

2020

volume 17 | issue 1

ENQ

The ARCC Journal for Architectural Research

László Moholy-Nagy and Alvar Aalto's Connections: Between Biotechnik and Umwelt

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Abstract

Departing from the fact that László Moholy-Nagy's *Von Material zu Architektur* (1929), had been an important source of inspiration for Alvar Aalto, this article examines the affinities between László Moholy-Nagy and Alvar Aalto's intellectual positions. The article places emphasis on two particular ideas: how Aalto and Moholy-Nagy conceived the connection of biology with standardization and technology and its relationship to light and perception. Special attention is paid to the notions of "flexible standardisation" and rationalisation in Aalto's thought, as well as to his belief that nature and standardization should be conceived as closely interconnected. In regard to their shared intellectual development, the article sheds light on the first encounters of the two men including: their meeting at the second Congrès International de l'Architecture Moderne (CIAM) in 1929; the June 1931 Finish meeting of Aino Marsio-Aalto, Alvar Aalto, Moholy-Nagy and Ellen Frank; the June 1931 exchanges between Aalto and Moholy-Nagy during the inner circle CIAM meeting in Berlin; and the common stay of the Aaltos and Moholy-Nagy in London in 1933 are discussed. Particular emphasis is placed on Aalto's "The Reconstruction of Europe is the Key Problem for the Architecture of Our Time", in which he argued that standardization in architecture should draw upon biological models.

Keywords: László Moholy-Nagy, Alvar Aalto, flexible standardization, biology, rationalization, *Biotechnik*, *Umwelt*

Introduction

The article aims to shed light on the common ground of László Moholy-Nagy and Alvar Aalto's thought, placing particular emphasis on their conception of standardization and its relation to nature and biology. The attraction to biological models permitted Moholy-Nagy and Aalto to shape biomorphic approaches to standardization, which differed from the most canonical appraisal of the machine as a dominant metaphor within the modernist context. Their biomorphic and more humanized perception of standardization

drew upon their embracement of alternative metaphors related to light, nature and biology. To contextualize the debates around rationalization and standardization during the modernist era and the diverse approaches towards the metaphor of the machine, it would be useful to recall the opposition between Le Corbusier and Eileen Gray regarding this issue (Ballantyne 2011). Gray's intention to embrace a more organic conception of modernism could be related to Moholy-Nagy and Aalto's biology-informed understanding of standardization. Aalto's critique of the automotive model of standardization, which was not

Stable URL: <https://arcc-journal.org/index.php/arccjournal/article/view/1080>
DOI 10.17831/enq:arcc.v16i1.1080

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only at the core of Le Corbusier's thought, but also quite dominant within the North-American context, is pivotal for understanding the intentions lying behind his conception of "flexible standardisation". In parallel, the rejection of the automotive model is of great significance for unfolding the reasons for which Moholy-Nagy saw in Raoul Heinrich Francé's theory of *Biotechnik* a key reference for his own path as artist, pedagogue and writer.

Moholy-Nagy, who resigned from his teaching position at the Bauhaus, where he had served as director of the *Vorkurs* and head of the metal workshop in Weimar (1923-1925) and Dessau (1925-1928), believed that individual experience is the very source of knowledge. In 1937, he moved to Chicago and was appointed Director of "The New Bauhaus: American School of Design". The article, taking as its starting point the fact that Moholy-Nagy's *Von Material zu Architektur* (1929), which was published in English as *The New Vision: From Material to Architecture* (1932), had been an important source of inspiration for Aalto, examines the impact of Moholy-Nagy's approach on Aalto's thought. Aalto, in a letter he wrote to Moholy-Nagy regarding his *Von Material zu Architektur*, described this book as "magnificent, lucid and beautiful [...] [and as Moholy-Nagy's] best book" (Aalto cited in Menin, Samuel 2003, 56). Moholy-Nagy's tripartite analysis of material's acquisition of form – *Struktur* (structure), *Textur* (texture) and *Faktura* (making) – influenced Aalto's conception of furniture and his use of curvilinear figures. As Eeva-Liisa Pelkonen remarks in "Aalto's Entangled Geographies", Moholy-Nagy's conception of *Struktur* concerned "how the inherent structure of material lends itself to form", while *Textur* was "how external forces play a role, in this case bending adds another layer", and *Faktura* meant "how a mechanical process, in this case lamination, further contributes to the final outcome" (Pelkonen 2015a, 52; idem 2009a).

László Moholy-Nagy and Alvar Aalto's first encounters

The two men met for the first time in 1929, one year after Moholy-Nagy had left the Bauhaus, at the second Congrès International de l'Architecture Moderne (CIAM), which was hosted by Ernst May in Frankfurt am Main. The theme of this CIAM was *Die Wohnung für das Existenzminimum* (*The Dwelling for Minimal Existence*). Among the participants were Le Corbusier, Walter Gropius, Sigfried Giedion, László Moholy-

