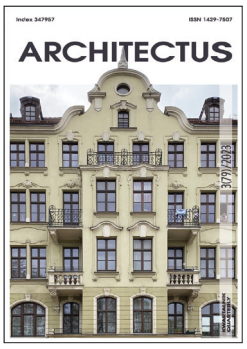

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Biomimetics and biomimicry. Their role as a tool and ideology in contemporary architecture

Abstract

The aim of the study is to present how biomimetics and biomimicry manifest themselves in the architectural practice on two basic levels: as a tool and ideology. Biomimetics can be perceived as an architectural tool. It takes inspiration from the details of form, structure, and behaviour of living organisms, producing architectural elements of specific functionalities. Biomimicry is a contemporary architecture's ideology. It means the imitation of biological rules and processes at the ecosystem level. Here, nature provides inspiration at the macro level, the idea of biomimicry is of a synthetic character, based on a holistic view and general laws and principles. The final products are buildings, perceived in a holistic way, and urban complexes. The idea of biomimicry can be implemented either using advanced *high-tech* solutions (biomimetic tools), or with a *low-tech* approach, taking inspiration from vernacular architecture or animals' habitats.

Key words: biomimicry, biomimetics, biomimetic tools, ideological biomimicry

Introduction

Biomimetics and biomimicry are two terms that have become quite popular in architectural discourse in recent years, and in their essence both mean the imitation (Greek: *mimesis*) of living organisms. However, these are not concepts created in relation to architecture, but applied to it. The term "biomimetics" was first used in 1957 by bio-engineer and physicist Otto Schmitt in reference to his synthetic nerve modelled on the nervous system of an octopus (Chayamoor-Heil 2023, 205). The concept of "biomimicry" was introduced later by Janine Benyus in her dissertation *Biomimicry. Innovation inspired by Nature*, first published in 1997, and was defined by her as drawing inspiration from nature to solve human problems (2002). According to Benyus, nature, with its 3.8 million years of evolutionary experience in optimizing processes and structures, should be treated as a mentor, model and measure in all areas of human activity. The theoretical discussion on the application of both concepts of biomimetics and biomimicry in architecture dates back to the beginning of the second decade of this century. Michael Pawlyn in his work entitled *Biomimicry in architecture* (2011) defined the essence of biomimicry as the imitation of not form but function. The architect's goal is therefore to define the design task in functional categories and analyze how a given function is implemented in nature. Pawlyn formulated guidelines for architectural biomimetic design in accordance with the principles of nature. These are primarily the efficiency of resource and material use, creation of regenerative closed systems based on solar energy, treatment of waste as elements in *cradle to cradle* loops and adaptation of the design to the specificity of the location. Currently, the prevailing tendency in the literature on the subject is to associate the concept of biomimetics with the scientific translation of natural forms, functions and processes for the purpose of technological innovation, while biomimicry results from ecological awareness and means modelling itself on nature at the level of ecosystems.

The concepts of biomimetics and biomimicry, before they appeared in architecture, were originally used in other fields of science and technology. Since architectural design is not a scientific process in its essence, attention should be paid to the specific conditions for the application of these ideas in architecture (Vitalis, Chayaamor-Heil 2022).

