every inner corner. 16 radial main roads are reaching out from the center to the corners of the octagon. The city center is the main square where the porticos with the palace, cathedral and commercial areas open to. The aqueducts which also exist in Leonardo Da Vinci's (1459-1519) ideal city are connected with the subject of hygiene and sanitation [86].

Described in the second volume of the book, the cosmic tower at the circular city center symbolizes the loop of one day. It is at the highest point of the city, where the water sources spring. The fact that the tower is located there may be connected with an ancient concept - *axis mundi* [99].

Filarete has created a taxonomic city construct. Areas that contain guilds are divided into zones in itself. The square where the merchants, blacksmiths and bookmakers are is the merchants' zone. The area where the butcher, bazaar and accommodation places are is the market zone. Trading operations related with shipyard works are maintained outside city walls [99].

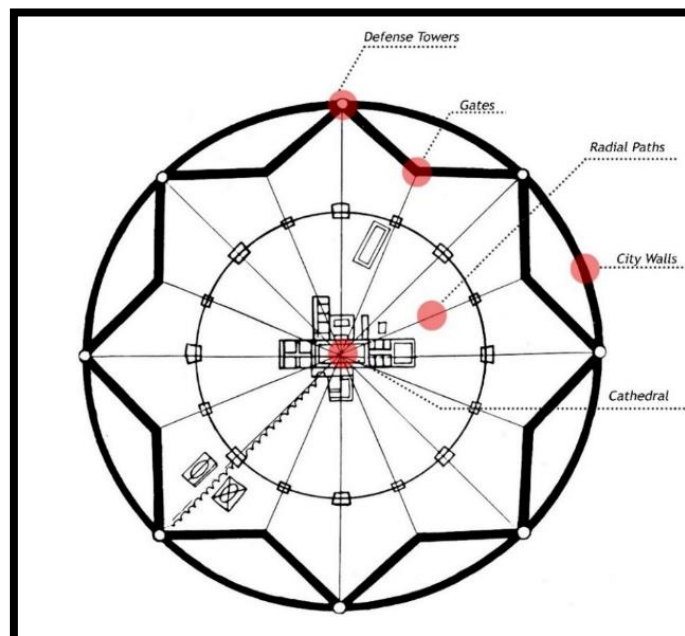


Figure 3.3. Sforzinda plan scheme with explanations (edited by thesis author)

In this circular plan ideal city design, Filarete has started off from cosmogram. Drawn into a circle in four interlocked squares, it was designed in parallel with a diagram that represents the four elements and tells the universe. It is also said that it symbolizes the world with its form. With both forms of representation, Filarete created a concept in which he emphasizes the universal and infinite command of Sforza in this ideal city he designed for Sforza [100].

It is assumed that the star shaped city plan was preferred because of the fact that it would be useful for the defense of the city. With this, vertical surfaces were avoided from firearms and a more durable facade is formed [18].

### 3.2.1. Examples of Applied Plans



Figure 3.4. Palmanova / Italy, 1593 [101]

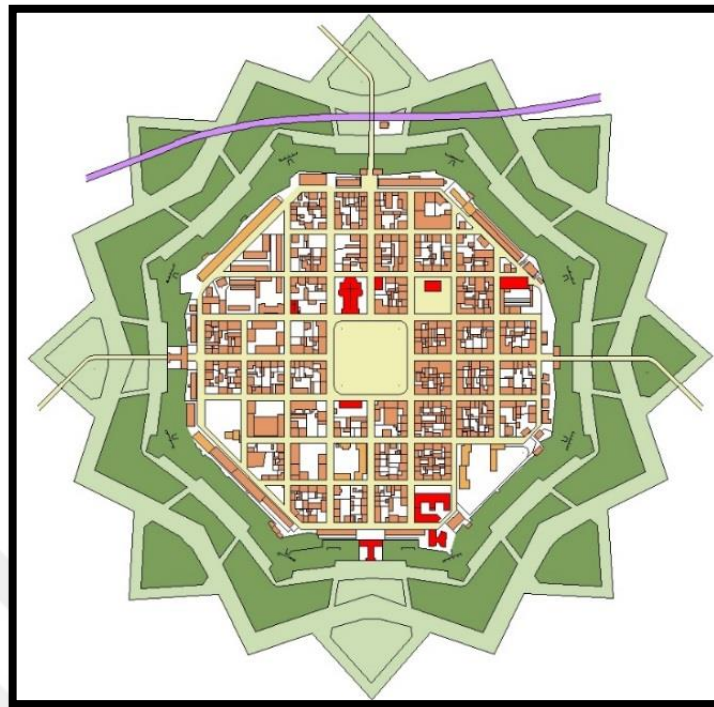


Figure 3.5. Neuf Brisach /France, 1698 [102]

### 3.3. FRANCESCO DI GIORGIO MARTINI (1439 - 1502) AND HIS ARCHITECTURAL UTOPIA WORKS

Francesco di Giorgio Martini is a Sienese painter, sculptor and architect who was taught by Vecchietta. Lived at several places, Martini has worked at Urbino Palace in Marche, and also Tuscany and Milan [103]. During the period he has worked in Milan, he has been in touch with Leonardo Da Vinci [101]. His work *Trattati di architettura ingegneria e arte militare* (Treatise on Architecture, Engineering, and Military Art) (1476-77) has reached today in the form of manuscript. In his book, there are many works with illustrations, such as palaces, churches, theatres, columns, architectural details, water channels, measurements, cartography, and military weapons [104].

Francesco di Giorgio has given lectures on architecture and wrote a modern version of Vitruvius' work. Although it shows similarity with Alberti's work, in terms of content it rather focuses on architects and architectural procedures, and it is written in a colloquial language and supported with illustrations. Works of Francesco di Giorgio are essentially on

detailed examination of ancient works. Although Di Giorgio was a cultivated architect who worked for Campania and on ancient structures and also translated Vitruvius' books, it is said that he could not manage to sufficiently impress Alberti [96]. Contrary to Alberti, it is a known fact that Leonardo Da Vinci has read Martini's work and was interested in it. Martini assumes that human body is a microcosmos in association with macrocosmos. Therefore, he argued in his architectural designs that structures should be designed with human body proportions so as to represent macrocosmos, and this is the only way to reach universal design (Da Vinci's views are discussed in detail in chapter 3.4) [106]. Da Vinci was known in Milan as "Sienese Leonardo" thanks to the success of his works [97].

There are three ideal cities drawn in Renaissance period. The ideal city of Urbino, Baltimore, and Berlin. Baltimore ideal city square design that is said to be made by Francesco di Giorgio in 15th century. Baltimore ideal city shows the big structure group at an area that is raised from the square by large stairs. There are ancient style memorial columns, a fountain, and a triumphal arch located in the middle of the square. Around it there are two palaces, a sacred building and a theater is planned with equal distance to each other. The sense of depth created with light and shadow can be seen in the picture [106].



Figure 3.6. The Ideal City of Baltimore [107]

It can be argued that the drawing of the ideal City of Baltimore is an eclectic model due to the difference of the structures in terms of style. The fact that T-shaped square is separated from the area with structures by stairs are interpreted by some as a prototype for theaters, but later on it is realized that there was no such purpose. The hill that can be seen behind the



triumphal arch gives transparency to the design. The four columns with no function in the middle of the square were used to define the square [108].

Francesco di Giorgio Martini has produced works which he conveyed opinions on architecture and engineering, apart from being a painter and a sculptor. In his work *Trattati di architettura ingegneria e arte militare*, he produced many works on architectural schemas which he wanted to create by using Vitruvius' ideal human body proportions. He created an anthropomorphic typology that is based on human body and develops the proportion system and its features in this direction [86]. Some of his anthropomorphic designs are as given below:

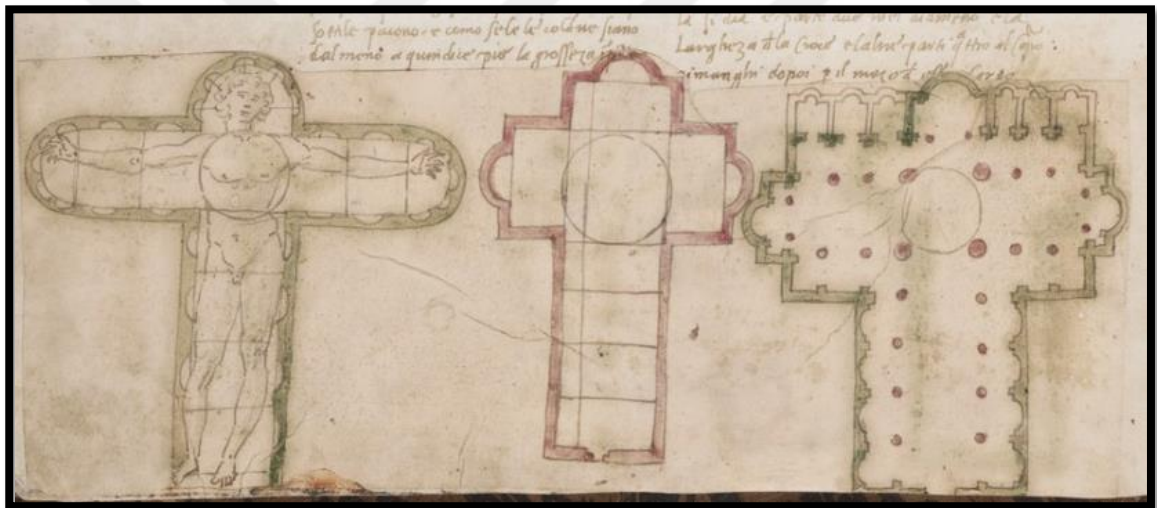


Figure 3.7. Anthropomorphic plan scheme from *Trattati di architettura ingegneria e arte militare* [109]



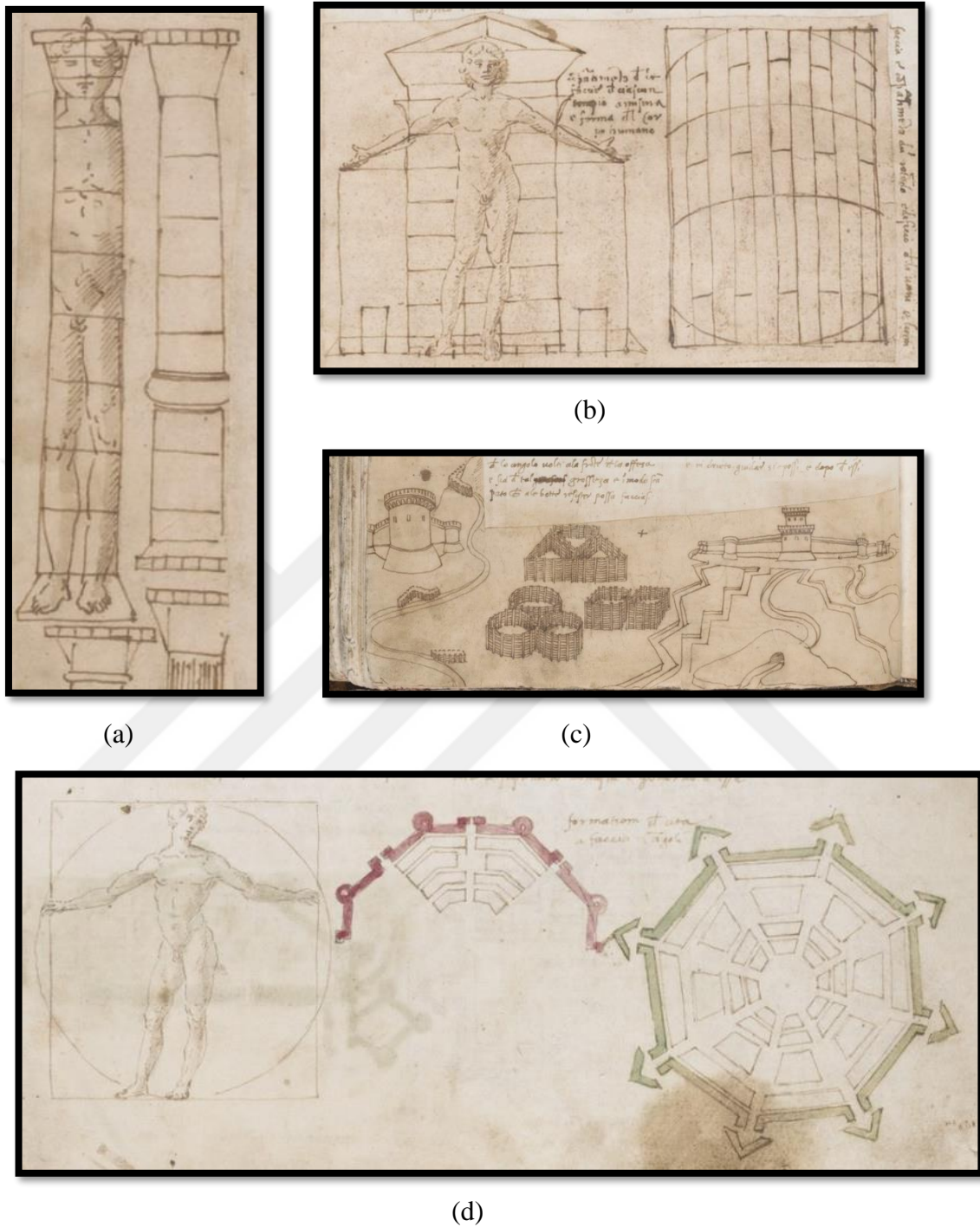


Figure 3.8. Anthropomorphic architectural drawings from *Trattati di architettura ingegneria e arte militare*. (a) Anthropomorphic column design, (b) Human body as a scale, (c) City wall designs, (d) Anthropomorphic city plan designs [109]

Deemed as perfect because of Vitruvius' views, this typology were used as a reference point in projects during renaissance period [86].

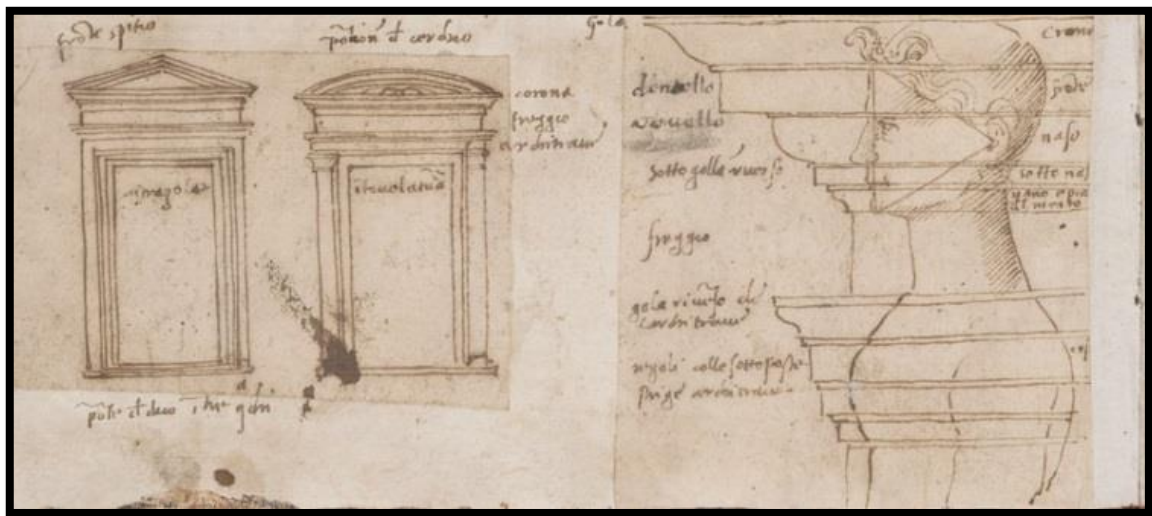


Figure 3.9. Human head used for the ideal architectural measure. (Drawings from *Trattati di architettura ingegneria e arte militare*) [109]

### 3.4. LEONARDO DA VINCI (1452-1519) AND HIS ARCHITECTURAL UTOPIA WORKS

Lived in 15<sup>th</sup> century Renaissance period, Leonardo Da Vinci is an artist who reflected the “technological imaginations” which most of the artists and engineers of his period shared, and one who gave a graphical imagery to these imaginations. Unlike most of the artists and engineers before him and of his period, he was detached from the perception of artisanship and successfully undertook the role of technology master. After his death, Benvenuto Cellini named him the “Superior Philosopher”. Da Vinci produced some ideal designs on urban planning. In order to solve the problem of overpopulation, presumably in 1487, he made ideal city drawings which he designed in two levels [86].

Instead of the geometrical approach in Renaissance period, Da Vinci preferred a rational arrangement based on function. He determined the measurement units for the city through the conclusions he drew from Vitruvius man drawing [110].

Da Vinci aimed to increase the quality of daily life, and he sought solutions for problems regarding traffic, infrastructure, and supplies. He suggested to create the trade and production areas and social life areas at different areas. He identified that the narrow streets and organic settlements, and especially the overpopulation and insanitary environment in low-income areas caused the plague to spread faster. Unlike the chaos of medieval cities, he proposed an ideal city with a more planned structure and that is created with wide and straight avenues. Da Vinci also addressed infrastructure problems, and made efforts for the construction and maintenance of water channels that will reach everywhere in the city, in order to protect the community health. He told that ideal city should be located near a fast-flowing river or seaside, instead of still water that could cause pollution. He designed the distribution of running water to the city via channels, sluice gates, and lock-up clutches. With water channels, Da Vinci facilitated the supply of provisions, and enabled direct access of some of the large buildings to storehouses. In addition to this, he formed the sewage system with underground channels. He reflected the double-layered pattern of water channels to the structuring of the city. He separated the streets which elites and nobles use from the ones that was used by public by carrying them to a higher elevation. He designed the housings with the same principle. While the landlord lived upstairs, he created functional rooms downstairs and opened the places to the yard and the street [111].