Nagy, Max Ernst, Joseph Frank, Gotthard Johansson, Karl Moserand, and Hannes Mayer among others. As has been highlighted by Aristotle Kallis, May "introduced the terminology of the *Existenzminimum* as the overriding functional norm of modern housing design" (Kallis 2020, 7). The notion of standardization, which was at the centre of the debates, had an important place in both Alvar Aalto and László Moholy-Nagy's lectures and writings. Aalto wrote the text entitled "The Housing Problem" just after returning from the second CIAM, in the framework of which Le Corbusier, Pierre Jeanneret, Ernst May and, more importantly, Moholy-Nagy had placed particular emphasis on the relationship between biology and standardization (Aalto 1930 in Schildt 1997, 76 – 84). The impact of these ideas on Aalto's thought becomes apparent in his claim that "[a]rchitecture is [...] deeply biological" (Aalto cited in Charrington 2008, 77). Aalto believed that "architecture and its details are in some way all part of biology" (Aalto 1947; idem 1948). His understanding of the so-called "flexible standardisation" was based on an analogy between variety of types in architecture and variety in nature, as evidenced by his description of the variety of the blossoms of an apple tree. Characteristically, Aalto admired "the blossoms on an apple tree [that] are standardised, and yet they are all different" (Aalto 1972 in Schildt 1997, 271). In *The New Vision*, Moholy-Nagy remarks that "[t]he biological make-up of man is the source of organic expression" (Moholy-Nagy 2012, 178).

Aalto had been interested in the notion of rationalization since the early 1930s. His conception of rationalization should be understood in conjunction with his fascination with existential psychology. An exhibition whose theme was closely related to the concepts of rationalisation, standardisation and minimum dwelling was "Rationalization of Minimum Dwelling" ("Pienasuntonäyttely"), held in 1930 at Helsinki Art Hall. Aalto was the curator of the exhibition and wrote two articles for the exhibition catalogue. This exhibition included Aalto's minimum *existenz* flat. During that same year, Moholy-Nagy had contributed to the Swedish National Exhibition for Modern Architecture, Design and Applied Arts ("Stockholmsutställningen") (Rudberg 1999). Aalto had "sent a German-language version of his ideas to Ernst Neufert in Berlin, then in charge of German standardization efforts" (Mumford 2018, 235).

In June 1931, Moholy-Nagy and his companion at the time Ellen Frank, who was Walter Gropius's sister-in-law, visited Aino Marsio-Aalto and Alvar Aalto in Turku, Finland (fig. 1). During their stay in Scandinavia in 1931, Moholy-Nagy and Frank visited Lapland, where the former took photographs of the Sámi people. These photographs had an important effect on both Aino Marsio-Aalto and Alvar Aalto's thought. Aalto conserved in his personal archives several of the photographs that Moholy-Nagy had taken during his trip to Scandinavia in 1931. A noteworthy photograph taken by Moholy-Nagy during this trip is the superimposition on a Finnish trawler (fig. 2). During that trip, both couples spent some time on the Oulujoki-river. Aino, Aalto's wife, was a prominent avant-garde photographer and exchanged ideas on photography with Moholy-Nagy (Launonen in Kinunen 2004; Suominen-Kokkonen 2007). For instance, in the photographs she took of Moholy-Nagy during the trip, and two years later during the short stay of Aino Marsio-Aalto and Alvar Aalto and László

Moholy-Nagy in London, one can discern an influence of Moholy-Nagy's approach on her own.

During his 1931 visit to Scandinavia, Moholy-Nagy offered to Aalto a copy of *Von Material zur Architektur* as a present. In this book, Moholy-Nagy placed particular emphasis on Rudolf Carnap's understanding of "experiential" space. More specifically, Moholy-Nagy refers to Carnap's texts entitled *Der Raum: ein Beitrag zur Wissenschaftslehre* (1922; Carnap 2019) and *Der Logische Aufbau der Welt* (1928; Carnap 1967) originally published in 1922 and 1928 respectively. In the former, Carnap analysed his notion of "experiential space". A question that arises is to what extent this concept of "experiential" space influenced Aalto's thought. Moholy-Nagy's conception of "experiential" space and his appraisal of the individual experience could be related to Aalto's understanding of the so-called "flexible standardization" and brings to mind the psychological functionalism to which Aalto refers in "The Humanizing of Architecture" (1940a).



Figure 1. Alvar Aalto, Aino Marsio-Aalto and László Moholy-Nagy on the Oulujoki-river, 1931. Credits: Alvar Aalto Estate, Alvar Aalto Museum, S42-3.



Figure 2. László Moholy-Nagy, Life on board, superimposition on a Finnish Trawler, 1931. Gelatine silver print. Credits: Moholy-Nagy Foundation

If one wants to grasp the nature of the interconnections between arts education and philosophy education in Chicago in the late forties it would be useful to reflect on the connections between Moholy-Nagy's pedagogical agenda and the logical-positivism-oriented context at the Department of Philosophy of the University of Chicago during this period. Within this context, important figures were Rudolf Carnap and Charles Morris. Carnap was a major member of the Vienna Circle, an advocate of logical positivism, and had been invited to the Bauhaus to give lectures on several occasions. In the framework of his effort to introduce philosophy into the education of the arts, Moholy-Nagy invited Charles Morris, who at the time was teaching at the Department of Philosophy at the University of Chicago, to lecture at the New Bauhaus. Morris, whose course was entitled "Intellectual Integration", remarked, regarding Moholy-Nagy's interest in "the unity of life" in the prospectus for the New Bauhaus:

Moholy-Nagy knew of the interest of Rudolf Carnap and myself in the unity of science movement. He once remarked to us that his interest went a stage further: his concern was with the unity of life.¹

An enlightening text regarding the relationship between the teaching approaches at the Bauhaus and the ideas of logical positivism is Peter Galison's "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism", in which the author interprets both logical positivism and Bauhaus as "attempts to interiorize an image of the machine world [...], one through language, logic, and thought, the other through color, geometry, and architecture" (1990, 750). Galison also argues that "the New Bauhaus imported the Vienna Circle's logical positivism as a fundamental component of its basic design program" (ibid., 711). The fact that the geographical trajectories of certain major figures of both the Bauhaus and logical positivism coincided – given that they emigrated to Chicago during the same period – contributed to the intensification of their exchanges. Carnap, for instance, settled at the University of Chicago in 1936, a year before the arrival of Moholy-Nagy in Chicago. The recruitment of

several members of the positivists' Unity of Science movement to teach at the New Bauhaus further reinforced the cross-fertilisation between logical positivism and arts education.