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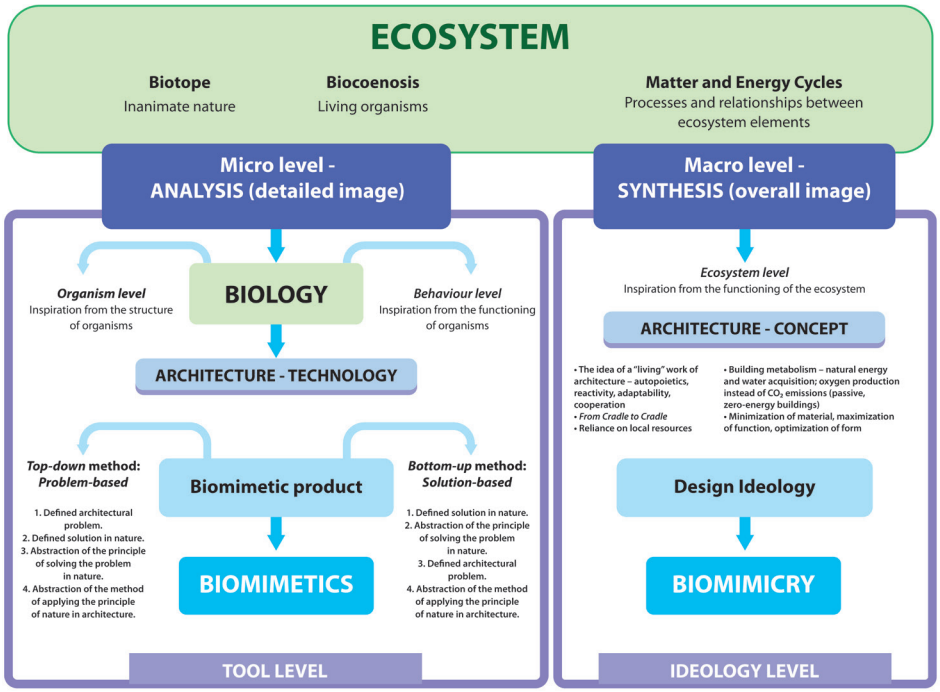

Fig. 1. Diagram of the flow of inspiration and interactions between the ecosystem, biology as an intermediary science and architecture in the concept of biomimetics and biomimicry (elaborated by J.J. Białkiewicz)

Il. 1. Schemat przepływu inspiracji i oddziaływań pomiędzy ekosystemem, biologią jako nauką pośredniczącą i architekturą w koncepcji biomimetyki i biomimikry (oprac. J.J. Białkiewicz)

This raises the question of whether biomimetics is only a specific way of solving architectural problems and issues (primarily structural and material), or whether it can be considered an independent architectural manifestation. The authors tend to agree that biomimetics can hardly be called a "style" or "trend" in contemporary architecture, which is confirmed by the lack of a consistent and coherent definition of the features of a biomimetic object. The thesis of the following review paper is that the concept of biomimetics and biomimicry makes its presence felt in contemporary architecture on two basic levels: instrumental (as a tool) and ideological, which to some extent coincides with the distinction between these two concepts. In the further part of the work, based on the available literature on the subject, both levels will be characterized and defined (Fig. 1) and examples of the corresponding architectural designs and implementations will be presented.

State of research

The issue of "biomimetic architecture" is a relatively new topic in the literature and – as mentioned – raises some controversy. It also seems that architectural practice in this case does not correspond to theoretical discourse, and some definitions include the statement that the described phenomena occur only in theory. Even before Pawlyn's work was published in 2011, Maibritt Pedersen Zari in several publications, including the article *Biomimetic approaches to architectural design for increased sustainability* (2007), indicated three levels of biomimicry, i.e., imitation of nature at the organism level, behaviour level and ecosystem level. The author pointed out that the tendency to imitate at the organism level is dominant, which results in the dominance of individual biomimetic products or materials, rather than holistic buildings. Zari stated that although biomimetics at the level of organisms can serve innovation, only through the imitation of ecosystems can the actual transformation of architecture take place, so that it is able to create a sustainable and regenerative human environment. In subsequent years, following Pawlyn's guidelines for designing in accordance with the principles of nature, some authors focused on an attempt to define the features of a "biomimetic" architectural object. Petra Gruber (2011) defined biomimetics in architecture as a discipline providing innovative solutions through the use of models from nature. At the same time, the author expressed doubts about the term "biomimetic architecture" as the name of a new "style or genre", indicating that the term "biomimetic design" is more appropriate, defining the architect's method of action based on the "principles of nature's design" mentioned by her. Achim Menges (2012) noted an important distinction, in his opinion, between biologically inspired building products and actual "biomimetic architecture", which is the effect of imitating nature in the creative process itself. Renee L. Ripley and Bharat Bhushan (2016) pointed out that in the field of creative expression, which is architecture, there should be no *mimesis*, i.e., imitation – copying nature, but only drawing inspiration from it. The authors therefore postulate "bioarchitecture" instead of biomimetics, based on inspiration that can be drawn directly from nature, also without the mediation of technology. Also in Poland, an interesting article by Adrian Krężlik *Biomimetyka w kilku przykładach* [Biomimetics in a few examples] (2016) was published. It refers to Joe Kaplinsky's text *Biomimicry versus humanism* (published in the journal "Architectural Design" in 2006), whose author stated that biomimicry, by uncritically recognizing the superiority of solutions based on biological processes over those proposed by humans, in a sense rejects the achievements of civilization and ignores centuries-old cultural codes. Krężlik also perceives biomimetics ideologically as an "alternative design paradigm" through which the contemporary generation defines its