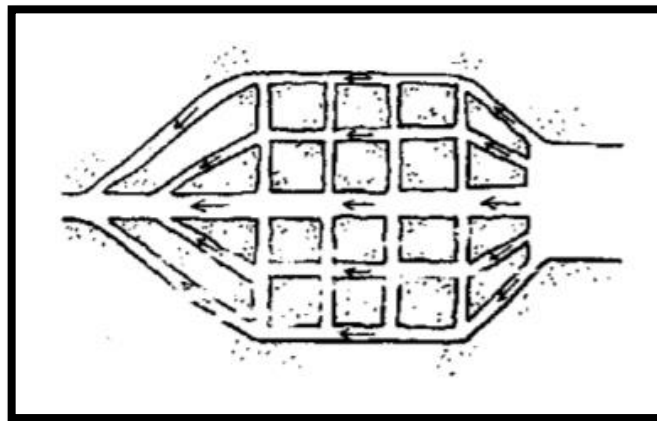


Figure 3.10. The layout of the ideas of Leonardo Da Vinci on a city that would be created on the river [18]

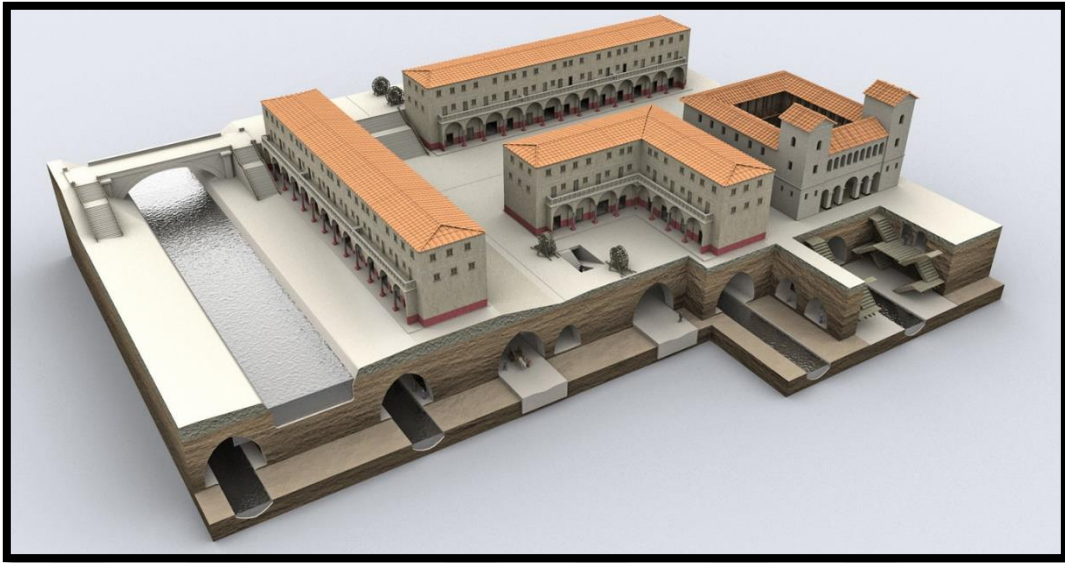


Figure 3.11. Model for the Ideal City [112]

Da Vinci made sketches about the ideal city center, and measured the double-layered city he mentioned with units.

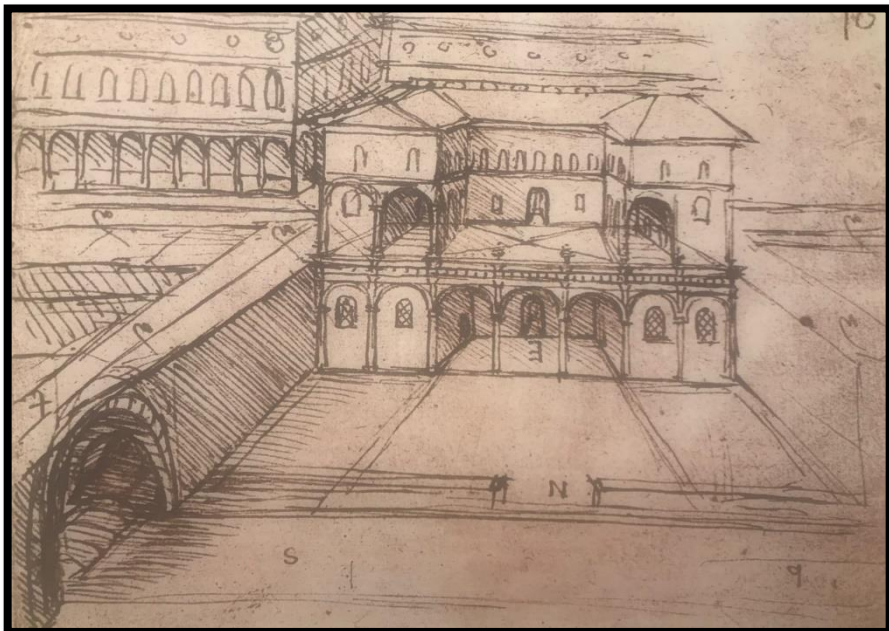


Figure 3.12. A sketch for double layered the Ideal City [113]



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*the roads that are shown with “m” are six braccio (1 braccio = 59.5 centimeters) higher than the roads “p” and “s”. The roads that are twenty braccios each are slanted  $\frac{1}{2}$  braccio from the edge to the middle; at the middle section, an opening of one braccio long and one finger wide should be left in every one braccio, in order to enable rain water to flow from the holes that are made in the same plane with “p” and “s”. There must be passages that are six braccios wide, and that are built on columns on both sides of the road. Requirements such as wood, wine etc. should be supplied from the gates “n”, and the discharge of toilets, barns, and other fetid material should be done underground [113].*

---

The houses are designed so as to be addorsed and in between the streets at the lower elevation. Utilization of the streets on upper elevation for other purposes are prohibited, and these streets are reserved for gentlemen. Carriages and their loads of the public are to be used at lower elevations. As seen in Figure 2.24, Da Vinci took a note that says “the width of the avenues should be equal to the average height of the houses” on the upper left of the image [113].

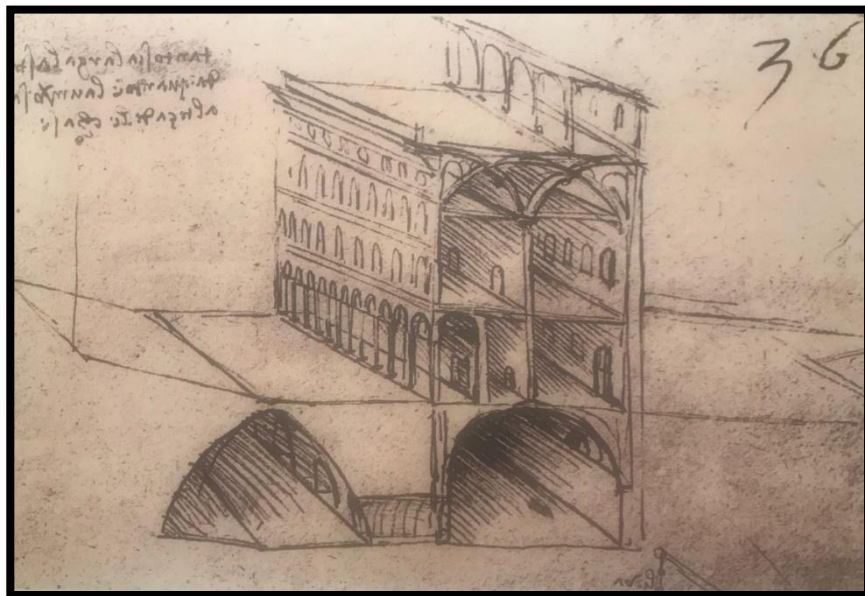


Figure 3.13. A sketch for the Ideal City [113]

It can be seen that he paid attention to human scale and made his designs so as not to affect the human perception. Human scale is an important design principle for Da Vinci.

Da Vinci stayed in Milan from 1482 to 1499. During this period, he was assigned for the great Sforza sculpture, the *Last Supper* painting, anatomy researches and other scientific tasks. He also worked on Filarete's treatise and many architectural drawings with the influence of Bramante. It is known that Leonardo has produced a meticulous work on anatomy in which he explained human body with illustrations, sections and diagrams. It can be said that he had a deeper knowledge on anatomy than his contemporaries. It is assumed that the fact that he researched and illustrated human body and its structure in all its details has prompted him to make architectural drawings [114].

As an artist who has extensive anatomic studies, Da Vinci worked on Roman architect Vitruvius' ancient period book *On Architecture* (B.C. 30). He made the drawing *Vitruvian Man*, visually interpreting the narration on the book in which relationship between the proportions of the human body with the geometrical proportions of classical order is mentioned. Showing the ratios of human body, this work emphasizes that all parts of the human body are pieces of the whole. Da Vinci's work places mankind to the center of macrocosmos as microcosmos. With this graphic narration, the book has been the representation of Italian Humanism and the Neo-Platonist thought that emerged in 15<sup>th</sup> century Italy [97].

Vitruvius used the ratios of the human body in the ratios of architectural designs. As can be seen in Da Vinci's drawing, he described human body in two different positions with two pairs of arms and legs in a circle and a square. While a pair of arms is reaching out straightly in the square, the other is reaching out to the circle. While the first pair of feet is at the bottom of the square, the other is half-open along the inner perimeter of the circle. With this drawing, Da Vinci aimed to determine the ideal ratios of human anatomy. He argues that the center of the body is the belly button. When the centers of the square and the circle are determined from different points, the human body fits perfectly into this geometry [115].



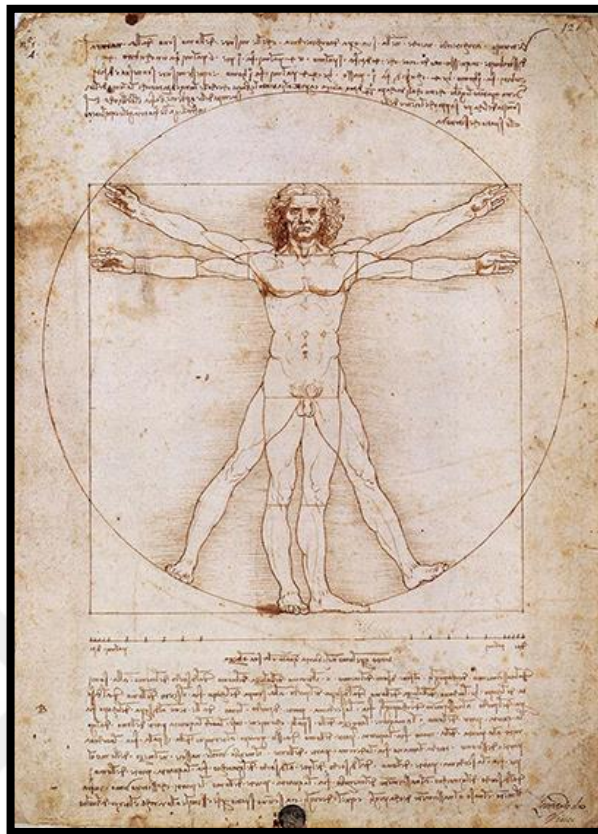


Figure 3.14. Vitruvian Man [97]

Translation of DaVinci's notes on Vitruvius' human drawing is as below:

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*On one of his studies he made on architecture, architect Vitruvius says that the standards of the human body is arranged by nature as this: Four fingers equal to one palm, four palms to one foot, and six palms gives the length from the elbow to the tip of the middle finger. Four times the distance between the elbow and the middle finger is one step. 24 palms is the length of a man. Vitruvius has used this measures in his structures. If you open your legs as to shorten your height in the ratio of 1/14, and if you raise your arms as to touch with your finger to a line over the tip of your head, your belly button is the center of your body whe your arms and legs are open, and the triangle between your legs is equilateral. [113]*

---

These two positions he visualized are images that represent the still and moving human. Circle and square are perfect shapes. Vitruvius has placed human right into the middle, as the symbol of perfection and harmony. On the other hand, Leonardo places human into two different positions by adding a frame to the square and the circle.

In 1490, Leonardo was developing a theory on “body in terms of architecture” in Vitruvius style. In the same years, upon Ludovico Sforza’s invitation, Sieneese architect Francesco di Giorgio Martini (1439-1501) has come to Milan to give advices on the construction of Milan Cathedral’s lighthouse. Leonardo has read and impressed by Martini’s *Trattati di architettura ingegneria e arte militare* which he wrote on architecture, engineering and military art. Updating the book after coming to Milan, Martini mentioned Leonardo in his accounts [97].

Leonardo’s scientific approach to anatomy has been reflected in many architectural drawings. Known as MS. B. from his manuscripts, on the draft of his treatise on architecture, there are drawings which he transformed from a central and simple plan to much more complex forms in terms of content. Although most of the drawings are too complex to be implemented, they are successful exercises on theory of architecture. His structures were visualized as bird’s-eye view, section, and perspective, and three dimensional forms are narrated differently. The main importance of these drawings are the fact that they are theoretical constructs that were deliberately created with a new representation technique that Leonardo has developed [114].

In his book *De re Aedificatoria* (1450), Alberti suggests the usage of circle and square as perfect forms, in order to enable the spiritual harmony in religious structures [97]. Having read this book, Da Vinci also used circle and square that are deemed perfect shapes in his central planned ideal church designs. In his own text, *Trattato del cupole*, he argued that all sides of the structure must be independent, and the form of the structure can only be perceived this way. In his work, he divides domed churches into four groups as rising on circular foundation, square foundation, four columned foundation, and octagonal foundation [97]. Leonardo had a strong interest in the relationship that Vitruvius established between the ratios of human body and the aesthetics of architectural structures. Therefore, he produced a design in which the perfect shapes circle and square are used as plan schema. As the central planned structures were generally churches in the period he lived in, his designs and researches were mostly on churches [97].

Figure Da Vinci's Architectural Drawings from MS "B" c. 1489 or later:

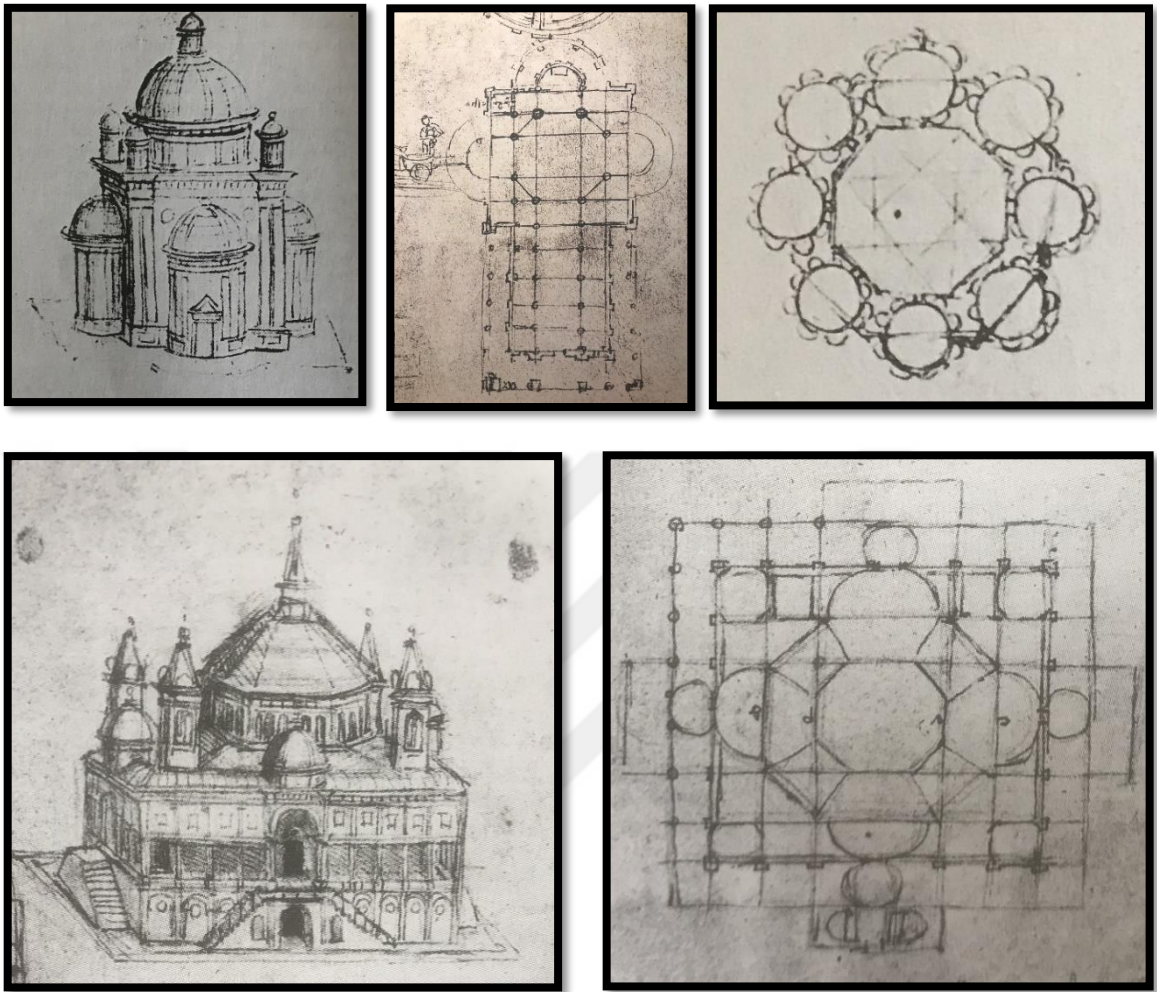


Figure 3.15. 1<sup>st</sup> row [113] 2<sup>nd</sup> row [97]

While in service of Cesare Borgia in 1503, Leonardo wrote a letter to Sultan Beyazid the 2<sup>nd</sup> and proposed to build a 100 meters long bridge. Under the drawing from 1502, he added an explanation as written below:

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Golden Horn Bridge in Istanbul. Width 40 braccias, height from water level 70 braccias, length 600 braccias. 400 braccias of length is above sea level, 200 braccias is at conjunctions and abutments [113].