Galison sees the left-technocratic meaning of 'Aufbau' as a linking aspect between the Vienna Circle and the Bauhaus, understanding the concept of 'Aufbau' as the articulation between their visions. It would be thought-provoking to relate the procedural aspect of Aufbau to Aalto's conception of "flexible standardisation" (Potochnik, Yap 2006). Note-worthy regarding this is Galison's remark that the *Wissenschaftliche Weltauffassung* supported a "unified science by 'constituting' all scientific theories out of the elementary bits of perception" (Galison 1990, 732). This unified science could be related to concept of "flexible" standardisation, especially as far as its intention to embrace all "the elementary aspects of the individual psyche, [...] it would rise to 'a layer above'[, while] containing physical objects" (ibid.). The procedural aspect of the "building-up method [that Galison describes, in his effort to explain the unifying vision characterising] the constructional form [Aufbauform]" (ibid.) could be compared Aalto's conviction that architecture's task is to broaden "humane, socio-economic, and psychological decisions" (Aalto 1930 in Schildt 1997, 99.).

Alvar Aalto's conception of "flexible standardization" vis-à-vis biological models

Aalto refers to the concept of "flexible standardization" in a brochure entitled *Post-War Reconstruction: Rehousing Research in Finland*, published through the Finnish Consulate in New York for American distribution in 1940 (1940b). In parallel, Aalto paid special attention to the notion of standardization in a lecture entitled "The Reconstruction of Europe is the Key Problem for the Architecture of Our Time" that he gave at various instances in Switzerland in April 1941, when invited by the founding patron of the CIAM – Madame Hélène de Mandrot – to present his ideas about Finnish reconstruction and "flexible standardization". In this lecture, which was originally published in Finnish in the journal *Arkkitehti-Arkitekten* (Aalto

¹ Charles Morris, Prospectus for the New Bauhaus (hereafter abbreviated P), American School of Design, founded by the Association of Arts and Industries, p. 10, accession record 70-65 F65 in the Institute of Design Collection, The University Library, Special Collections

Department, The University of Illinois at Chicago (hereafter ID/UIC). Morris to Lloyd Englebrecht, 3 June 1968, ID/UIC.

1941 in Schildt 1997,149-157; Aalto 1941) and became later known as the “Swiss Sermon on the Mount”, Aalto “criticized the practice in the United States of basing standardization in architecture on car-manufacturing models” (Moravánszky 2017, 3). He argued “that standardization in architecture should be based on biological models” (ibid.), and not on “the principles of automobile industry” (Moravánszky 2018, 76). Aalto also remarked that “[n]ature is the most remarkable standardization institute of all”. At the centre of this talk was his intention to express his admiration for nature and the variety that one can encounter in nature, such as in flowers and trees. He shed light on the “innumerable apparently uniform proton-cells” of blossoms, highlighting that this variety should be the model for what he called “flexible” or “elastic” standardization. More specifically, he underlined that thanks to their quantity “the cells [...] [permit] the most extraordinary variety in the linkage of cells” (Aalto 1941 in Schildt 1997, 154).

Shortly after he had attended Aalto’s lecture in Zürich in 1941, Sigfried Giedion wrote an article entitled “Irrationality and Standard” (“Irrationalität und Standard”) for the Swiss magazine *Die Weltwoche* (Giedion 1941a, 2). This article would also be the basis of his chapter on Aalto in the second edition of *Space, Time and Architecture: Towards a New Tradition*, which was published in 1949 (Giedion 1949; idem 1941b). Giedion wrote his first articles devoted to the work of Aalto in 1931. That same year, Aalto attended the meeting of the inner circle of CIAM in Berlin, the so-called “Special Congress”, held between 4 and 6 June 1931, where he met Marcel Breuer, Moholy-Nagy and Walter Gropius, among others.

The interest of Aalto’s understanding of the so-called “flexible” or “elastic” standardization lies in the fact that it “allowed architecture to absorb various contingencies from site conditions to programmatic needs” (Pelkonen 2009b). Aalto believed that “[...] architecture – the real kind – only exists where the little man is at the center” (Aalto in Schildt 1997, 264). His conviction that architecture’s task is to broaden “humane, socio-economic, and psychological decisions” (Aalto 1938 in Schildt 1997, 99) could be compared with Moholy-Nagy’s belief that a new individuality is a prerequisite condition for a new society. Aalto’s

conception of standardisation was closely related to his admiration for nature and the compositional elements of the forest. He conceived standardisation as a means contributing to the osmosis with nature, claiming that “[a] building cannot fulfil its purpose if it does not possess a wealth of nuances equal to that of the natural environment to which it will belong as a permanent element” (Aalto cited in Charrington 2008, 228). His conception of “flexible” or “elastic” standardization was based on the use of a plethora of biological metaphors such as that of “cells”.