identity. In his doctoral thesis entitled *Elementy biomimetyki w projektowaniu architektury w środowisku zrównoważonym. Ewolucja i interpretacja bioniki na przykładzie polskich i zagranicznych konkursów architektonicznych* [Elements of biomimetics in designing architecture in a sustainable environment. Evolution and interpretation of bionics by the example of domestic and foreign architectural competitions] (2019), Jakub Onyszkiewicz defined 10 features of a biomimetic architectural object, broadly consistent with Pawlyn's ecological ideas. Based on these features, Onyszkiewicz formulated criteria (including formal, functional and structural), according to which he assessed approximately 200 projects submitted to international architectural competitions. The result of this analysis is the statement that only two projects out of 200 meet all the criteria, in the remaining ones biomimetic elements are treated selectively by architects. After 2020, there have been quite a few publications devoted to the issue of applying biomimetics in architecture, including collective works *Biomimicry in architecture* (Verbrugghe et al. 2023), *Applications of biomimicry in architecture, construction and civil engineering* (AlAli et al. 2023), or *Bio-logic, a review on the biomimetic application in architectural and structural design* by Saurav Dixit and Anna Stefańska (2023). They repeat essentially the same statements that biomimetics is not about reproducing form, but about imitating the rules and principles of nature's functioning, and biomimicry is closely linked to the ideology of sustainability. The difference is that biomimetics as a method of solving a specific problem does not have to have long-term goals that guide the idea of biomimicry in the ecological aspect. Osama Nasir and Mohammad Arif Kamal also noted in their article *Inspiration from Nature: Biomimicry as a paradigm for architectural and environmental design* (2022) that the term "biomimetic" refers to materials, systems and tools that imitate patterns from the natural world, while biomimicry is the imitation of biological processes and laws aimed primarily at the idea of sustainability.

Tool/analytical level – biomimetics

At the tool level, which can also be called utilitarian, we are dealing with the use of various biomimetic technologies in architecture, drawing design and inspiration from the details of the structure and behaviour of living organisms. The aim of innovation is the structural and functional optimization of individual architectural elements. This is biomimetics at the micro and medium level, from inspiration from the structure of organisms and natural forms at the cellular level to the reactions and behaviours of plants and animals that function in a specific way. Biomimetic products and technologies are also used in architecture at various levels of detail, these are primarily materials, structures, individual elements or systems with strictly defined functionalities that respond to specific architectural issues or problems. There are two possible approaches in the design process, which the authors of publications on biomimetics describe as *top-down* and *bottom-up*. The *top-down* methodology (problem-based) assumes starting from an architectural issue, for which a solution is sought in nature through analogy. The components of this procedure are as follows:

– a defined architectural problem,
– a defined solution in nature,
– abstraction of the principle of solving the problem in nature,
– abstraction of the method of applying the principle of nature in architecture.

The *bottom-up* approach (solution-based) starts from a specific described phenomenon in the field of biology, for which an application in architecture is found. In principle, the elements of the procedure are the same as in the case of the *top-down* methodology, but their order is different:

– a defined solution in nature,
– abstraction of the principle of solving the problem in nature,
– a defined architectural problem,
– abstraction of the method of applying the principle of nature in architecture.