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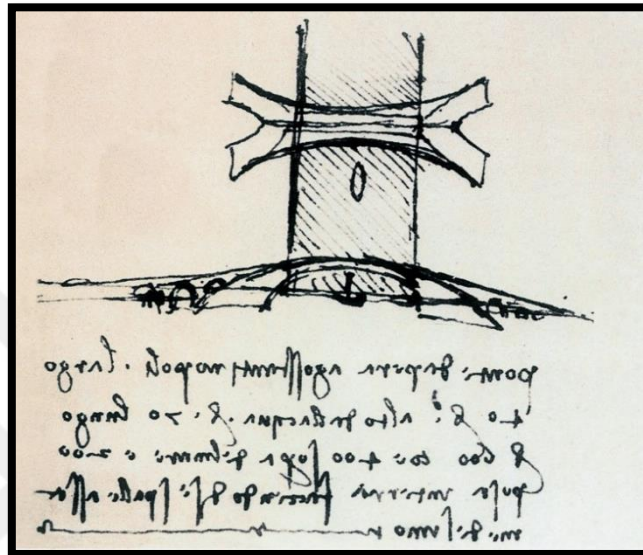


Figure 3.16. Leonardo Da Vinci; Golden Horn Bridge, 1502 [18]

The implementation of the project is denied by the Sultan with the reason of impracticability, and it was built in 2001 with Leonardo's method. This example shows that designs of the past which was deemed impossible or utopic can be the reality of future.

### 3.5. THOMAS MORE (1478-1535), UTOPIA (1516) NOVEL

Sir Thomas More is a British writer, statesman, and lawyer. When he first used the term "utopia" in 1516, in his book titled *Utopia* in which he described an ideal island country, he not only invented a new word, but also a new form [3]. The literary structure of the book is essentially formed bilaterally. At the first stage, the criticism of kingdom as a model and political principle for the state is discussed through a conversation. At the second stage, Utopia, an island which a traveler visits is described. This bilateral narrative actually is the indicator of the fact that the criticism of reality is hidden in the imagination of the ideal. Therefore, utopia is not just a figment of the imagination or a social construct that is



irrelevantly created. The subject matter of utopia is to make a criticism of the existing situation -like Thomas More's novel or 18<sup>th</sup> century architect Ledoux's ideal city- regardless of its reflection [116].

Utopia was written twenty four years later from the discovery of America. The idea that there are unknown places on earth and they can be discovered may have reflected in More's book as the Utopia island. Similarly, the fact that Raphael Hythloday who describes Utopia island is a sailor can be regarded as an emulation of the fact that Amerigo Vespucci whose travel book "Four Voyages" was published in 1507 is a sailor.

On the cover of the first edition of the book, it writes "The Figure of the Island Utopia". Utopia's meaning is materialized as an island. This is also interpreted as another place, a place which can only be reached by sea, or after a journey or a discovery. The utopia island figure on the cover of the book resembles a skull. The symbol of death in Arcadia - the imaginary place in Ancient Greece where pristine and happy people live - was the skull. In other words, this detail can be perceived as the symbol of *memento mori*. This can be interpreted as another way of saying that utopia never existed and never will exist, but the possibilities that utopias provide can be fantasized [116].



Figure 3.17. The cover image that was made by German painter Hans Holbein and was used in the first edition [117]

Like 16<sup>th</sup> century London, which is the period that More lived, Utopia island has divided into 54 dwelling units. Cities consist of families. There are six thousand families in cities. Families constitute the government unit called “phliarch”. While there are regional differences, every city are essentially the same. The capital city Amaurote is quadrangularly located on the slopes of a low hill. The city starts at the foot of the hill and stretches out to the banks of river Anydra. The city is surrounded by thick and high walls. There are towers and fortresses located in certain intervals. On three sides of the city walls, there are deep and wide ditches with spiny bushes. The river on the fourth side of the city acts as a natural ditch. The location of city squares and the streets are designed so as to provide easy transportation and shelter from the winds. Houses are arranged in a row along the streets and there are large backyards behind each one of them. Every house has two doors that open to the streets and to the backyard. The doors don’t have a lock and they are so light that they can be opened just by slowly pushing. Everyone can enter the houses whenever they want because the things in the houses don’t belong to anyone and are everyone’s property. Utopians don’t have the concept of private property. In order to efface this mentality, they have an understanding of housing that is based on partnership. They change their houses by drawing lots decennially [118].

The injustice in Britain of that period and the economic problems that public suffered may have lead More to create such an egalitarian utopia. The working conditions were also designed equally in Utopia. Work were done collectively. People worked six hours a day; being three in the morning, and three in the afternoon. German Marxist, and socialist democracy theorist Karl Kautsky argues that the same working hours proposal is also referred in Marx’s *Das Capital*. As a critical reflection of 18<sup>th</sup> century Britain, the insignificance of materiality can be seen in almost every part of the island. Precious metals such as gold or silver are worthless in island Utopia. Gold is a valueless material that is used in the production of the chains of the slaves.

More argued in Utopia that an egalitarian and ethical society with no class discrimination, where religion is practiced freely, time and nature is utilized in the best way possible, people live without a concern for the future, public ownership is predicated upon instead of private ownership is the ideal society.



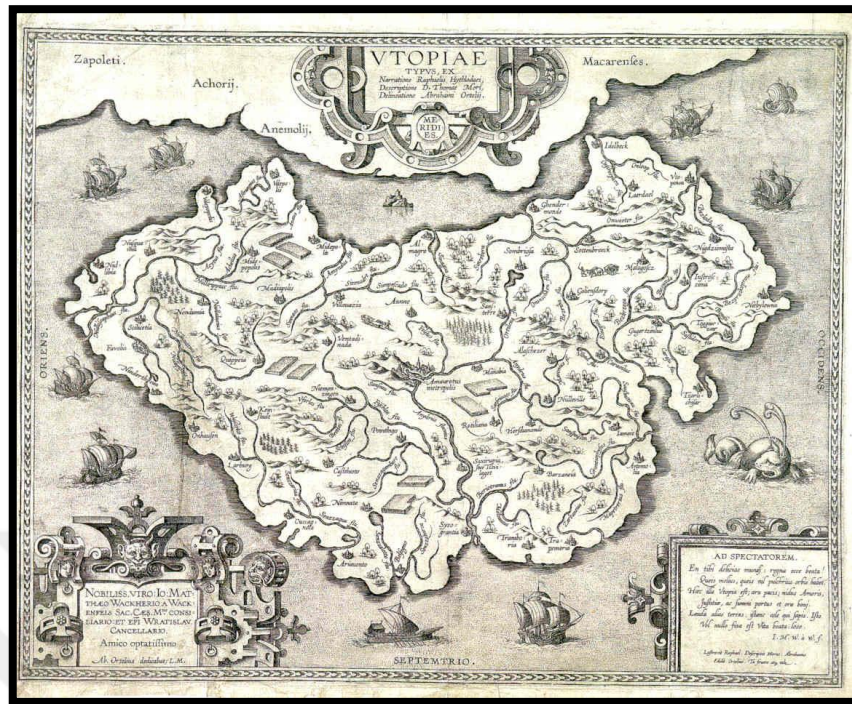


Figure 3.18. Map by Ortelius, ca. 1595 [119]

### 3.6. SIR FRANCIS BACON (1561-1626), NEW ATLANTIS (1624) NOVEL

Sir Francis Bacon is a British philosopher, writer and statesman who lived between 1478-1535. He was against the Aristotelian deduction logic and scholastic thought [120].

Francis Bacon and his philosophy can be regarded as the beginning of a new period. In a time when his contemporaries looked back and progressed with what they perceived from it, Bacon realized the innovation and sought for the myth of paradise that mankind has longed for - utopia. With this notion, he paved the way of philosophy and science for many scholars of the future. As a metaphor of Plato, he turned his back to the light in a cave, and enabled that only the ones who are aware of their shadow look at the light [121].

Bacon argued that experience plays an important role in being informed, and laid the foundation of scientific empiricism. Bacon started to design the ideal state that will support establishing a center for scientific inventions in 1608. New Atlantis, his utopian work in which he described the ideal state has come up, as far as is known, in 1614 or 1618, and was finished with its last annexes in 1624-25 [122]. In the preface he wrote for New Atlantis in

1638, Bacon's chaplain Guillelmus Rawley said Bacon's aim in writing this novel was to exemplify and promote the institute he called Solomon House or College of the Six Days' Work, which was founded to interpret nature. He also wanted to show how strong was the productions of the Institute [123].

In New Atlantis' utopia, the story of the sailors who wanted to reach to Japan and China from Peru, and their encounter with a regime unknown to them, upon landing on Bensalem Island after a storm on the uncharted region of the Southern Sea.

Being a hospitable and kind community, the people of Bensalem has established the Stranger's House that was allocated for the strangers who come to the island. The house was quite big, was made from bricks of shades of blue, and that has elegant windows which has glasses in some rooms and oiled linen in some. Sick and wounded people stay in the rooms at the hospital for treatment. The hospital has forty small rooms separated to partitions with cedar trees. Most important structure of the kingdom is the Salomon's House that was built by King Salomon [124].

Salomon's House is narrated in three stages in the book. The first stage is the foundation phase. Salomon's House is founded to search the meaning of everything in nature, to question their reasons, fathom all mysteries of the world, and thus to extend the boundaries of human dominance. In other words, it can be said that it was founded to make researches on the philosophy of nature [124].

The second stage is the stage that hardware and tools are described. The inhabitants use the large and deep caves to thicken, solidify, freeze, and store in the island. At the caves which they call the lower area, they duplicate the natural metals. They used the material which they have buried years ago and produce new artificial metals. They also used the caves for the treatment of certain diseases and to provide for the ones who retreat into seclusion to extend their lives [124].

Like the pot clays of the Chinese, they made sepulchers made of natural materials to the surface of the earth. They also mixed their wastes with soil and used that as fertilizer at various areas, enabling the natural cycle [124].

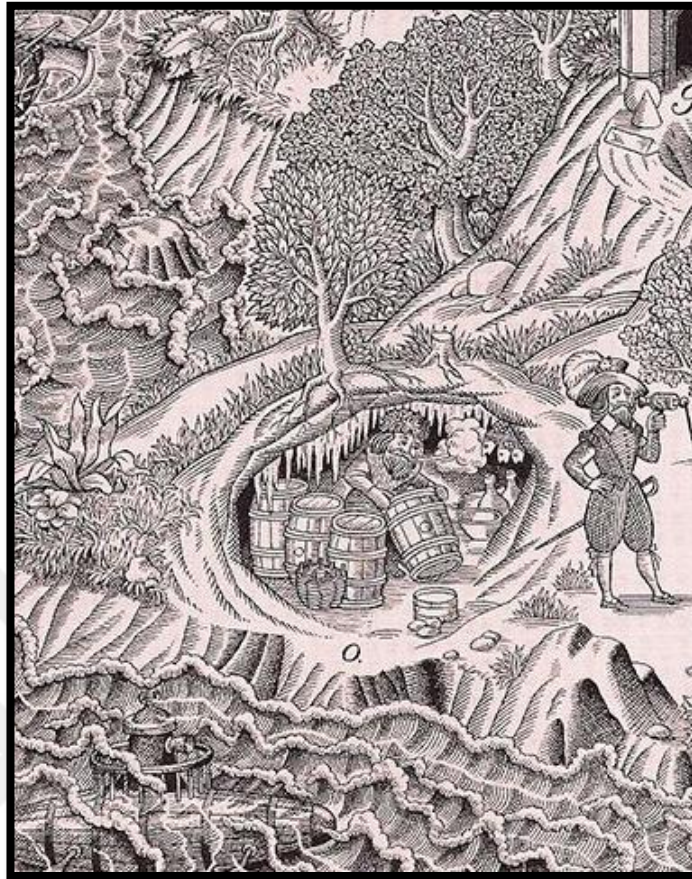


Figure 3.19. Underground storages [125]

They had towers with heights up to half a mile, and some of these towers were located on very high mountains. If the calculation is made by including the height of the mountain, there are towers at three miles high. This part is called the high area. The towers are used as insolation, refrigeration, and storage area, according to their locations. Towers are also used in weather forecast observations [124].

A lot of water springs were utilized. They had lakes with both salty and fresh water. They used these lakes for breeding fish, birds, and every kind of creature that lives in the swamps. They also used these lakes for burying certain natural material. By this, they could observe the difference between the material that was buried under the soil and that was buried under water. They had ponds which they produced fresh water from salty water, and fresh water was turned into salty water for some processes. They had rock in the middle of the sea, and some sunny parts at the seashore. They did work that requires sea air. Fast-flowing rivers



and waterfalls were used to create movements with different intensities. They had many machines which they used to increase and strengthen winds [124].

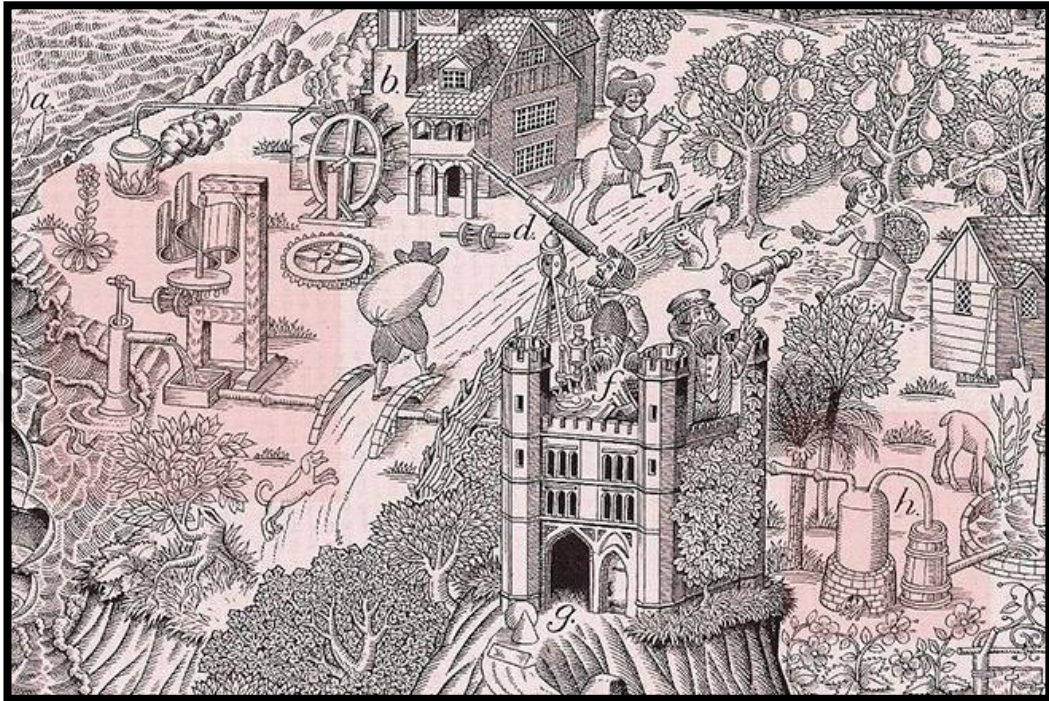


Figure 3.20. The systems for turning salty and fresh water to each other [125]

There were artificial sources where they create by mimicking underground sources with wells, and by adding minerals such as blue vitriol, Sulphur, steel, brass, lead, and saltpeter. They also had wells and water reservoirs where they melt many materials. Water obtains the characteristics of the material it is mixed as this much easier than in basins or containers. Among these wells, there was one which they produce a medicine for a healthy and long life, which they called water of paradise [124]. While this drink they called the water of paradise has created a positive perception in New Atlantis utopia, it was also seen that this water of paradise idea was used in a dystopian example in 20<sup>th</sup> century. Known as the elixir of immortality in Indian philosophy, *soma* was used as a drug that decreases the dystopian sentimental awareness in Aldous Huxley's *Brave New World*.

In New Atlantis utopia, observation of nature went as far as to mimic natural events. They had large buildings in which they made representations of natural events. They made artificial rain from vapor droplets, and also mimicked thunder, lightning, constellation.

In rooms which they called health rooms, they saturated the air and used it for the treatment of some diseases. Similarly, they had large public baths where they applied invigorating compounds that prevent the human body from drying [124].