In an essay entitled “The Humanising of Architecture”, originally published in 1940 and accompanied by sketches showing how patients inhabit a typical room at the Paimio Sanatorium, Aalto intended to explain his view of rationalization, which could be contrasted to Giedion’s. He proposed that “[i]nstead of fighting rational mentality, the newest phase of modern architecture [should try] [...] to project rational methods from the technical field out to human and psychological fields” (Aalto 1940). In the same text, he sustained that “[t]echnical functionalism is correct only if enlarged to cover even the psychological field” (ibid.). Aalto believed that “objects that can rightly be called rational often suffer from a fragmented inhumanity”². His practice was based on the intention to “humanise architecture” (ibid). He maintained that “the purpose of a building is to act as an instrument that collects all the positive influences in nature for man’s benefit” (Aalto 1941 in Schildt 1997, 154). At the same time, he saw “[n]ature [...] [as] the symbol of freedom” (Aalto cited in Alvar Aalto Museum 1994, 10), sustaining that architects should base their “technical efforts in nature” (ibid.). In 1939, a year before publishing “The Humanizing of Architecture”, Aalto had visited Moholy-Nagy in Chicago when he travelled to the United States to witness the opening of the New York World’s Fair for which he had designed the Finnish Pavilion (fig. 3). During his stay in New York, he took part in a discussion that followed Giedion’s lecture “American Architecture Viewed from Europe”, which was part of “A Symposium on Contemporary Architecture” held in May 1939 at the Institute of Fine Arts of New York University. The discussion also featured architects Sven Markelius, George Howe and Buckminster Fuller, while among the people who attended was Moholy-Nagy, who

² Aalto, (1935), quoted in exhibition, Helsinki Design Museum, 2004.

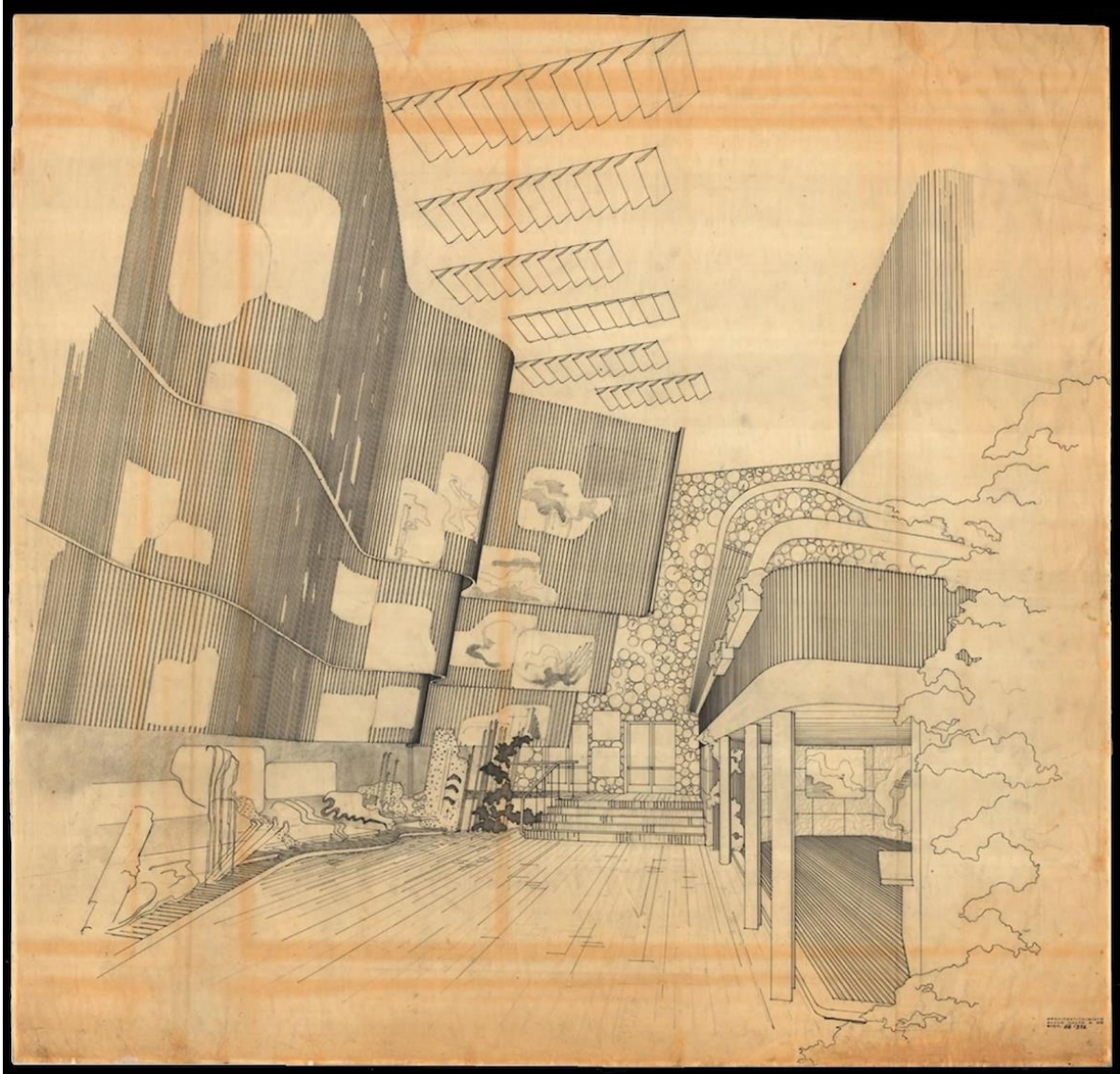


Figure 3. Alvar Aalto's drawing for the Finnish Pavilion at the New York World Fair, 1939. Credits: The Victoria and Albert Museum, London

took part in the CIAM meeting that took place a day after the aforementioned symposium.