In both of these methodologies, we are dealing with an analytical approach – i.e. examining specific issues – the aim of which is not to formulate general principles, but to find a solution to a specific problem. The key and at the same time most critical element of the process is each time abstracting the principle defining the essence of a given natural phenomenon and its translation into materials and manufacturing processes achievable for humans. Both to understand the essence of natural phenomena and to recreate it in laboratory conditions, technologically advanced tools must be involved. Therefore, tool biomimetics can be called *high-tech*. Not only in architecture, but in no other field of human activity, biomimetics in this aspect would not be possible without modern digital tools, the increase in computing power of computers, the development of material technologies and additive manufacturing methods. When we look at examples of architectural biomorphism, we see superficial inspiration, but also direct inspiration – the architect empirically experiences nature visually and imitates observed shapes, colours or textures. He recreates nature in a way that is accessible to every human from the level of sensory perception. Hence, every recipient is also able to read this inspiration. In the case of tool biomimetics, common empirical experience is replaced by scientific knowledge, accessible to people with the appropriate knowledge and tools. Nature infiltrates architecture not directly, but through two necessary intermediary factors. These are biology as a science describing natural phenomena and forms, and technology enabling their translation into objects and materials useful in architecture. Reproducing the principles and rules of nature in technology does not have to entail morphological similarity, moreover, the source of inspiration is often the structure of organisms or processes occurring at the cellular level, hence biomimetic elements in this aspect may be illegible to the general recipients of an architectural work. We are therefore dealing here with functional-construction inspiration, indirect and potentially hermetic in reception.

The interdisciplinarity and strong technological dependence of projects using tool biomimetics means that they require large financial outlays, hence at the moment they

Fig. 2. The atrium render of PhotoSynthetica Tower Linz 2020, designed by ecoLogicStudio
(courtesy of ecoLogicStudio)

Il. 2. „Photo.Synthetica Tower Linz", wnętrze lobby, koncepcja 2020, proj. ecoLogic Studio
(źródło: dzięki uprzejmości ecoLogicStudio)

are mainly concentrated in academic centres with an appropriate budget[1]. The intermediate stage between scientific research and solutions available in construction practice is constituted by experimental demonstration pavilions, which have been built since 2011, such as the "One Ocean Building" pavilion at EXPO 2012 in South Korea designed by SOMA (Oliveira 2019), the Silk Pavilion designed by the Mediated Matter team led by Neri Oxman (2013), the Rosenstein Timber Pavilion in Stuttgart (Kovaleva et al. 2019) or the ICD/ITKE Research pavilion series (Schwinn et al. 2019). The listed structures present biomimetic structural solutions, e.g. in the case of the Rosenstein Timber Pavilion, it is an extremely light supporting structure inspired by crustacean shells. The Silk Pavilion, in turn, is a 3 m wide dome made of thread woven by 6,500 living silkworms on a frame of polygonal panels. Interdisciplinary research centres conduct research on many diverse innovative structures, materials and biomimetic fabrication methods. Examples include kinetic façade systems inspired by plant dynamics, which adjust the degree of shading to atmospheric conditions, such as Flectofin and Flectofold[2] (Saffarian et al. 2019). Among the numerous innovative biomimetic elements, there are also lightweight structures with high load-bearing capacity (gradient, porous), e.g., bricks modelled on the structure of bones (Logan "Continuing education…"); polymer composites reinforced with natural fibers (NFRP) (Stefańska, Cygan 2022), the 3D layered printing technique inspired by the growth of snail shells (Allgaier et al. 2019); or load-bearing structures modeled on plant support systems[3] (Bunk et al. 2019). Among the solutions already commonly available in construction practice, a good example of tool biomimetics is façade paint inspired by the dirt-binding properties of *Nelumbo nucifera* leaves in rainwater drops.

An additional distinction should be made here between synthetic materials and products, but in their essence modelled on the structure and functions of living organisms, and products using natural materials or elements of nature. In the latter case, the imitation of patterns from nature is replaced by the incorporation of nature into a human work, i.e., instead of producing a product that repeats a given functionality, the organism or element of nature that has it is used directly. Examples include the aforementioned Silk Pavilion or installations created by ecoLogicStudio, such as prototypes of "living" façades, i.e., frames generated using 3D printing technology and then inhabited by colonies of photosynthetic algae (Fig. 2) or tarantulas filling modules with their webs ("Biomimetyzm w architekturze 2.0." 2019).