In orchards and gardens, fertility and appropriateness of the soil for the growth of trees of different varieties are sought, rather than afforestation of the roads or adornment of similar places. In some of the orchards, there were fruits for the production of alternative beverages to wine. In these orchards, results of the gemmation and grafting of both the wild plants and the fruit trees were assessed. With this information, they enabled the trees to bear fruit before or after their natural season. They could grow the trees and the plants, and also their fruits much bigger than their actual sizes. They could flavor the fruits, and change their taste, smell, colour, and shapes. With this, they could produce fruits to be used in medicine production. They could mix the soil to produce seedless plants. They could grow unknown new fruits instead of common ones. They could also turn one species into another one [124].

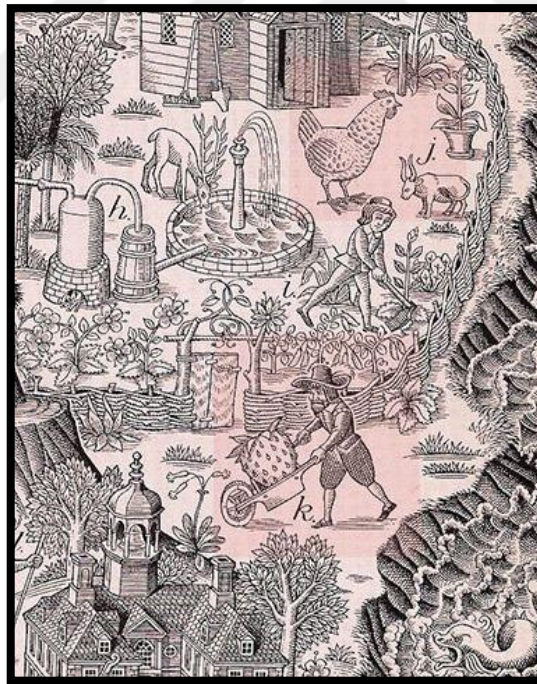


Figure 3.21. Cultivation of plants and animals in different sizes from their original state [125]

They had indoor spaces and parks for all kinds of animals. These animals were bred to be used in experiments, and produced data for the benefit of human body. They tried to keep



eviscerated animals alive, and resurrected some animals that were thought to be dead. They also experimented with the venoms and antidotes to find ways of better protecting the human body. They could grow animals bigger and longer than they are supposed to be, against their nature. Similarly, they could stop their growth and cause them to stay small. They could pair animals from different species and produce fertile crossbreed species [124].

They had ovens with many types of heat for various purposes. They produced heat by changing sunbeam and orbits and imitating the progression and rotation of celestial bodies. They could produce heat from manure, animal intestines, blood and carcasses. They could also produce heat from compressed hay and grass, and caustic lime. They had tools that radiate heat only by movement. Sunsoaked places and underground caves radiated natural or artificial heat [124]. As mentioned here, they used material energy by mimicking nature and used it in many that enable to see the areas and meet their requirements.

They had houses where human senses are examined. They had optical art houses where they could experience on and produce lights, beams and all colors. In these houses, they worked on tools that automatically radiate light, that enable to see the celestial bodies (telescopes), and lenses [124]. They had sound houses where they could experiment on and create all sounds. They had devices which they could produce all alphabetical notes and articulated voices, and which they could imitate the sounds of birds and wild animals. They had smell houses in which taste and smell experiments are made. In these houses, they could imitate natural smells and tastes [124].

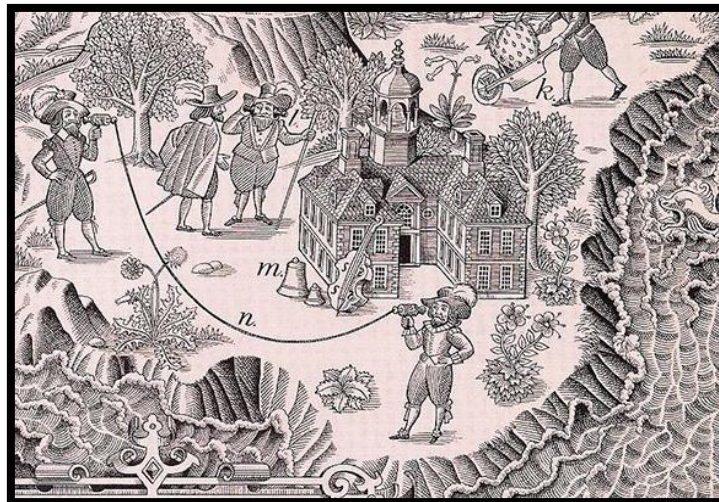


Figure 3.22. Sound houses [125]



In these machine houses, many things were produced and invented. They produced wheels, all kinds of war machines (cannons, rifles etc.), Greek fire that could burn in the water (the compound that was used in Byzantine period and consisted of sulphur, caustic lime and naphtha), and fireworks for amusement. They developed devices that enable them to fly to some extent, imitating the flight of birds. This invention resembles the model which Leonardo Da Vinci made by observing the birds. They could imitate the movement of animals by making mechanical models of quadrupedal animals, birds, fishes and snakes [124].



Figure 3.23. Mimicking bird [125]

In illusion houses, the fallacy of all circumvention and forgery was shown. Because of the abundance of natural sources at their disposal, making natural things look like artificial and acting like it is a miracle was deemed a big crime [124].

All implementations that are told in the second stage, and the new understanding of science that Bacon has founded against deduction was also told in his work *Novum Organum*. Bacon aimed to progress in science by reaching the uncharted and hidden aspects of nature. According to Bacon's new scientific approach, nature should be observed in order to be the master of the world [120]. Bloch interpreted Bacon's new approach to science as the best way to surrender to and learn from nature. He argued that nature then would surrender to mankind. He said that the better nature is observed and known, the more science will progress [126].

At the third stage, Bacon tells the positions and tasks in Salomon's House. Here, the tasks are completed by division of labor. Known as the *Merchants of Light*, twelve people act as if they are from another nation and bring books, materials, and samples from experiments

from other countries. Known as the *Depredators*, three people collect the experiments which are in all books. Known as the *Mystery Men*, three people collect the data from the experiments of all mechanical arts and of liberal sciences. Known as the *Pioneers* or the *Miners*, three people work on new experiments that they think are useful. Known as the *Dowry Men* or the *Benefactors*, three people are responsible from the supervision of all experiments. They obtain findings from the experiments and make assessments. They make researches on how to contribute to human life and sciences. Clearly proving the natural causes, and identifying forecast methods about nature are among their purposes. The three known as the *Lamps* supervise all works and collections in detail. They progress by obtaining new experiences from the mysteries of the nature. Three people known as the *Inoculators* execute the experiments that were determined and put into practice, and inform everyone in Salomon's House about the results. Lastly, three people known as the *Interpreters of Nature* raise the former discoveries by experiments into greater observations, axioms, and aphorisms [124].

Mumford likens the state order to a man-machine that is formed by technicians, scientists, doctors and soldiers [127]. With the humanist influence of the period, it may be perceived that humanity is placed in the center in this ideal construct, and all obtained knowledge is to be used for the benefit of humanity. With the scientific progression of the period, with Bacon's discourse, "knowledge is power", the aim to have control over nature has been effective in the utopia he created [128]. What Bacon wanted to do in New Atlantis is to examine and observe nature down to the last detail, and use it for the benefit of humanity. In this work, Bacon opposed the Christian logo and Aristotelian deduction, founded a scientific approach that embraces experiment and observation as a principle, and conveyed the requirements of an ideal state that is established in this manner in line with his ideas.

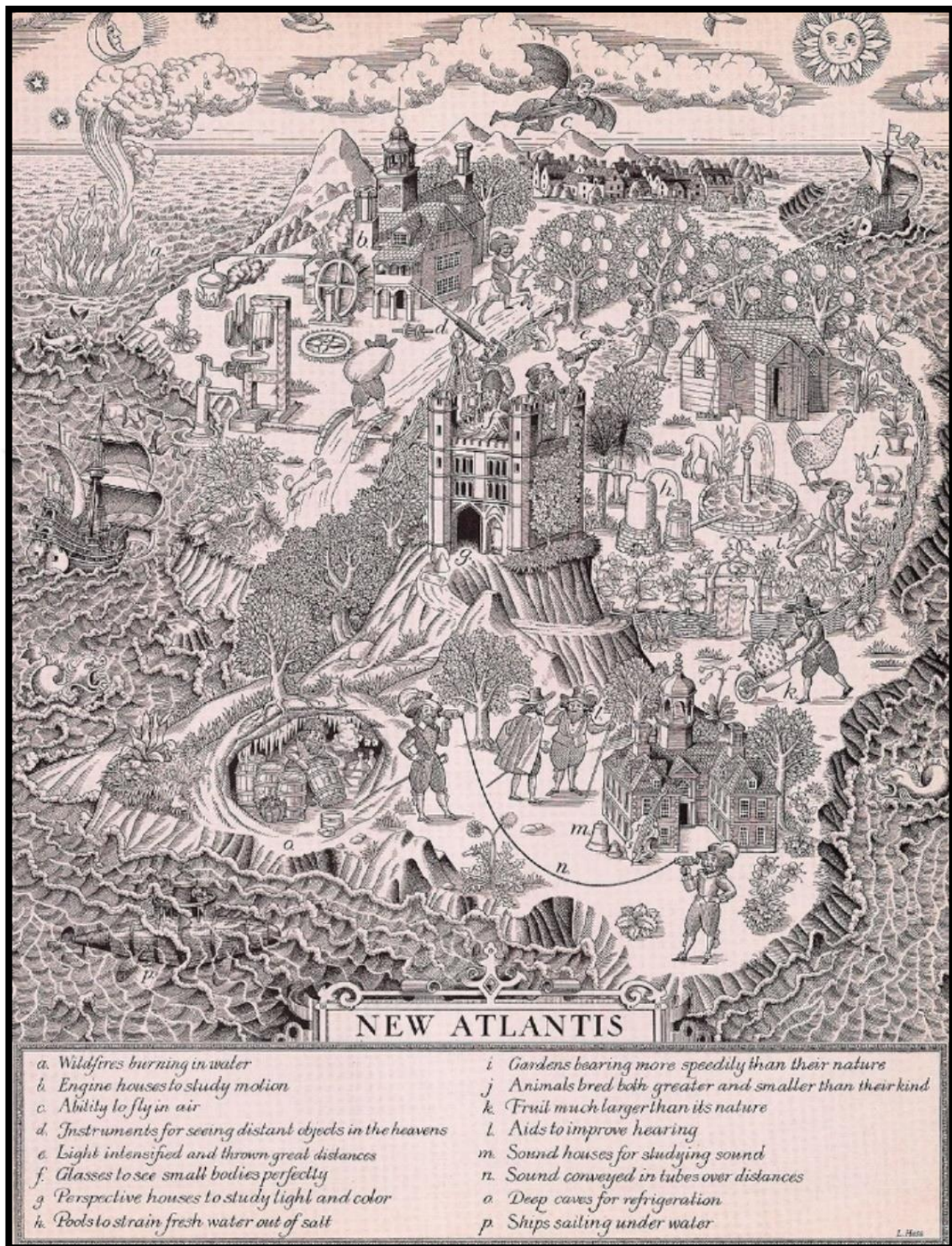


Figure 3.24. Image of New Atlantis utopia [125]



### **3.7. TOMMASO CAMPANELLA (1568-1639), THE CITY OF THE SUN (1602) NOVEL**

Italian poet, writer, and Platonist philosopher Tommaso Campanella has joined a group which wanted to end the invasion of the Spaniards in Naples and Sicily in 1599, and eventually served time for twenty seven years in Naples and then for three years in Rome. During his imprisonment, he wrote many books [128]. In 1602, he wrote a utopia with the title of the City of the Sun, and published it in 1623. During these years which are deemed Baroque era, a time when Renaissance has grown into maturity, although traditional symbolism and iconography has collapsed, the City of the Sun has been an example which continued the traditions of Renaissance as a plan schema [105].

Renaissance utopists have adopted a Platonist approach. In Plato's Republic, the concepts of family and private property were forbidden only for administrators, in order to provide a successful administration. Unlike Plato, Thomas More has supported the concept of family in his utopia. With a Platonist approach, Campanella ignored the concept of family. Like in the Republic, children belong to the society and do not acknowledge their parents. As society is divided into classes in Plato's Republic, there are no rules to be applied to everyone. Contrary to this, More and Campanella have removed the concept of private property not only for the ruling class, but also for the whole society in their utopias. Because they have no class in their societies and rules are binding for everyone. Campanella also ignored the concept of family for whole society and applied to whole society the ideas which Plato applied to classes [129].

With Renaissance, the regard to science has embarked on a new quest. In this process, the foundations of modern man and modern science has been laid. A scientific notion based on tradition has been left behind and was replaced by a scientific notion based on observation and experiment [130]. The City of the Sun is an ideal city which is based on the laws of nature. The top administrator of the city is a metaphysicist, and is named Sun (Sol) by the inhabitants. The helpers of the sun are power, wisdom, and love [130]. In the City of the Sun, science and education are related with each other. All sciences are highlighted in a book called "Knowledge". All walls of the city are adorned with the paintings which these sciences are illustrated. Within this context, it can be argued that architecture and city construct in the City of the Sun was designed in order to serve education. Universe is

represented with nested circles. Every circle represents a planet. It can be again argued that the city turns itself into an open door museum by telling different sciences in every circle. With this architectural design, scientific education is carried also into urban life [129]. Starting from childhood, society is being educated with the visuals on the walls and other obtained scientific data. In the City of the Sun utopia, Campanella tries to reach a humanitarian society that has a grasp of scientific thought and that is in harmony with the state [120].

According to Campanella's personal opinion, a philosopher must first read the book of the nature, because reality is not hidden and must be pursued [131].

In order to found a real philosophy of nature, one must compare the infinite book of the nature with book written by the hand of man; only with this method the mistakes made due to the deficiencies of man can be corrected. So nature is a book written on "*Infinite Wisdom*" [131]

The City of the Sun is described by a Genoese captain who was sailing to the Taprobana Island under the Ecuator, upon him seeing the island. This utopian city has a circular plan that consists of seven concentric circles with different sizes, the widest being two miles in diameter, and which every circle represents a planet. There are four main avenues that goes to every four direction on the compass from the center.

The city is strongly protected from outside forces by earthen walls, towers, ditches, and weapons. The main entrance has an iron gate and watchmen stand guard in front of it night and day. In the event of an assault, should the first circle be passed over, the assailants need to double up their efforts at every other circle [132].