Distinguishing standardization in automobile industry and in architecture

Aalto drew a distinction between centralized and decentralized standardization. The notion of centralized standardization related, for Aalto, to the model of standardization that we encounter in the automobile industry while de-centralized standardization related to the variety found in nature – such as variety

present in blossoms, for instance. Aalto compared the variety of types at which architects should aim through their design practice to the variety that one encounters in nature, shedding light on “nature’s infinite capacity of nuance” (Aalto cited in Ruusuvoori 1978, 141; Aalto 1941). During an interview he gave in 1929, Aalto made several remarks regarding his understanding of standardization in architecture:

The use of standard elements is the manner of the industrial age; it is the only means to achieve scientifically sound results and raise

quality . . . the architect creates the standards ... he may himself use these units in several buildings or someone else may use them. The architect creates an entity, a system of these units. (Aalto cited in Pallasmaa 1998, 34, 35; Aalto, Enajarvi 1929, 7)

Aalto was interested in unfolding the intellectual aspect of standardization. Characteristically, he made the following statement: “it is a question of the spirit, of the soul, a question of what is intellectual in standardization” (ibid.). Useful for understanding Aalto’s distinction between centralized and decentralized standardization is his belief that the main difference between the model of standardization in automobile industry and the model of standardization in architecture is related to the fact that in the case of the former the efforts focus on eliminating the variety of the types, while in the case of the latter the main objective should be to multiply the types. He made further remarks regarding this difference in his text entitled

“Culture and Technology” (“Kulttuuri ja tekniikka”) (1947):

Whereas the course of development in relation to the automobile is for more and more effort to be made to concentrate on just a few types, the task of the architectural production process is exactly the opposite. (Aalto 1947)

Telling regarding Aalto’s concern about standardization is the fact that he was appointed chairman of the Standardization Institute, which was founded by the Finnish Association of Architects in 1943 (Pallasmaa Sato 2007, 38). Aalto proposed the establishment of the institute in order to promote a model of rationalization based on subtlety and variety (Ruusuvuori 1981, 123). As Juhani Pallasmaa remarks, in *Alvar Aalto: Toward a Synthetic Functionalism*, “Aalto’s furniture concepts are also systems of flexible modular standardization” (Pallasmaa 1998, 35). Aalto designed his best-known piece of bent plywood chairs – the Paimio Chair – between 1931 and 1932 (fig. 4). In

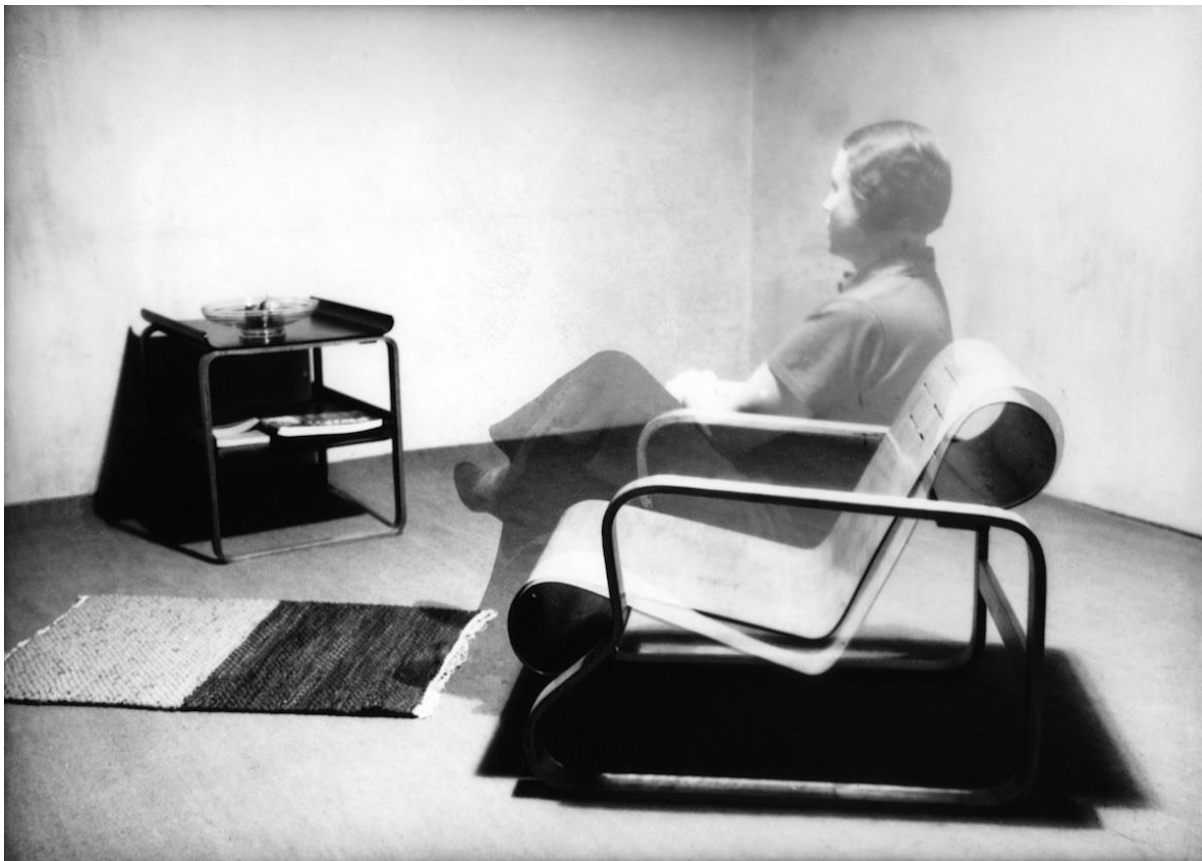


Figure 4. Aino Marsio-Aalto on a Paimio chair, circa 1930. Credits: Alvar Aalto Museum, Artek Collection