Ideological/synthetic level – biomimicry

The presence of the idea of imitating nature in architecture at the ideological level differs in general from what we have called tool biomimetics, although both of these concepts can successfully coexist and complement each other. It is the imitation of biological laws and processes, inspiration from nature on a macro scale, i.e., the pursuit of mapping the rules and functioning of ecosystems in a building. While tool biomimetics drew patterns from the structure and individual functionalities of plants and animals, at the ideological level the goal is to create a work of architecture that will "live", i.e., exist in interaction with the environment on the same principles as organisms in the ecosystem. Such an approach, ideologically consistent with the principles of sustainability, is connected with the concept of biomimicry. The idea of biomimicry in architecture is primarily ethical and ideological in nature. Starting with Pawlyn, subsequent authors indicate the features of the building, as well as the principles of the design process itself, consistent with the idea of biomimicry, i.e., consistent with the way nature functions. The basic principle is to move away from linear systems that generate waste at the end of the life cycle (*from cradle to grave*) in favour of closed loops, in which each waste is also a raw material (*from cradle to cradle*). This applies to both the acquisition and production of building materials and the way the finished architectural

[1] Examples include the Institute for Computational Design and Construction (ICD) and the Institute of Building Structures and Structural Design (ITKE) at the University of Stuttgart, and the Media Lab at the Massachusetts Institute of Technology.

[2] The inspiration for the Flectofin system was the Royal Strelitzia (*Strelitzia reginae*), while Flectofold was inspired by the Vesicular Aldrovanda (*Aldrovanda vesiculosa*).

[3] An example is the columns made of woven carbon and glass fibres presented at the exhibition "Baubionik – Biologie beflügelt Architektur" (2017/18, Stuttgart State Museum of Natural History).

object is used. Other guidelines for architects include the principle of minimizing material, maximizing function and optimizing form; using local resources; and relying on renewable energy sources. According to the idea of biomimicry, a work of architecture should be autopoietic, it should respond to changing external conditions and adapt to them by modifying its form. Like living organisms, architecture should have its own metabolism, acquire water and energy naturally, and produce oxygen instead of emitting CO_2. Each building is also part of a larger whole – a housing estate, city, settlement, natural landscape, therefore it cannot be an "intruder" draining resources, but must function like living beings in an ecosystem, cooperating in order to fully utilize the possibilities, but also to maintain the good condition of the habitat. There is therefore a significant change in the approach to the architectural design process itself, which is no longer about giving the building a material shape, but managing material and energy, and thus creating relationships between the "living" building and the environment (Januszkiewicz, Gołębiewski 2020).

The concept of biomimicry in architecture is synthetic in nature, based on the overall picture, in the broadest possible perspective and inspired by general principles. It is not individual details that are important, but the overall effect, i.e., the way buildings or complexes of buildings function and their interaction with the environment. Of the three levels of imitation indicated by Zari, tool biomimetics includes the level of organism construction and their behaviour, while biomimicry – the most general level of the ecosystem. Hence, the idea of biomimicry should also be implemented on an architectural macro scale, i.e., in urban planning. The issue of the impact of biomimicry on contemporary urban planning will not be discussed, since it requires a separate, extended analysis.

The concept of biomimicry can be implemented both using modern *high-tech* solutions and in a *low-tech* way, referring to vernacular architecture and animal habitats[4]. In architectural objects inspired by the idea of biomimicry, one can often find elements of biophilic design, which is based on the concept that broadly understood direct contact with nature promotes human health and well-being (Contreras et al. 2023). This includes the use of natural materials, access to sunlight, the physical presence of natural objects, primarily plants. As was the case with biomaterials, this concept assumes the direct use of nature, not just modelling on it. A popular and frequently used solution today are rooftop and vertical gardens covering building façades. In its radical form, the concept of "living" architecture leads to experiments such as creating building structures in trees. An example of this are the projects of the Terreform ONE group (led by Mitchell Joachim), including the Fab Tree House (Fig. 3) – a house constructed of a tree shaped in a form similar to an igloo, the "walls" are filled with vines, straw and clay, and the windows are

Fig. 3. "Fab Tree Hab" 2005, designed by Terreform ONE
(M. Joachim, L. Greden, J. Arbona)
(courtesy of Mitchell Joachim, Terreform ONE)

Il. 3. „Fab Tree Hab" 2005, proj. Terreform ONE
(M. Joachim, L. Greden, J. Arbona)
(źródło: dzięki uprzejmości Mitchella Joachima, Terreform ONE)

transparent panels made of a soy-based material (Vallas, Courard 2017). Gruber noted that in order to resemble the way nature functions, architecture should meet the "criteria of life", among which she listed openness, self-organisation, hierarchy, autopoietics, growth, energy processing and evolution. According to the author, their architectural interpretation is possible, but currently mainly experimental structures are being implemented, so it is not yet the moment when this type of "living" architecture can exist on a larger scale and for a wider audience.