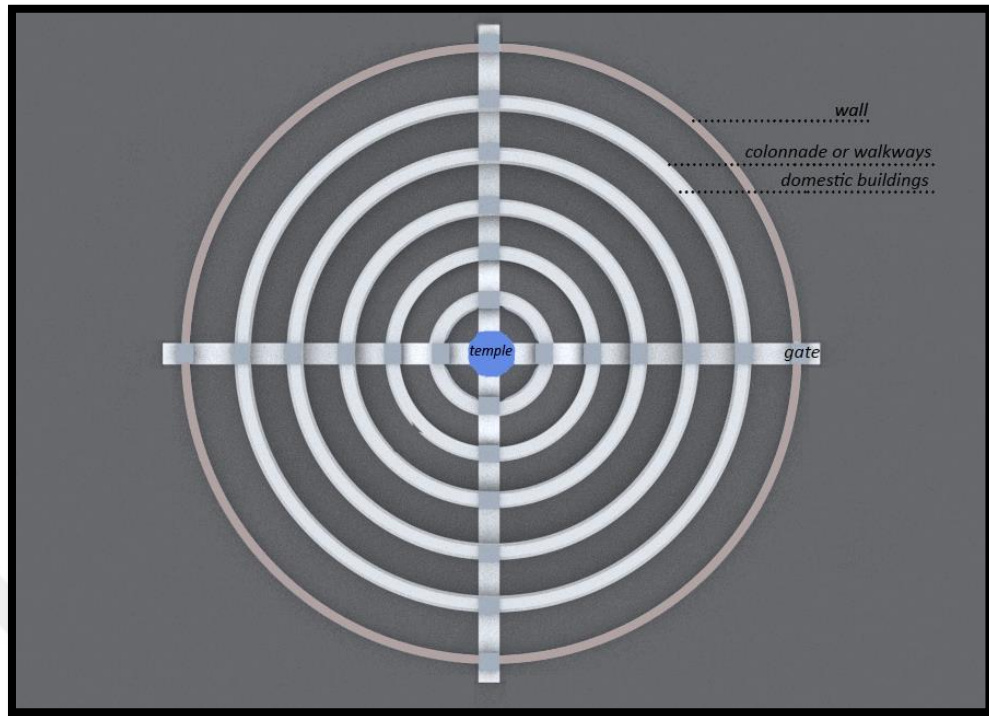


Figure 3.25. Plan of The City of the Sun

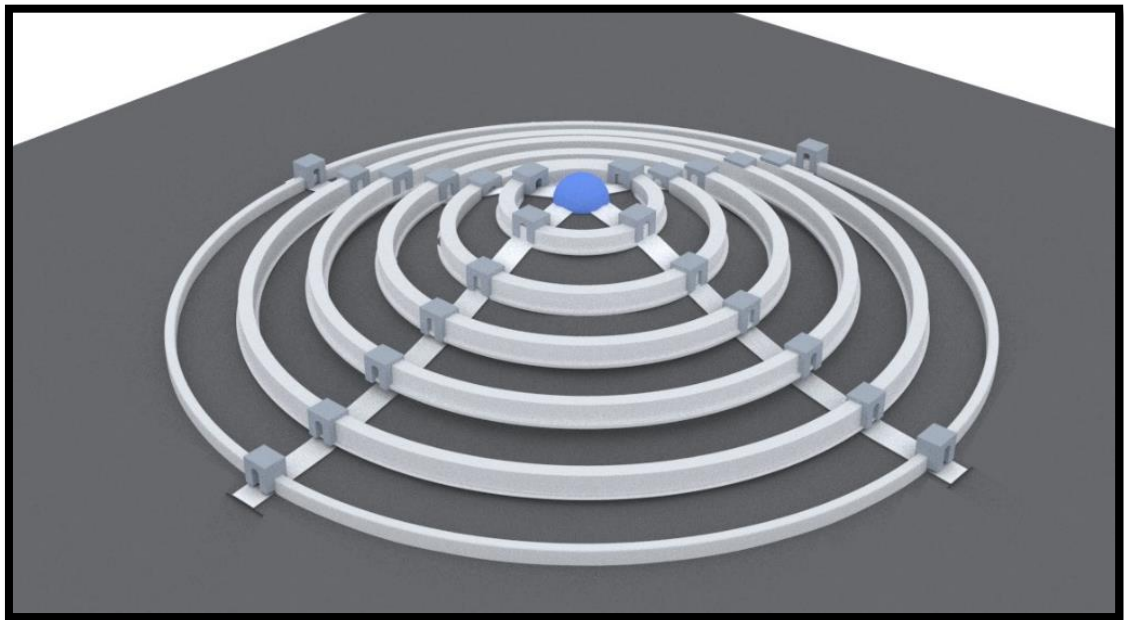


Figure 3.26. 3D model of the City of the Sun

There is a distance of 70 steps (1 step = 76 cm) from the first circle to the second. Multiple mansions with the look of one is located adjacently on the wall of the second circle. There are arches as high as half of the mansions, which go all the way on the circle, of which tops are used for the purpose of excursion. There is no entrance for the mansion from the lower elevation. There is only a system from the inner wall, which opens to the lower part of the building by passing to the concave side of the circle, and has marble steps that goes to the upper parts. The part that marble steps open is designed as the entrance of the rooms upstairs. The distance from the second circle to the third is three steps less. Mansions are completed with porches and adorned walls arranged in the same fashion. Thus and so, one passes through similar circles and reaches to the last circle. Passing through doors in and out of the wall, one goes up by climbing the steps with low risers. At the top, there is a majestic temple, masterfully built in the middle of a large plain. There is a big dome at the center, and another small dome with a hole in the middle right on top of the altar. Over the top of the altar, there is a huge sphere. On it, the sky is painted. In the City of the Sun, astrology takes an important place. Many decisions on the island are made according to the astrological synods and interferences [132].

While seven nested circles in the city plan are built with defensive purposes, they also contain many visualizations, graphics, and poems about science. The visual elements are very important in terms of education. It can be argued that this method of narration is in relation with the middle ages, because there were paintings of Jesus Christ's teachings on the walls of churches and monasteries, and education was given thus. Seven circles and seventy steps that Campanella used in this city design are also deemed as an indicator of the influence from the sacred numbers of the Middle East and Pythagoras such as 7, 70, 700 [129]. Although the City of the Sun is a utopia designed in late Renaissance, it also has the qualities of an innovative Renaissance work of art enlightened with the scientific point of view and the importance it attaches to education, and also has the influences of the middle ages with symbolic meanings and religious references.

### 3.7.1. Examples of Applied Plans

The central planned circular schema of the City of the Sun which applied as a utopia was used in the 20<sup>th</sup> century for some city designs and are still being used. This is regarded as one of the examples that the utopian designs of the past can be actualized in the future.

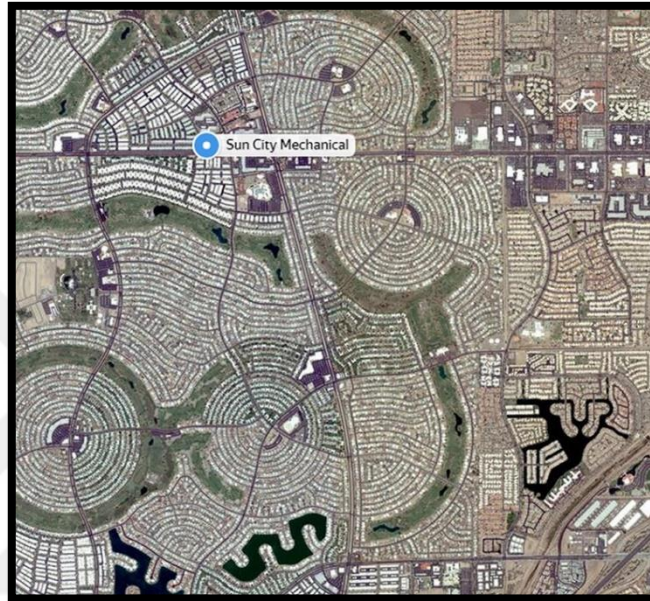


Figure 3.27. Sun City / Arizona, 1960 [133]

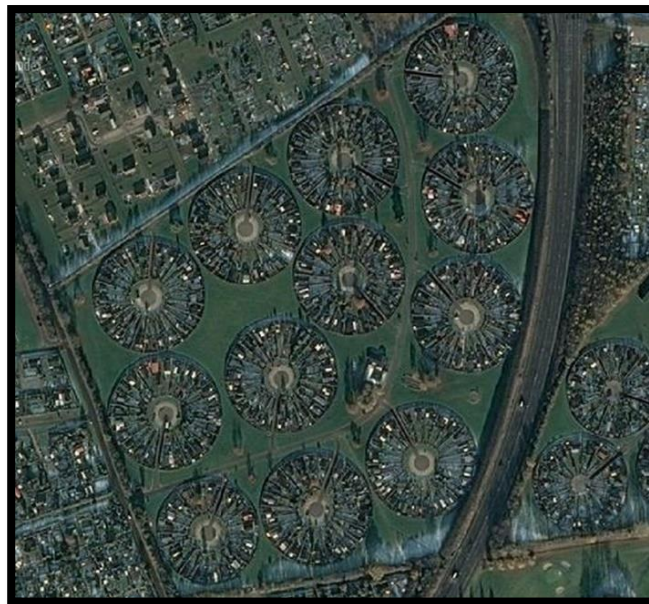


Figure 3.28. Brøndby Garden City Copenhagen, Denmark, 1964 [133]

### 3.8. RESULT OF THE CHAPTER

Renaissance has been a period that utopianism and the concept of ideal life were revived through the examination of ancient period works of art. There has been spatial projects on utopianism in which the political order is constructed, and many intellectual and literary works were produced. The relation between macrocosmos and microcosmos of ancient era were conveyed to the designs as the relation between the city and the human. The architectural designs that have started with Leon Battista Alberti became urban planning, on the path opened by the doctrines of ancient period architect Vitruvius. Deemed as sacred and also representing the universe, the circular form has shaped the designs in many of the city plans.

Constituting the foundation of Renaissance architectural doctrines, symmetry has been related with human body ratios which are the microcosmos of macrocosmos. There has been an effort to relate architectural ratios with human body ratios, and many work were produced in this manner. Architectural theorists of the period, Leon Battista Alberti, Filarete, Francesco di Giorgio Martini, and Leonardo da Vinci have produced works on human body ratios and maintained the relation between human body ratios and architectural aesthetics both in the city plans and the architectural structures. With this, they considered their designs as ideal and adhered to their ideas in the utopias they designed.

All four architects that are chosen for examination in this thesis are regarded as the influencers on the shaping of the architectural laws of Renaissance. They maintained a relationship in the period they lived and were informed of each other's works. It can be said that they have all crated a common design perception in their utopias, in other words, their search for ideal city and life. This perception has caused universal and Platonist designs that contain ideal arrangements to develop as a reaction to the Christian logos of the middle ages.

During Renaissance period, philosophy and science has embarked on a new quest. Being a consequence of Humanism, Renaissance has introduced the thought that humans can reach to perfection with his intellect and judgement. In this period, modern science's foundation has been laid and a scientific perception of life based on progression instead of traditional approach was developed. This new scientific perspective had an influence on utopianism. The utopias that were designed until Renaissance were anything but a fantasy in the shadow

of paradise myth. With renaissance, it was thought that happiness, peace and prosperity that constitute the foundation of utopianism can be reached by progressing with the principles of science and nature.

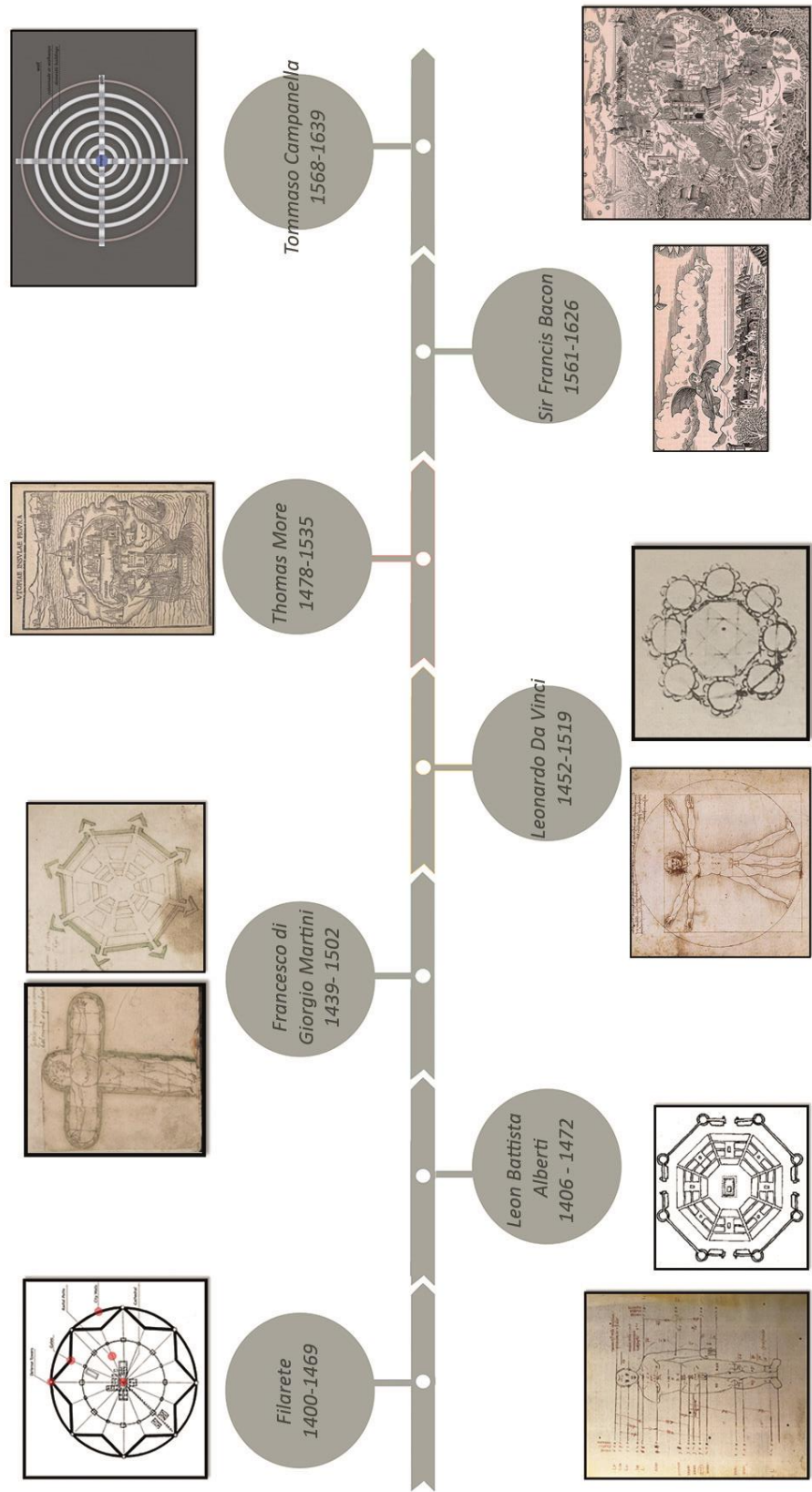
The social and scientific regeneration in Renaissance has also influenced the literary side of utopianism. In the books that were written in this period, state, social structure and the city was designed in a holistic manner. The idea that a new country can be discovered which has emerged with the discovery of America has influenced the utopian constructs of the period, and ideal life descriptions were made over mostly life on unknown islands.

Thomas More's novel *Utopia* was written as a narrative of an ideal life. With this novel of his, More has introduced the word "utopia", which means "a perfect place" or "non-existing place" to literature. Thomas More has objected to the unjust way of life of the period, and developed an egalitarian approach in his utopia. Traces of this equality principle can be found in utopias that were written after *Utopia*. In Renaissance which is a period when mankind was placed in the center, with the changes in the understanding of science, ideal state designs based on science such as Campanella's *The City of the Sun* or Francis Bacon's *New Atlantis* have emerged. Scientific empiricism and scientific education have helped the production of utopias that provided the development and progression of society.

As a result, architectural and literary utopias in Renaissance have essentially verged to the notion of universal knowledge, adopted the discovery of what nature presents as a principle, and foresaw that progression is only possible this way. In Renaissance utopias where traditional perceptions are brought down and mind is liberated, philosophy and observation of nature is used as a method of design.



Table 3.1. Renaissance utopias



## 4. BIOMIMICRY AS A DESIGN METHOD IN RENAISSANCE UTOPIAS

### 4.1. BIOMIMICRY AS A DESIGN METHOD

Being new as a concept but quite old as an idea, *biomimicry* has been derived from the Greek words *bios* (life) and *mimikos* (imitate) [134]. Biomimicry was first used as a scientific term in 1962 [135]. Some researchers prefer to use the term *biometry*, or *bionic*. From 1980's onwards, the use of the term *biomimicry* has become widespread [134]. In his work *Biomimicry in Architecture*, Michael Pawlyn has used the words *biomimicry* and *biomimetic* as synonyms. He defines *biomimicry* as “producing sustainable solutions by mimicking the functional principles of biological forms, processes, and systems” [134].

Biologist and writer Janine Benyus, Biology Professor Steven Vogel, and Biomimicry Professor Julien Vincent have conducted extensive studies on biomimicry. Julien Vincent defines biomimicry as “abstraction of a beautiful design in nature”, and Janine Benyus as “imitating the genius of nature” [134]. Both of them argue that solutions can be reached in designs by observing the data in nature.

Janine M. Benyus has said in her book *Biomimicry Innovation Inspired by Nature* in 1997 that sustainable designs can be made by having inspiration from nature. According to Benyus, there are many things we can learn and observe from the ecological cycle of the world which has been existing for 3.8 billion years. By examining the existing processes in nature, being able to satisfy our needs and overcome our problems with the help of today's technology may be a way of design [136]. Humankind has developed and continue to develop itself in many subjects including modern medicine and digital revolution. However, it can be said that there are still many things to be learned from nature [134].

Biomimicry aims to act like nature, instead of using it. In Janine Benyus' book, biomimicry is defined in 3 stages [136].

*Nature* as a model: Biomimicry is a new design method science that offers solutions to the problems of humankind by examining the models in nature. By being inspired from nature

and imitating systems, solutions are sought for the problems of mankind. Sun panels that are designed through inspiration from the photosynthesis of leaves by turning to the sun can be given as a simple example to these solutions [136].

*Nature as a measure:* Biomimicry postulates that nature has learned what serves the purpose, what is convenient, and what is sustainable, and uses the ecological standards as a criterion for crosschecking while checking the accurateness of the innovations you have made [136].

*Nature as a Mentor:* Biomimicry is a new point of view that prefers learning from nature instead of using it, as a new way of examining and assessing nature [136].

Benyus offered a new design model in the light of these definitions, and made an extensive study on this. Many researches have closely examined Benyus' works. In the light of Benyus' works, a professor at Wellington at Victoria University, Maibritt Pedersen Zari has created a chart that describes the relation that main ideology of biomimicry has established with biology, nature, and architecture. As a conclusion of her works, she divided biomimicry into three categories as *Organism, Behaviour and Ecosystem*. Organism category is described as mimicking the whole or part of an organism such as animals or plants. The second category, Behavior, is described as mimicking organism's behavior, or in a wider context, the relationship that the organism establishes with its environment. The third category, Ecosystem, is described as mimicking the whole ecosystem and the common principles that successfully work [137].

All three categories Zari has made are divided into five possible situations according to the mimicking methods. A design can be biomimetic according to its form, material, production stage, working process, and function. The differences between the types of biomimicry are tabulated through the example of termite by Zari [137].