the case of his design for this chair, one can admire the outcome of such an analogy between nature and industrial design. As its name demonstrates, this chair was designed for the Paimio Tuberculosis Sanatorium. Aalto's exchanges with Sigfried Giedion played an important role for his conception of "flexible standardization", and especially for his application in the design and manufacturing of his famous furniture, as his Paimio chair was displayed at the 1933

Triennale di Milano, where Giedion had the chance to admire it. After having seen the Paimio chair, Giedion sent a postcard to Aalto on 7 July telling him: "You will one day become the Magician of the North!" (Pelkonen 2015b) Their conversations played an important role for the formation of Aalto's conception of "flexible standardization", and it is not just a coincidence the fact that the same year that Aalto designed the L-leg stool (fig. 5, fig. 6), one of his most famous pieces

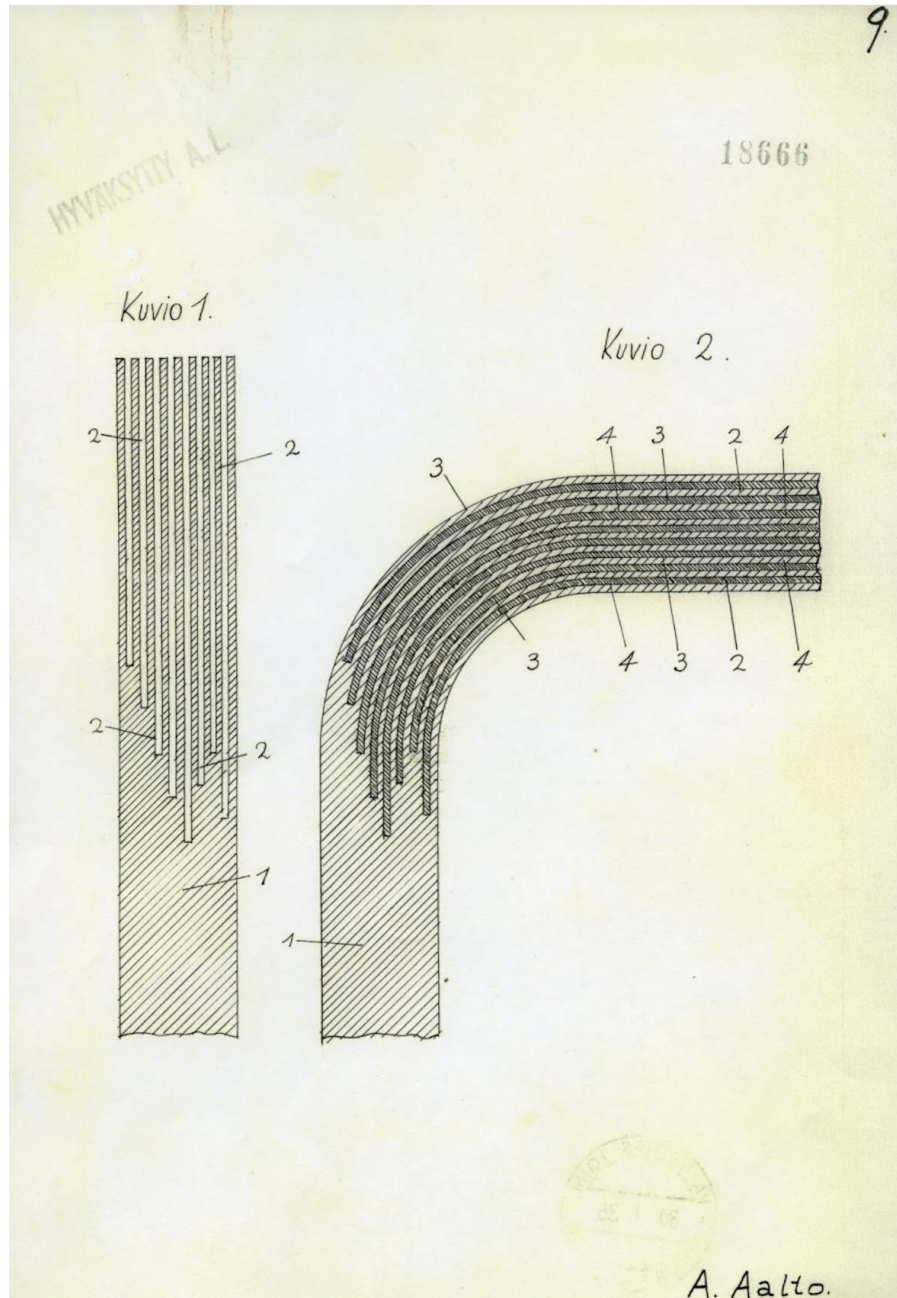


Figure 5. Alvar Aalto's Patent document for the L stool. Credits: Alvar Aalto Foundation

of furniture³ – Aalto travelled by car with Giedion to Zurich⁴. Apart from the impact of the discussions of the two men – Giedion and Aalto – one should also consider the influence of German-Swiss art historian Carola Giedion-Welcker –wife of Sigfried – on Aalto’s thought and especially of her analysis of curvilinear forms in the work of German-French sculptor, painter, and poet Jean Arp. A point of convergence of Aalto and Arp’s work is the embracement of biomorphism (Pelkonen 2015b, 146), and their conception of curvilinear forms as mechanisms or apparatuses serving to render standardisation more human and elastic. Aalto had met Arp at Giedion’s house in Zurich as early as 1931, that is to say the same year that Giedion wrote his first texts focusing on Aalto’s work (Giedion 1931a; idem 1931b).