Among the features mentioned in the literature, which according to the authors should characterize biomimetic architecture in the sense of biomimicry, architects are currently most focused on solutions for zero-energy buildings, methods of natural water acquisition and recovery, ventilation and the use of biophilic and biodegradable materials. In his doctoral dissertation, Onyszkiewicz formulated a total of 13 criteria that allow defining a given architectural object as biomimetic. They are divided into groups: formal, structural, functional and additional ("external") criteria. As the author himself noted, architects' interest in individual criteria is not equal, and the percentage of buildings meeting all of them is very small. Taking into account not theoretical thought, but current architectural practice, we can distinguish four most popular aspects, most often undertaken by designers interested in the idea of biomimicry. These are:

[4] The Eastgate Centre building in Harare (1996, designed by M. Pearce), often cited in the literature as an early example of biomimicry in architecture, which uses a ventilation system modelled on termite mounds, is an example of imitation not so much of nature itself, but of building – animal technology.

1. The ecological aspect of the functioning of the building (acquisition and management of energy and water, zero emission, passivity), associated with this is the value of adaptability to changing external conditions.

2. The presence of elements taken directly from nature in accordance with the idea of biophilic design. This is related to the concept of invisible architecture, blended into the surroundings, e.g., by covering the roof with grass.

3. Departure from the traditional spectrum of schemes and the standard repertoire of architectural forms, materials and structures. Use of biomaterials, construction systems modelled on natural, atypical building plans.

4. Biomorphism.

In recent years, numerous innovative and experimental projects based on the principles of biomimicry have been created, but many of them remain only in the form of concepts. Some visions are futuristic in nature, e.g., Vincent Callebault's designs for cities of the future, with green skyscrapers growing like trees – *Treescrapers* (Vincent Callebaut Architectures 2023). Among the completed buildings, there are several examples recognized in the international architectural community, the diversity of which is the best confirmation that biomimicry should be treated primarily as an ideology, not a stylistic doctrine. These are, in chronological order: Quadracci Pavilion in the Milwaukee Art Museum complex (2001, designed by S. Calatrava); Esplanade cultural center in Singapore (2002, designed by M. Wilford & Partners, DP Architects); 30 St Mary Axe skyscraper in London (so-called The Gherkin Tower, 2003, designed by Foster + Partners); The National Stadium in Beijing (the Bird's Nest, 2004–2008, designed by Herzog & de Meuron); the Agora Garden (*Tao Zhu Yin Yuan*) residential skyscraper in Taipei, Taiwan (2010–2018, designed by V. Callebault); the BIQ House apartment building in Hamburg (2013, designed by Splittewerk Architects); and the Bosco Verticale skyscrapers in Milan (2014, designed by Boeri Studio). In the Quadracci Pavilion, the most important element from the point of view of biomimicry are the movable solar screens, which fold at night and unfold during the day like a bird's wings. The Esplanade Theatre also has a kinetic façade that provides shade while also letting in natural light, modelled on durian fruit shells. The Gherkin Tower draws inspiration from a Pacific Ocean sponge called the Venus' flower basket (*Euplectella aspergillum*). The sponge's exoskeleton is replicated in the building's structure, which is highly wind-resistant while minimizing the amount of material used and allowing for effective ventilation. The Beijing National Stadium imitates a bird's nest in shape and structure (it is therefore a reference to animal structures). The building's façade consists of a steel skeleton filled

Fig. 4. Agora Garden (Tao Zhu Yin Yuan) in Taipei (Taiwan), 2010–2018, designed by Vincent Callebault Architectures (courtesy of Vincent Callebaut Architectures, Paris)