Level of Biomimicry		Example - A building that mimics termites:
<b>Organism level</b> (Mimicry of a specific organism)	<i>form</i>	The building looks like a termite.
	<i>material</i>	The building is made from the same material as a termite; a material that mimics termite exoskeleton / skin for example.
	<i>construction</i>	The building is made in the same way as a termite; it goes through various growth cycles for example.
	<i>process</i>	The building works in the same way as an individual termite; it produces hydrogen efficiently through meta-genomics for example.
	<i>function</i>	The building functions like a termite in a larger context; it recycles cellulose waste and creates soil for example.
<b>Behaviour level</b> (Mimicry of how an organism behaves or relates to its larger context)	<i>form</i>	The building looks like it was made by a termite; a replica of a termite mound for example.
	<i>material</i>	The building is made from the same materials that a termite builds with; using digested fine soil as the primary material for example.
	<i>construction</i>	The building is made in the same way that a termite would build in; piling earth in certain places at certain times for example.
	<i>process</i>	The building works in the same way as a termite mound would; by careful orientation, shape, materials selection and natural ventilation for example, or it mimics how termites work together.
	<i>function</i>	The building functions in the same way that it would if made by termites; internal conditions are regulated to be optimal and thermally stable for example (fig. 6). It may also function in the same way that a termite mound does in a larger context.
<b>Ecosystem level</b> (Mimicry of an ecosystem)	<i>form</i>	The building looks like an ecosystem (a termite would live in).
	<i>material</i>	The building is made from the same kind of materials that (a termite) ecosystem is made of; it uses naturally occurring common compounds, and water as the primary chemical medium for example.
	<i>construction</i>	The building is assembled in the same way as a (termite) ecosystem; principles of succession and increasing complexity over time are used for example.
	<i>process</i>	The building works in the same way as a (termite) ecosystem; it captures and converts energy from the sun, and stores water for example.
	<i>function</i>	The building is able to function in the same way that a (termite) ecosystem would and forms part of a complex system by utilising the relationships between processes; it is able to participate in the hydrological, carbon, nitrogen cycles etc in a similar way to an ecosystem for example.

Figure 4.1. A framework for the application of biomimicry [138]

Different methods that can be mimicked through termites in the chart. Different organisms can also be examined through this chart, and thus different design principles of biomimicry can be applied.

In society, having a command on nature, or “developing” nature are known as accustomary methods. The imitation method that biomimicry suggests can be seen as a radical revolution so long as it is applied on all innovations. Unlike the industrial revolution, biomimicry revolution adopts learning from nature as a principle, instead of consuming it [136]. After years of studies, ecologists have started to learn the hidden similarities between many interlocking systems. As a scholar who interpreted these studies, Janine Benyus has listed the laws, strategies and principles of nature in her book *Biomimicry Innovation Inspired by Nature* as follows [136]:

*Nature runs on sunlight*

*Nature uses only the energy it needs*

*Nature fits form to function*

*Nature recycles everything*

*Nature rewards cooperation*

*Nature banks on diversity*

*Nature demands local expertise*

*Nature curbs excesses from within*

*Nature taps the power of limits*

[136]

In this list, Benyus specifies the common features of the perfect cycle design of nature. It can be argued that humankind has got to imitate nature for the ideal design. It can also be deducted from this list that nature optimizes everything. Nature makes designs by only using as much as it needs and by inhibiting excess. However, human designs are not founded on optimization. Industrial production is based on high efficiency and growth ratios.

As systems mature, the concept of success is being redefined. According to Cooper, “In today’s economy, the description of success is a fast growth - if you grow faster than your competitor, winning gets easier. But, in tomorrow’s world, being competitive, doing more with less, and being more efficient than competitors may be the key to winning. Companies can obtain more profitable results by not being so big, and by providing small and high quality products and services. By emphasizing quality instead of material, the production of material can be slowed down [136].

When Fordist assembly line was invented with the Industry Revolution, the production style of humankind has radically changed. The products which were handmade once are now being mass produced. This facilitates affordability, and also causes cheapness in products and disposable product consumption of today [136]. The increase in consumption that has come with industry revolution causes non-economic solutions. The usage of raw material



increases, and people use more than their needs. In contrast with the natural systems where nothing is wasted, squandering and waste is ever increasing in production systems that has come with industry.

Nature uses the material in its designs in the most economic way possible. Forms in nature are practical designs that have developed with years of evolution. Living things have to adapt many variables such as finding food, heat control, mating, avoiding predators. Their forms are evolving to the ideal in order to maintain their lives. Due to genetic mutations or other adaptation processes, refined structures take shape. When nature is observed, the most ideal structures in life take shape at the end of the development process of life on earth. There are many examples in nature where “less material - more design” paradigm is used effectively [134].

As Frei Otto has argued in one of his essays, structures have a geometric form and an inner structure. Form and structure take shape by way of a common growth, and based on physical and chemical laws or humans’ creative ability [139]. Upon these remarks, we can say that the structure formation in nature is essentially similar to the man-made structures. When forms of the material in structural systems are applied by imitating nature, much more economic results are obtained.

In nature, the principle of the integration of function, form and structure is effective and adapting to the environment [140]. Steven Vogels’ book *Cats’ Paws and Catapults* has both positive and negative arguments on biomimicry. Vogels expresses points that he criticizes and finds deficient in biomimicry. He defines his criticisms as “naïve Biomimicry”. His intention in using the term “naïve” is the effort of scientists and designers for the exact adaptation of a technology that exists in nature to human scale without making any arrangement. Most of the designs that are applied in this manner fail. In his book, Vogels gives examples that support this discourse. His examples are mostly from designs that are based on the movement ability on air and in water. He regards Wright Brothers’ designs that were made by observing the birds and their gliding as a fine start. However, he argues that this has lead them to a wrong way. Birds are much smaller than humans and the characteristics of their flight technology is designed quite differently from the one that would be needed for humans. A bigger and heavier object needs to move much faster in order to stay up in the air. Therefore they need jet motors and high-powered propellers. Birds are much smaller and lighter than humans and do not need a propelling power like this. This fact

is the reason for the failure of many designs [141]. At the end of this process, after many revisions and attempts, today we have come from single-seater aeroplanes to aeroplanes that are designed and used to carry hundreds of people to every corner of the world.

Derived from the words ecology and mimicry, Ecomimicry is a method that has the same design principles as Biomimicry as a design method that is based on mimicking natural ecosystems. It postulates that designs and technologies in nature are superior to all kinds of man-made designs. As a design method that imitates the structural features, functions, and processes of natural ecosystems, ecomimicry offers solutions for a sustainable life [142].

Ken Yeang says that biointegration can be made possible by transforming the linear production system of humans into a state which it imitates the cyclical system in nature [142]. Today, wastes of built environment are designed as the resource of another system. In nature, every waste is the life source of another living thing. As a system where all wastes are utilized, ecological cycle works so as to sustain itself. According to Yeang, if the cyclical system is taken as an example in man-made designs, new sustainable production strategies can be developed. Yeang has schematically visualised the production systems of humans and nature in his book *Ecodesign: A Manual for Ecological Design* [142].

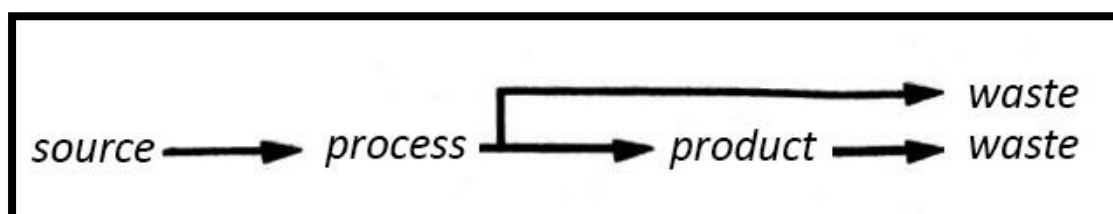


Figure 4.2. Linear human economy [142]

As can be understood from the figures 4.2 and 4.3, in the linear system that humans practice, wastes are left at the environment and accumulate, instead of being the resource of another system. This harms the environment. However, all wastes are utilized in nature and become a part of the production, enabling the system to work without any external intervention. By integrating this mechanism to all design systems, a life that has not lost its relation with nature can be achieved. Just like ecomimicry, biomimicry suggests using the methods of nature by observing it. As a sustainable, economic, and environment-friendly design methods, biomimicry can be implemented in designs that are related with architecture, urban

planning, and built environment. Architecture is a discipline that is directly related with life and place. A life that is in harmony with natural environment also brings with itself sustainability. Biomimetic designs are applicable methods for the emergence of such harmony.

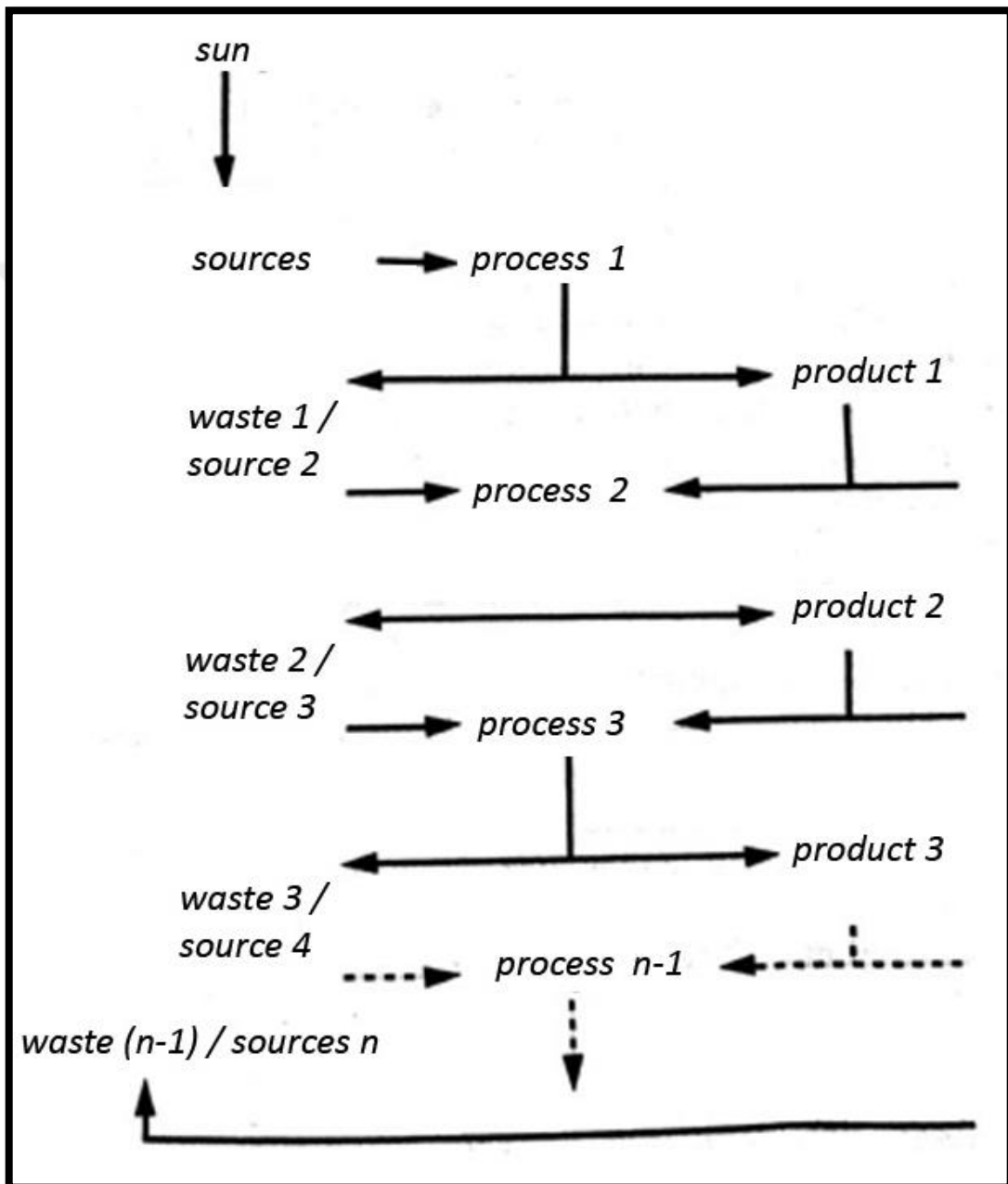


Figure 4.3. Circular nature economy [142]

## 4.2. THE RELATION BETWEEN BIOMIMICRY AND ARCHITECTURE

Today, half of the human population lives on areas with dense population. The habitat that humankind deems “normal” has turned to built environment, instead of natural environment. The features that existed in natural environment once was replaced by artificial cultural and social environment for the sake of increasing the quality of life. Therefore architectural designs are increasingly gaining importance [140].

While architecture is a discipline essentially related with structures, it also has a relation with big scale place and city designs. With the increase in world population, the development of economy and technology had a great effect on environment. The structure industry and architecture also have a great share in this. It has an effect on so many areas such as disappearing natural areas, the irreversible damage given to biodiversity, exhaustion of raw material, excessive energy use, waste production, and soil, water and air pollution [140].

Architecture is a discipline that adapts to environmental changes. If environmental pollution continues to increase as this, the architecture of the future will need to evolve to be space designs that provide life opportunity in a damaged and denaturated environment. Making researches on biology and natural processes helps architects to see this process and effect [140]. In the early stages of history, many designers have chosen biology as role model. Renaissance designer Leonardo Da Vinci has made so many inventions by observing nature. He wrote a book with the title “Sul vol degli uccelli” (Codex on the Flight of Birds) about the flight of the birds in 1505. He designed artificial wings which was worn as corset and fluttering of birds is mimicked. Flying by fluttering did not happen technically, but parachute has been designed in 1483 over observation of birds’ gliding. The parachute that Da Vinci has designed was remade and tried with the material of the period by Adrian Nichols in 2003. Nichols went up to 3000 metres high with a hot-air balloon and glided down with the parachute that Da Vinci has designed. He made the landing with the modern parachute in order not to take a risk. Da Vinci has also made many inventions for military use. These designs have been instructive for most of the innovations of today [140].

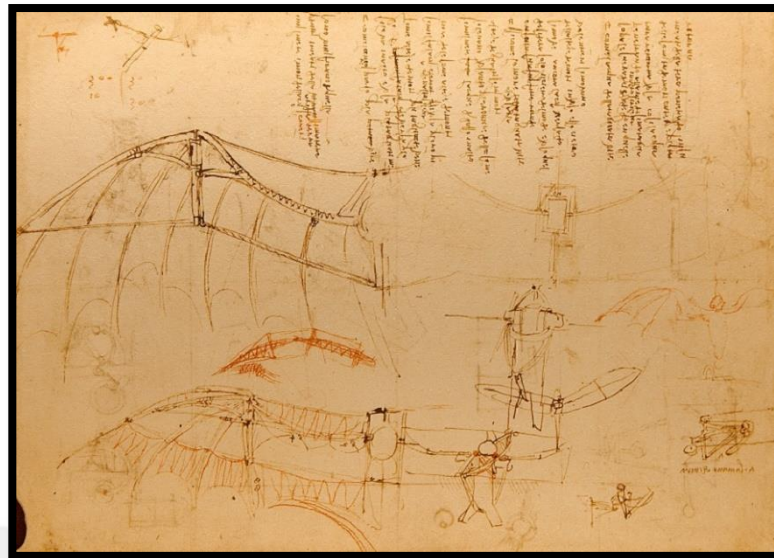


Figure 4.4. Leonardo, design for a flying machine [113]

Mathematics professor Alfonso Borelli (1608-1679) has also observed the fluttering of birds and defined fluttering as a cuneatic displacement (“de motu animalum”) [140].

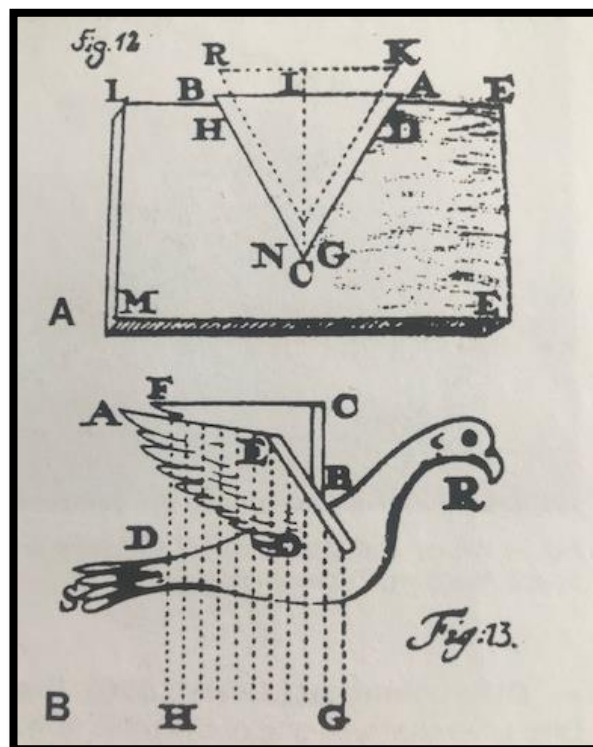


Figure 4.5. Alfonso Borelli, sketch about the impact of wedges and the flapping wing [140]



Another design example which was made with influence from nature is the Crystal Palace, designed by Joseph Paxton in 1851. Paxton has observed the Amazon water lily during the design of the structure [143].