In Aalto’s design strategies and his use of the curvilinear line in the Paimio chair, one can discern an influence from the well-known Hungarian-born

modernist architect and furniture designer Marcel Breuer. This hypothesis can be further confirmed by the fact that Aalto owned several of Breuer’s chairs. Despite the fact that Aalto often used Breuer’s chairs constructed by Thonet company in his early buildings, he criticized their materiality:

If we wish to list the requirements that these chairs do not succeed in filling we could mention the following: a piece of furniture that forms a part of a person’s daily habitat should not cause excessive glare from light reflection; it should not be disadvantageous in terms of sound, sound absorption, etc. A piece that comes into the most intimate contact with man, as a chair does, shouldn’t be constructed of materials that are excessively good conductors of heat. I merely name these three criteria that the tubular metal



Figure 6. Furniture factory Korhonen, Mauno Mannelin, 1936. Credits: Alvar Aalto Foundation

³ Alvar Aalto submitted the first patent application for it on 8 November 1933 in England and on 7 November 1934 in Finland.

⁴ Alvar Aalto and Sigfried Giedion travelled by car together in late August 1933.

chairs hardly fulfill. (Aalto in Pallasmaa 1984, 115-116; Schildt 1978, 48)

Rationalism and man: The limits of the *neue Sachlichkeit*

To better grasp Aalto's conception of "flexible standardization", one should contextualise it, relating to the debates around the contrast between the European and American modes of manufacturing. In 1935, Aalto wrote: "A standardised object should not be a finished product, but on the contrary be made so that man and all the individual laws controlling him supplement its form" (Aalto cited in Pallasmaa 1998, 35). That same year, on 9 May Aalto gave a lecture entitled "Rationalism and Man" at the annual meeting of the Swedish Craft Society held in Stockholm. During this talk, he underlined that "[a] confrontation with the mass of the *neue Sachlichkeit* produced in recent times causes a person to take a skeptical attitude" (Aalto cited in Mussari 2016, 39; Plumb 2006; Grüttemeier, Beekman, Rebel 2013). He sustained that the dangers of the so-called *neue Sachlichkeit* are related to the fact that it often treats modernism in a non-creative way, that is to say in a way that is not based on the search of new "forms that has arisen through the analysis of materials, new working methods, new social conditions" (Aalto cited in Mussari 2016, 39). It is not a coincidence that the company *Artek* was established in Finland to mass-produce and distribute wood furniture designed by Alvar Aalto and Aino Mariosio-Aalto. The foundation of *Artek* could be interpreted as a means that would provide a context for going beyond the limits of the *neue Sachlichkeit* that Aalto highlighted in his address at the annual meeting of the Swedish Craft Society held in Stockholm in 1935.

In 1938, Aalto, in a conference under the title "The Influence of Construction and Materials on Modern Architecture" he gave at the Nordic Building Congress in Oslo, underlined that "[t]he [...] misconception of style has led to widespread standardisation, *Gleichgestaltung*, which is one of the biggest obstacles to the expression of the innermost quality of architecture" (Aalto 1938 in Schildt 1978, 60-63; Aalto in Schildt 1997, 98-101). This declaration shows that he was interested in reinventing the concept of standardization in architecture in a way that would take into account what he called "broadening humane, socio-economic, and psychological decisions" (ibid.). He believed that, in order to fulfil this task, standardization

in architecture should allow a "freedom of manoeuvre, both internally and in external form" (ibid.). Aalto argued that this freedom could be achieved only if form is connected with everyday life. He declared: "If form somehow fails to be logically connected with everyday life, it will suffer and lose significance" (Aalto cited in Harwood 2006, 110). For him, "[t]here [were] [...] only two things in art: humanity or not" (Aalto 1938 in Schildt 1978, 60-63; Aalto in Schildt 1997, 98-101).