Il. 4. Agora Garden (Tao Zhu Yin Yuan) w Taipei (Tajwan), 2010–2018, proj. Vincent Callebault Architectures (źródło: dzięki uprzejmości Vincent Callebaut Architectures, Paris)

with ETFE membrane panels, which have insulating properties, allow sunlight to pass through and are self-cleaning. The Agora Garden skyscraper combines biomorphic, biophilic and ecological elements. Its shape resembles a DNA chain (Fig. 4). It was designed in the concept of a vertical garden, which is particularly popular in Callebault's work. The cascading suspended gardens cover the entire building, and thanks to the huge number of plants, the skyscraper absorbs about 130 tons of carbon dioxide per year. This project is an excellent example of sustainable architecture, including the integration of bioclimatic passive systems (natural lighting, ventilation, rainwater recycling system, low-emission glass, double skin of the façade) with the optimal use of renewable energy (Szołomicki, Golasz-Szołomicka 2020). The vertical garden concept is also implemented by the Bosco Verticale, which house over 900 trees in total. The BIQ (Bio Intelligent Quotient) building in Hamburg is notable for its bio-adaptive façade that uses algae to generate energy (Wallis 2013).

Conclusions

As mentioned, biomimetics is not a "trend" or "style" in contemporary architecture, which in its essence is characterized by formal heterogeneity and freedom from stylistic definitions and limitations. In the literature on the subject, there are various combinations of features of architecture that can be called biomimetic, and some authors question the terminology itself, suggesting rather the use of the term "biomimetic design", which emphasizes the creative concept itself based on broadly understood modelling on natural processes. In addition, there is a multitude of terms in the literature, the concepts of biomimetics and biomimicry are accompanied by terms such as biophilic design, ecomimicry, bio-logical design and sustainable design. Apart from a certain theoretical chaos that has arisen around these issues in recent years, in architectural practice, two basic levels of manifestation of biomimetics and biomimicry can be noted, which for the purposes of this study have been called tool and ideological biomimetics. While in the case of tool biomimetics, architects obtain, through biology and engineering, primarily materials and construction solutions modelled on the details of the structure and behaviour of living organisms, in ideological biomimetics, identified with the concept of biomimicry, nature "teaches" designers primarily how to effectively manage resources and create closed circuits instead of linear systems that are harmful to the environment. Tool biomimetics usually requires the involvement of high technologies and is developed primarily in interdisciplinary centres with significant funds. The idea of biomimicry, i.e., designing buildings that function in an ecosystem in a way that is consistent with nature, can also be implemented with the participation of modern technological solutions in the field of energy efficiency, water management or recuperation, but it can also be combined with inspiration from vernacular architecture and a return to simple "natural" solutions and materials. In this comparison, an example of *high-tech* biomimetics can be advanced kinetic façade systems, while *low-tech* biomimetics can be covering a house with reeds as an excellent insulating material. Tool biomimetics, as the name suggests, provides tools and materials for biomimicry, which should be treated primarily as an ideology. Therefore, an architectural object can be ideologically consistent with the concept of biomimicry, even if it does not use strictly biomimetic technologies. For contemporary architects, referring to the idea of biomimicry has ethical significance, as it is an expression of ecological awareness and social sensitivity.

Translated by
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Streszczenie

Biomimetyka i biomimikra jako narzędzie i ideologia we współczesnej architekturze

Tezą opracowania jest stwierdzenie, że koncepcja biomimetyki i biomimikry zaznacza swoją obecność w praktyce architektonicznej na dwóch poziomach: narzędziowym i ideologicznym. Na poziomie narzędziowym mamy do czynienia z wykorzystaniem w architekturze różnorodnych technologii o charakterze biomimetycznym, czerpiących wzór i inspirację ze szczegółów budowy i zachowania organizmów żywych, w celu optymalizacji konstrukcyjnej i funkcjonalnej poszczególnych elementów architektonicznych. Na poziomie ideologicznym biomimikra to naśladownictwo praw i procesów biologicznych, inspiracja naturą w skali makro, czyli dążenie do odwzorowania w budynku reguł i sposobu funkcjonowania ekosystemów. Produktem finalnym są kompleksowo postrzegane budynki i zespoły urbanistyczne. Idea biomimikry może być realizowana zarówno z użyciem rozwiązań wysokotechnologicznych (*high-tech*) – posługując się biomimetycznymi narzędziami, jak i w sposób niskotechnologiczny (*low-tech*) – nawiązując do architektury wernakularnej i habitatów zwierząt.

Słowa kluczowe: biomimetyka, biomimikra, biomimetyka narzędziowa, biomimikra ideologiczna