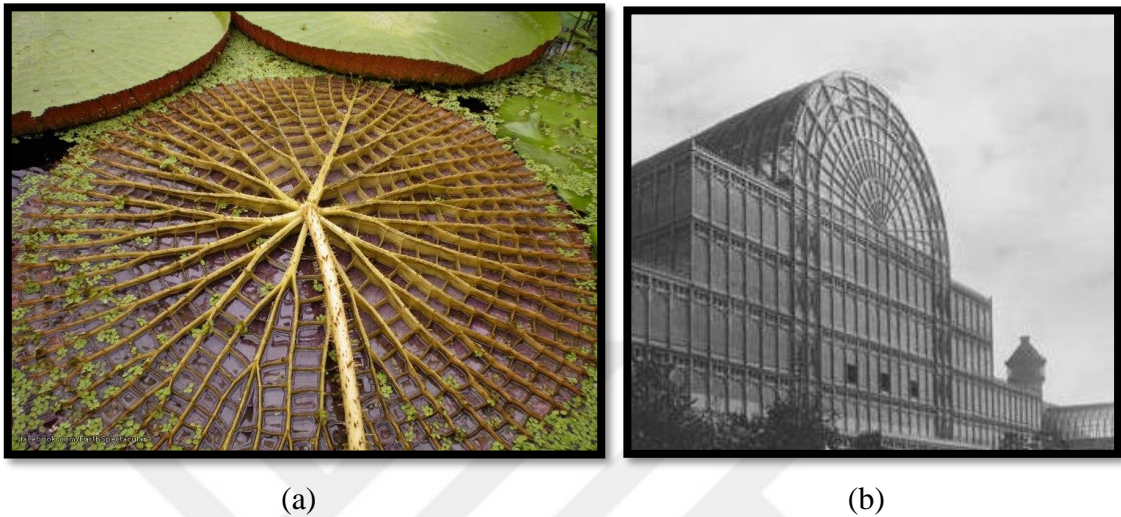


Figure 4.6. (a) Amazon lily [144], (b) Crystal Palace 1851 [145]

Between 1887-1889, during the design of the Eiffel Tower, Stephen Sauvestre and Gustave Eiffel observed the thigh bone, and saw that it could balance and carry the weight of the body. After microscopic examinations, he was influenced from the empty structure of the bone and created his structures through the principles of the thigh bone [146].

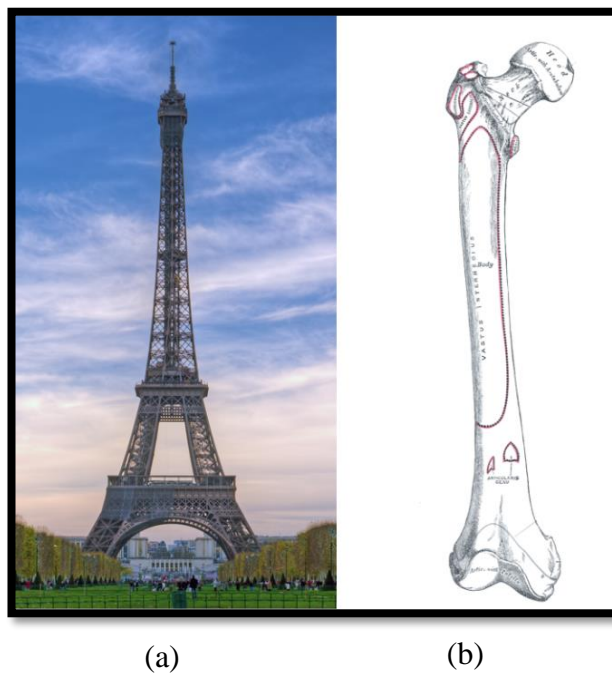


Figure 4.7. (a) Eiffel Tower, (b) Bone [146]

Spanish architect Antoni Gaudi was inspired by nature in his designs. He expressed that the right answer of everything can be found in nature with these words: *“The great book, always open and that we have to make an effort to read, is that of Nature, and the other books are taken from it, and in them are found the errors and misinterpretations of men.”* He made many architectural designs with influence from nature. An example which he has had inspiration from nature in both visual and functional terms is Casa Batlló, which he built with a redesign of an existing building [147].



Figure 4.8. Casa Batlló by Antoni Gaudi [147]

In Casa Batlló, Gaudi has used openings that mimic the gills of a fish in order to provide fresh air circulation in the interior [147].

Technological developments bring many innovations to architectural designs. At the same time, they provide an opportunity for the reinterpretation of architecture to enable the harmony and functionality between humans and environment. In accordance with the current developments, architectural projects are being effective on providing life criteria. Architecture is a third layer of skin for humankind, rather than just a need for sheltering [140].

In this parallel, the solution for most of the problems about housing can be found by innovative designs. When “nature” is taken as a role model with its designs that renew itself and evolve in years, answers for architectural design problems can be found [140].

There is a distinctive difference between “biomimicry” and “biomorphism”. Modern architects are inspired from nature for unusual forms and symbolic associations. Eero Saarinen has designed a biomorphic form in his TWA terminal building in order to symbolize the poetry of flight. Similar to Crystal Palace, the columns of Frank Lloyd Wright’s Johnson Wax building is also designed through inspiration from the flowers of water lilies. Although it resembles water lilies morphologically, they do not have a common point in terms of functionality [134]. According to Michael Pawlyn, if there is a functionality in a design that is taken from any adaptation in nature, it can be called biomimicry; if not, it can be called biomorphology. Pawlyn remarks that biomimicry rather than biomorphism is the design method that satisfies the requirements of today [134].



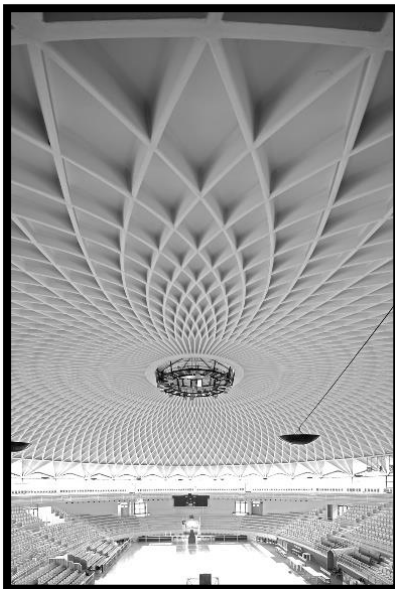
Figure 4.9. TWA terminal at John F. Kennedy Airport New York in which Eero Saarinen used biomorphic forms to capture the poetry of flight [148]





Figure 4.10. Frank Lloyd Wright, Johnson Wax building [149]

Biomorphology and biomimicry can also exist in the same structure. For example, Pier Luigi Nervi's Palazzetto dello Sport Pier which he designed its structure with inspiration from the Amazon water lily is influenced from nature both in terms of morphology and function [134].



(a)



(b)

Figure 4.11. (a) Palazzetto dello Sport Pier-Luigi Nervi, (b) Amazon water lily [150]

Biomimicry as an architectural design method provides solution to many problems with the design process through the observation of data in natural environment. When biomimicry is used as a design method in architecture discipline where process is as important as the result, efficient results are obtained. With the help of advanced technologies, the structures, processes, and ecosystems in nature have become more imitable. Implementation of biomimetic solutions in structures with today's architectural technology can help reducing the problems of built environment.

Humans have been trying to reach ideal life and ideal designs for centuries. Nature has a system which has been developing with evolution for 3.8 billion years and that contains the most ideal designs within itself. In nature where designs are developing and changing, the most ideal living thing according to the current situation continues its lineage. Life and death are parts of nature's cycle. A dying creature provides life to another. Thus and so, nature has created its own ideal system and its life designs has evolved according to current situation.

Life and architecture are directly related with each other. Nature, on the other hand, is life itself. When life designs in nature are adapted to man-made methods, it can be argued that humankind will reach the ideal. With the principle of learning from nature by imitating it, biomimicry provides many solution offers to architecture as a design strategy. In architecture discipline, being inspired by nature and using it as a mentor is a way of reaching the ideal design.



### **4.3. FINDINGS ON BIOMIMICRY AS A DESIGN METHOD IN RENAISSANCE UTOPIAS**

Defined as rebirth, Renaissance is the period when new scientific developments have begun by reaching the knowledge of ancient era with a Platonist approach. In that period, the oppression of the church has been left behind, human has been dignified, and humanism movement has started. Humans are interpreted as the microcosmos of macrocosmos and a representation of universe. Studies on human body has been made and the ratios of human body has been accepted as ideal measurement. Many utopias have been designed with the pursuit of idealty and the fantasies of ideal life. With the downfall of Scholastic thought, natural sciences have been the focus, and nature has been observed in order to reach the ideal life. Reaching every knowledge in nature has been accepted as a method for the development of humanity. Utopias with a state system based on natural sciences were designed.

Utopias are products of ideal life visions according to the current situation. Nature also has designs that contain the ideal. Utopias cannot be fantasized without place. Therefore, the spatial construct in utopias reflects the ideal life. During Renaissance, utopias that were created with influence from nature. Having adopted producing design solutions by learning from nature as a principle, biomimicry are seen in Renaissance utopias, although it is a contemporary term. In this thesis, Renaissance utopias with biomimetic designs are being examined. Designs in which solutions are made through inspiration from nature are examined in four architects and three utopian novels that are chosen from Renaissance period.

In table 4.1, nature influences in utopian designs of Renaissance architects Alberti, Filarete, Martini, and Da Vinci are shown. In the ideal city designs of all four architects, circular form which was deemed sacred as reflection of universe are seen in the plans.

With humanism, mankind is dignified. In Renaissance period, the use of human figure in the search of idealty in architectural ratios as a criterion can be seen in all four architects' works. All of them have designed utopian architectural structures with the morphological interpretation of human body. Human head has been used as a measurement unit for architectural column types, and there has been an effort to create a universal ratio. Filarete

and Martini have studied on this subject. Along with his architectural designs, Da Vinci also has designs that were made for flying, through observation of birds.

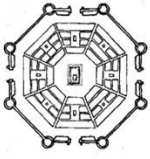
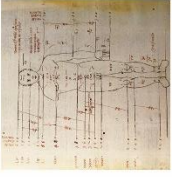





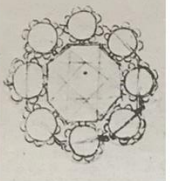
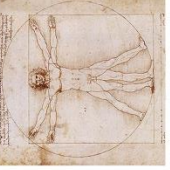
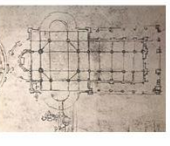




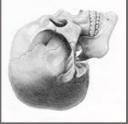

Selected for this thesis, the utopias *Utopia* by Thomas More, *New Atlantis* by Francis Bacon, and *The City of the Sun* by Tommasso Campanella are examined within the context of biomimicry in Table 4.2 The representation of universe that were seen in the ideal city plans of architectural utopias are also seen in the city plan of the utopia *The City of the Sun*. The knowledge obtained through the observation of nature are depicted on these walls. Society is closely related with natural science.

The cover image of Thomas More's *Utopia* is the map of the island. The map is in the shape of a skull. Although this was not a selection that was made by observing nature, it is demed as a reference to memento mori. Skull is the symbol of memento mori and a representation of life cycle. Therefore it can be argued that the resemblance of the *Utopia* island to a skull is a biomimetic approach.

*New Atlantis* is the novel with the most biomimicry finding among examined utopias. The model that Da Vinci designed for flying by observing birds is also seen in *New Atlantis*. Similarly, vehicles that can move under water has been designed by observing fishes. Storehouses where temperature is controlled were designed by mimicking caves. At the same caves, counterparts of the natural material in mines were produced. Wastes were buried and natural cycle was maintained. Fruit formation on plants was observed and mimicked. They could grow their own fruits in any season and any size by changing the growth speed of the fruits. That have made the same examination on animals. They changed the size of the animals, and could grow large animals as small, and small animals as large.

If we examine both table in one chart, we can see that there are biomimetic inspirations both in architectural utopias and utopian novels.

Table 4.1. Biomimetic inspirations of the utopian architects in the Renaissance period, (Appendix A)

	IDEAL CITY PLAN	IDEAL MEASUREMENT	IDEAL ARCHITECTURAL PROPORTION	IDEAL UNIT FOR MEASURE	IDEAL DESIGN FOR FLYING
LEON BATTISTA ALBERTI 1406-1472			NO VISUAL DATA *		
FILARETE 1400-1465		NO VISUAL DATA **	NO VISUAL DATA ***	NO VISUAL DATA ****	
FRANCESCO DI GIORGIO MARTINI 1439- 1502					
LEONARDO DA VINCI 1452-1519					
RENAISSANCE PERIOD UTOPIAN ARCHITECTS	UNIVERSE 	HUMAN BODY 	HUMAN PROPORTION 	HUMAN HEAD (SKULL) 	BIRD 
BIOMIMICRY INSPIRATION					

\* Leon Battista Alberti is the first modern architect that investigates the relationship between proportions of the human body and architectural designs.  
Ormiston R., Leonardo Da Vinci, 500 Görsel Eşliğinde, Yasam ve Eserleri, çev. Albayrak M.B., Türkiye İşBankası Kültür Yayınları, 2. Basım 2017, p.45










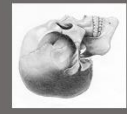





\*\* Filarete mentioned about inspiring from the human body for ideal architectural proportion in his book called Treatise on Architecture  
Mallgrave H. F., Architectural Theory, Volume 1, An Anthology from Vitruvius to 1870, s. 39

\*\*\* In his book, Treatise on Architecture, Filarete studied human proportion and architectural relationship.  
Mallgrave H. F., Architectural Theory, Volume 1, An Anthology from Vitruvius to 1870, s. 39

\*\*\*\* In his designs, Colonn types are proportional to the human body. Human head is used as a measure unit. The Doric style, is nine heads. The small type Ionic style is seven heads. The medium one Corinthian style is eight heads. Adam's ideal ratio of a human head.  
Mallgrave H. F., Architectural Theory, Volume 1, An Anthology from Vitruvius to 1870, s. 39

RENAISSANCE PERIOD UTOPIAN ARCHITECTS  
BIOMIMETIC INSPIRATIONS

Table 4.2. Biomimetic inspirations of the utopian novels for designing the ideal city in the Renaissance period (Appendix B)

	IDEAL CITY PLAN	MOVEMENT SKILL RESEARCHES	MORPHOLOGY OF THE UTOPIAN ISLAND	IDEAL DESIGN FOR FLYING	DESIGN FOR THE MOVEMENT UNDER THE SEA	STORAGE DESIGN	ARRANGING THE TIMING OF FRUIT PRODUCING	ARRANGING THE SIZE OF FRUIT & ANIMAL PRODUCING
THOMAS MORE UTOPIA 1516								
TOMMASO CAMPANELLA THE CITY OF THE SUN 1602								
SIR FRANCIS BACON NEW ATLANTIS 1624		NO VISUAL DATA *						
RENAISSANCE PERIOD UTOPIAN NOVELS	UNIVERSE 	HUMAN BODY 	HUMAN HEAD (SKULL) 	BIRD 	FISH 	CAVE 	FRUIT GROWTH 	FRUIT & ANIMAL GROWTH 
BIOMIMETIC INSPIRATIONS								

\* In Salomon's House , by mimicing the human body they produce a mechanical model of a human in order to research the movement skills. (Bacon F., Yeni Atlantis, çev.Dürüşken Ç, Alfa Yayınları, 2. Basım 2018, s.100).

RENAISSANCE PERIOD UTOPIAN NOVELS

BIOMIMETIC INSPIRATIONS

Table 4.3. Biomimetic inspiration matrix of the Renaissance period utopias, generated by thesis author

	LEON BATTISTA ALBERTI	FILARETE	FRANCESCO DI GIORGIO MARTINI	LEONARDO DA VINCI	UTOPIA THOMAS MORE	THE NEW ATLANTIS FRANCIS BACON	THE CITY OF THE SUN TOMMASO CAMPANELLA	RENAISSANCE PERIOD UTOPIAS	BIOMIMETIC INSPIRATIONS	UNIVERSE	HUMAN BODY	HUMAN PROPORTION	SKULL	BIRD	FISH	CAVE	FRUIT GROWTH (TIMING)	FRUIT & PLANT GROWTH (SIZE)	
LEON BATTISTA ALBERTI																			
FILARETE																			
FRANCESCO DI GIORGIO MARTINI																			
LEONARDO DA VINCI																			
UTOPIA THOMAS MORE																			
THE NEW ATLANTIS FRANCIS BACON																			
THE CITY OF THE SUN TOMMASO CAMPANELLA																			
RENAISSANCE PERIOD UTOPIAS																			
BIOMIMETIC INSPIRATIONS																			

RENAISSANCE PERIOD UTOPIAN ARCHITECTS  
 RENAISSANCE PERIOD UTOPIAN NOVELS  
 BIOMIMETIC INSPIRATIONS



In Table 4.3, we can see that there are common findings on architectural utopias and utopian novels. The representation and imitation of the universe, the skull’s feature as a criterion and its symbolic meaning, and mimicking of flight through the observation of birds are all seen both in architectural utopias and utopian novels.

The Renaissance utopias that are examined in the thesis are assessed with the table system that is discussed in Chapter 4.1 in which Pederson Zari divided biomimicry into three categories. As a result of this study, a distribution about the findings of biomimicry at levels of organism, behavior, and ecosystem. This distribution is shown on Table 4.4 as the content of the findings, and on Table 4.5 as numeric data.

Table 4.4. Level of biomimicry inspirations in the Renaissance utopias, generated by thesis author, based on Pederson Zari’s System

		LEON BATTISTA ALBERTI	FILARETE	FRANCESCO DI GIORGIO MARTINI	LEONARDO DA VINCI	UTOPIA THOMAS MORE	THE CITY OF THE SUN TOMMASO CAMPANELLA	THE NEW ATLANTIS FRANCIS BACON
Organism Level (mimicry of a specific organism)	form	Human Body	Human Body	Human Body, Human Head (Skull)	Human Body, Bird	Human Head (Skull)		Human Body, Bird, Fish, Cave
	material							Cave
	construction	Human Body	Human Body	Human Body	Human Body			
	process							Animal Growth
	function							Human Body & Animal Growth
Behaviour Level (mimicry of how organism behaves or relates to its larger context)	form							Fruit Growth
	material							Fruit Growth
	construction							
	process				Bird			Bird, Fish
	function							
Ecosystem Level (mimicry of an ecosystem)	form	Universe	Universe	Universe	Universe		Universe	
	material							
	construction							
	process							
	function							

■ RENAISSANCE PERIOD UTOPIAN ARCHITECTS

■ RENAISSANCE PERIOD UTOPIAN NOVELS

When Table 4.4 is examined, it can be seen that human body, skull, birds, fishes, and caves are mimicked in the form sub-heading where the designs that aim to morphologically resemble any organism, on the first stage which is called the organism level of biomimicry in Renaissance utopias. In Renaissance period architectural designs, the form of the human head has been accepted as the ideal form, and ideal structure and ideal city designs that visually mimic human body were made and used in structures. In New Atlantis utopia, the model of the human body was designed. In this example where the organism is mimicked formally, examining the bodily movements of humans has also been one of the purposes. In this sense, as the last stage on the level of organism, the imitation of function is seen in the model of human body in New Atlantis utopia. In New Atlantis utopia, this method that is explained for human body is also used for other animals. However, this is not touched upon lengthily in the novel.

The morphological imitation of human skull can be seen in examples which architects designed column heads with inspiration from human skull and its ratios. Human head is also used as a measurement unit. In Thomas More's Utopia, skull is imitated by being used as a form for the shape of the island. This is deemed as a symbolic reference to memento mori.

Da Vinci has designed wings for flying through observation of the birds. He has observed the gliding of the birds, and made prototype drawings that imitates their wings. The situation that Vogel calls "naïve biomimicry" can be mentioned here. The flying attempt with Da Vinci's design has failed, because the weight of the human body is not the same with that of the birds. A heavy object needs to move fast in order to stay up in the air. It can be argued that the thing that made Da Vinci's design utopic in his period has to do with this adaptation. The design method of Da Vinci for flying has been both a physical emulation to the organism and a biomimetic example where the observed animal's behavior process was mimicked.

Similarly, birds were observed and mimicked for the designs that were made for transportation in New Atlantis utopia, and fishes were observed and mimicked for movement under water in order to build new transportation vehicles. In these designs, wings that resemble that of the birds, and vehicles that resemble fishes and that can go under water were designed. These are examples with biomimicry at the level of organism. In addition to morphological mimicry, in order to practice flying and swimming, the physical processes of birds and fishes in motion were observed, and this has been instructive in new designs.

Behaviour level process mimicing is seen in both in Da Vinci's utopian design and in New Atlantis utopia. The morphological imitation of the organism and the imitation of the process of observed living thing's behavior was used as a biomimetic design method.

Creating the same components which the mimicked organism consists of is the material imitation method at the level of organism. This method is seen on the cave example in New Atlantis utopia. Caves and the mines in it are imitated and replicated clear to their material.

The fruit production in New Atlantis utopia can be given as another biomimetic design example. By observing the behaviour of the fruits, they could imitate their forms and change their taste, or produce fruits that are at the same form but with different sizes. With this production type, a design method that is implemented as an imitation of form at behaviour level is used. At the gardens of New Atlantis utopia, production of fruits are mimicked, and new and unknown fruits are produced instead of common ones. They could turn a kind of plant into another one. They could artificially produce the fruits in any form they liked. In this situation, the material imitation of biomimetic design method at behavior level is seen.

In New Atlantis utopia where there are confined spaces and parks for animals, data was obtained on what could be done for the benefit of human body by testing on animals. They could make eviscerated animals live, and resurrect some of the animals that they thought were dead. With artificial methods, they could make animals larger and longer than they are supposed to be. Similarly, they could stop their growth and make them stay small. They could breed crossbreed fertile animals by pairing animals from different species. The research methods on the animals that are mentioned in this utopia can be interpreted as a biomimetic research and production method that mimics function and process at organism level. By mimicking natural functions of animals, life function was given to dead animals, live animals were bred differently from their actual sizes, and different species were produced by pairing different animals.

Lastly, in the utopias of all chosen architects and in the city plan of The City of the Sun utopia, it can be seen that there is an effort to create the microcosmic representation of macrocosmos by implementing the symbolic and formal meaning of the universe to city plans. With the centric city plan that was used, a biomimetic design approach was adopted by mimicking a form at ecosystem level.

Table 4.5. Level of biomimicry in Renaissance utopias, quantity results, generated by thesis author, based on Pederson Zari's system

LEVEL OF BIOMIMICRY IN THE RENAISSANCE UTOPIAS		LEON BATTISTA ALBERTI	FILARETE	FRANCESCO DI GIORGIO MARTINI	LEONARDO DA VINCI	UTOPIA THOMAS MORE	THE CITY OF THE SUN TOMMASO CAMPANELLA	THE NEW ATLANTIS FRANCIS BACON	TOTAL
Organism Level (mimicry of a specific organism)	form	1	1	2	2	1		4	11
	material							1	1
	construction	1	1	1	1				4
	process							1	1
	function							2	2
Behaviour Level (mimicry of how organism behaves or relates to its larger context)	form							1	1
	material							1	1
	construction								0
	process				1			2	3
	function								0
Ecosystem Level (mimicry of an ecosystem)	form	1	1	1	1		1		5
	material								0
	construction								0
	process								0
	function								0
TOTAL		3	3	4	5	1	1	12	29

0  15 30

As can be seen on Table 4.5, the biomimicry findings in Renaissance utopias are mostly seen on organism level, then on behavior level, and the fewest on ecosystem level. Form mimicry on organism level is the most implemented design method, with eleven findings. It is seen in every utopia except The City of the Sun. On organism level, there are traces of biomimicry as form, material, construction, process and function.

On behaviour level, process mimicry is the most seen biomimicry method, with three findings. There are form, material, and process mimics. However, there are no traces of construction and function methods.

On ecosystem level, five different form mimics are seen in the utopias of Alberti, Filarete, Martini, Da Vinci, and Campanella. In Utopia and New Atlantis utopias, no trace of biomimetic design could be found on ecosystem level. There are no findings of material, construction, process and function methods on ecosystem level.

As a result, in the utopias of Renaissance period, different biomimetic design methods were used and nature was inspired through different methods. When all biomimicry methods that

were used are gathered under a single title, twenty nine biomimetic design findings were obtained in the examined Renaissance utopias.





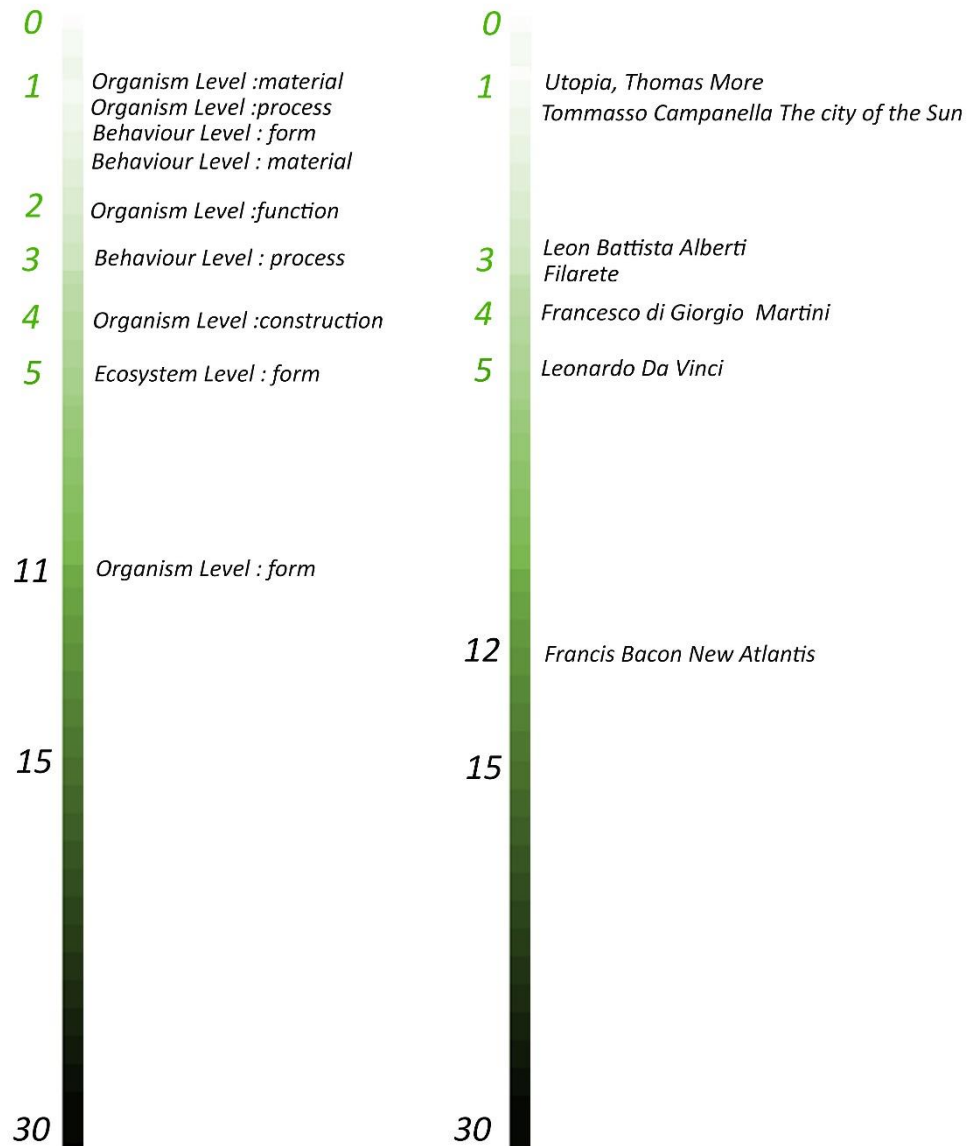
## 5. CONCLUSION

Within the context of the thesis, findings on questions about the reflection of the researches that were made during Renaissance on natural sciences and whether biomimicry which suggests being inspired from nature was used as a design method were asked, and answers were sought to the research questions that were asked in line with the aim of the study.

According to the findings of the thesis, biomimicry were used as a design method in Renaissance period utopias. There were efforts for reaching the ideal by learning from nature, and utopias were designed in this direction. The Platonist logos notion of Renaissance has lead the way for scientific tests and observations. Rationalist approach has increased the self-esteem of mankind and humanism movement has born in its aftermath. With humanism, humans were dignified and human body was accepted as a microcosmic representation of macrocosmos. Through this perception, the measurement of human body that represents the universe was used as the ideal ratio in architectural utopias. It is also seen that the circular form that symbolizes the universe was used as ideal geometrical shape in architectural designs. In addition to these approaches, there are design examples where data that are obtained through the observation of nature was mimicked in utopias.

Being a concept of today, biomimicry is a design method directly in relation with natural sciences. As a period when the foundations of modern science has been laid, Renaissance has shaped the science notion of today. Reaching the knowledge of nature with the development of scientific empiricism has been described by the Renaissance intellectuals as the way of the development of humanity. During Renaissance, with the decrease on the oppression created by the Scholastic order in the middle ages, intellectuals have believed that they have much to learn from nature and argued that the ideal design could be found in nature. They wanted to reach every knowledge and detail in nature and develop the society. As is in every period throughout history, utopias have also been created in Renaissance. In Renaissance period utopias, taking advantage of the wisdom of nature was used as a design method. In other words, biomimicry has been a design method that was resorted in many areas such as ideal city plans, ideal state order, ideal life style, and ideal production type. According to the findings that are obtained from the examined utopias, the scaled version of biomimetic design traces that were reduced to numeric values can be seen in Table 5.1

Table 5.1. Biomimicry findings in Renaissance utopias, on number chart.



As it can be seen on the chart, biomimicry has been used in Renaissance utopias as a design method in different styles and different intensities.

Nature contains in itself the answers for all design problems. Today, humankind damages the ecosystem by destroying nature instead of looking for answers in it. As a part of the ecosystem, humankind too will get harmed by this process in the long run. Capitalist world order affects the nature adversely as it has a production-oriented and linear system. A biomimetic world can be the utopia of today's world with the sustainable solution it brings to the problems that capitalist order poses.

Vehicles and transportation that became established in the city center with modernism have introduced the concept of speed to urban life, and settlement has occurred accordingly. The settlement has become denser in city centers, and the multi-storied, dense populated cities that were seen in 20<sup>th</sup> century utopias have started to develop. In other words, modern cities have evolved into vehicle-centered places that are designed as the utopia of modernism, where the element of speed has settled into daily life, and where designs are made through standardization. The city structure that was seen in 20<sup>th</sup> century utopias have turned into an unhealthy dystopia.

Urban life is constantly changing due to the existing technological developments. A virtual world where social media is at the center of life, and that is dependent on devices such as telephones, computers, and tablets have started to be used as a place of socialization. Many dystopias are being created in this manner. The perception of the relation between the environment and humans have changed, and have inclined to a state that is disconnected from nature and dependent to virtual world. Technological developments have changed human life radically, and utopias that were just fantasies centuries ago have become reality today. Dystopias that show behaviours that will cause disappointing consequences in the long term such as the natural environment that is forgotten due to these developments, reduced green areas, human-centered designs that tyrannize nature, and production systems without waste management are being created. As a result of these current developments, it is seen that dystopias rather than utopias are designed.

Every utopia has the purpose of creating a new vision and offering a solution to problems for the subsequent period to its period of writing. In the science-based urban order that was desired to be created in Renaissance, if designs that understand and keep pace with nature are made instead of an approach that mimics nature but gives harm to it in the long run, it is likely that solutions will be found to contemporary problems. Although the optimization-oriented biomimetic world that utilizes the advanced technology of today is a utopia for the world for now, its designs about future may have a positive effect on ecological environment with the perception it creates.

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# APPENDIX A: ARCHITECTURAL BIOMIMIMETIC INSPIRATIONS

Table A.1. Biomimetic inspirations of the utopian architects in the Renaissance period

	IDEAL CITY PLAN	IDEAL MEASUREMENT	IDEAL ARCHITECTURAL PROPORTION	IDEAL UNIT FOR MEASURE	IDEAL DESIGN FOR FLYING
LEON BATTISTA ALBERTI 1406-1472			NO VISUAL DATA *		
FILARETE 1400-1469		NO VISUAL DATA **	NO VISUAL DATA ***	NO VISUAL DATA ****	
FRANCESCO DI GIORGIO MARTINI 1439-1502					
LEONARDO DA VINCI 1452-1519					
RENAISSANCE PERIOD UTOPIAN ARCHITECTS	UNIVERSE 	HUMAN BODY 	HUMAN PROPORTION 	HUMAN HEAD (SKULL) 	BIRD 

\* Leon Battista Alberti is the first modern architect that investigates the relationship between proportions of the human body and architectural designs.  
Ornstein R., Leonardo Da Vinci, 500 Güncel Eşliğinde İyşam ve Eserleri, çev. Alpayrak M.B., Türkiye İşbankası Kültür Yayınları, 2017, p.45

\*\* Filarete mentioned about inspiring from the human body for ideal architectural proportion in his book called Treatise on Architecture  
Mallgrave H. F., Architectural Theory, Volume 1, An Anthology from Vitruvius to 1870, s. 39










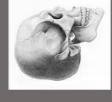





\*\*\* In his book, Treatise on Architecture, Filarete studied human proportion and architectural relationship.  
Mallgrave H. F., Architectural Theory, Volume 1, An Anthology from Vitruvius to 1870, s. 39

\*\*\*\* In his designs, Colon types are proportional to the human body. Human head is used as a measure unit. The Doric style, is nine heads. The small type Ionic style is seven heads. The medium one Corinthian style is eight heads. Adam's head is considered as the ideal ratio of a human head.  
Mallgrave H. F., Architectural Theory, Volume 1, An Anthology from Vitruvius to 1870, s. 39

RENAISSANCE PERIOD UTOPIAN ARCHITECTS  
BIOMIMIMETIC INSPIRATIONS

## APPENDIX B: BIOMIMIMETIC INSPIRATIONS OF THE UTOPIAN NOVELS

Table B.1. Biomimetic inspirations of the utopian novels for designing the ideal city in the Renaissance period

	IDEAL CITY PLAN	MOVEMENT SKILL RESEARCHES	MORPHOLOGY OF THE UTOPIAN ISLAND	IDEAL DESIGN FOR FLYING	DESIGN FOR THE MOVEMENT UNDER THE SEA	STORAGE DESIGN	ARRANGING THE TIMING OF FRUIT PRODUCING	ARRANGING THE SIZE OF FRUIT & ANIMAL PRODUCING
THOMAS MORE UTOPIA 1516								
TOMMASO CAMPANELLA THE CITY OF THE SUN 1602								
SIR FRANCIS BACON NEW ATLANTIS 1624		NO VISUAL DATA *						
RENAISSANCE PERIOD UTOPIAN NOVELS	UNIVERSE 	HUMAN BODY 	HUMAN HEAD (SKULL) 	BIRD 	FISH 	CAVE 	FRUIT GROWTH 	FRUIT & ANIMAL GROWTH 
BIOMIMIMETIC INSPIRATIONS								

\* In Salomon's House , by mimicing the human body they produce a mechanical model of a human in order to research the movement skills. (Bacon F., Yeni Atlantis, çev.dürüşken Ç, Alfa Yayınları, 2. Basım, 2018, s.100).

RENAISSANCE PERIOD UTOPIAN NOVELS

BIOMIMIMETIC INSPIRATIONS