Light-space construction and the transformation of human perception

Another point of convergence of Aalto's and Moholy-Nagy's understanding of form-making is the importance of the notion of light for their thought and work. Both Aalto and Moholy-Nagy paid special attention to light. The former through his interest in daylight and its significance for architecture and the latter through his photographs and films. An example in which Aalto's interest in lighting becomes evident is his design for a light fitting for the 1930 Minimum Apartment Exhibition ("Pienasuntonäyttely") in Helsinki (Norvasuo 2014; idem 2010). Moholy-Nagy's interest in light is very apparent in his book *Painting, Photography, Film*, originally published as *Malerei, Fotografie, Film* in 1925. This book, which was the eighth book of the so-called *Bauhausbücher* series consisting of fourteen books in total, was part of Aalto's library. Moholy-Nagy remarked, in *Painting, Photography, Film*: "to expand the technological horizon of a light-space construction [*Lichtraumgliederung*] hitherto created only with great difficulty" (Moholy-Nagy 1925, 16; Charrington 2008, 75). In the same book, Moholy-Nagy defined photography as a means of "transformation of human perception" (Tsai 2014, 83; idem, 2018). Aalto's library also included *Die Bühne im Bauhaus*, the fourth book of the *Bauhausbücher* series, which was originally published in 1924 and in the pages of which one can see the well-known photo-collage by Moholy-Nagy entitled *Menschmechanik* (Moholy-Nagy, Schlemmer, Moirar 1924, 65). Moholy-Nagy, during the period he worked at the Bauhaus, was the editor of the *Bauhausbücher* series. A later text by Moholy-Nagy, which is of great importance for understanding the importance of light in his thought and practice, is an article entitled "From Pigment to Light", which was written in 1934 and originally published in 1936 in the first issue of *Telehor* (1936). In the aforementioned text, Moholy-Nagy analyses the emergence of

photography as a new artistic medium relating to the notion of *Lichtraumgliederung*. Moholy-Nagy's work entitled *Light-Space Modulator* is useful for grasping his conception of the relationship between space and light.

In 1933, the Aaltos and Moholy-Nagy spent some time together in London (fig. 7). Shortly before his visit to London, Moholy-Nagy's "How Photography Revolutionises Vision" was published in *The Listener* (Borchardt-Hume 2006, 86). In this article, Moholy-



Figure 7. Aino Marsio-Aalto and László Moholy-Nagy in London, 1933. Photograph by Alvar Aalto. Credits: Alvar Aalto Foundation

Nagy maintained that the photographer's task was to enable "humanity [...] [to acquire] the power of perceiving its surroundings, and its very existence, with new eyes" (Moholy-Nagy 1933, 690). This text of Moholy-Nagy was translated by Philip Morton Shand, a contributor to the *Architectural Review* who played an important role through his articles in the dissemination of Aalto's work in the UK and beyond. Morton-Shand helped Aalto realise the exhibition of his furniture at Fortnum and Mason's Piccadilly store, on 13 November 1933 (fig. 8). It is noteworthy that "Moholy helped his friend Alvar Aalto to arrange his bentwood exhibition" (Borchardt-Hume, 86). The exhibition included Aalto's newly designed wooden furniture and their reliefs, which had been produced in collaboration with Korhonen's workshop. Moholy-Nagy introduced Aalto and Morton-Shand to one another. It is worthy of note that *Architectural Review* sponsored Aalto's exhibition thanks to Morton-Shand's support. In 1933, an article by Morton-Shand devoted

to Aalto's Paimio Tuberculosis Sanatorium was published in *Architectural Review* (Morton-Shand 1933). Morton-Shand also translated Moholy-Nagy's "How Photography Revolutionises Vision" for *The Listener*. Alvar Aalto and Aino Marsio-Aalto's decision to found the company *Artek*, in collaboration with Maire Gullichsen and Nils-Gustav Hahl, should be understood in conjunction with the publicity that Alvar Aalto and Aino Marsio-Aalto's furniture gained due to the aforementioned exhibition in London. Aalto wrote, regarding the wood reliefs and furniture that were displayed at the exhibition of his furniture at Fortnum and Mason's Piccadilly store:

At our London exhibition in 1933 (on the work of architect Aino Aalto and myself, arranged by The Architectural Review), we displayed some wood constructions. Some of these directly represented the structures we had used in our furniture; others were



Figure 8. View of the exhibition of Alvar Aalto at Fortnum & Mason, London, November 1933. Credits: Archives Artek, Helsinki

experiments with the form and handling of wood without any practical value or even any rational bearing to practice. (Aalto in Schildt 1997, 108)

The way Moholy-Nagy filmed the journey by *Afros* – a smaller boat on which a group among the attendants of the fourth CIAM visited several Greek islands, including Santorini – shows his shift towards abstraction, arguing that the most essential medium of the film is light⁵ (Blencowe, Levine 2018). Moholy-Nagy's understanding of film as light becomes apparent in the way he captured Greek island reality. His perception of film as light suggests a new conception of *méditerranéité*. Aalto was among the participants to the fourth CIAM, which took place in 1933 on *Patris II*, on a cruise from Marseille to Athens (fig. 9). The fact Moholy-Nagy edited his 29-minute documentary film entitled *Architect's Congress*, which he had filmed during the fourth CIAM and features Giedion, Le Corbusier, Josep Lluís Sert, Cornelis van Eesteren, and Alvar Aalto. Sigfried, during his short stay in London in 1933, the same year that he had spent some time in London with the Aaltos, invites us to relate his shift towards abstraction and his upgrading of the light to his core concern to his connection to the Aaltos. This hypothesis is further reinforced by the fact that Aalto was interested in cinema in general and in the films by Moholy-Nagy more specifically.

Biotechnik and Umwelt: The relationship between nature and architecture

Aalto's analogy between the variety of types in architecture and furniture design, and the variety of "cells" in nature, brings to mind Moholy-Nagy's interest in Raoul Francé's understanding of *Biotechnik*. The latter, who was a renowned Austro-Hungarian botanist, microbiologist, and natural and cultural philosopher, developed a reflection on how the biotechnic principles could be applied to the fields of art and engineering. Francé's concept of *Biotechnik* as well as his understanding of the so-called "objective philosophy" had an important impact on Moholy-Nagy's pedagogical vision (Botar 2007). A work by Francé that had a significant impact on Moholy-Nagy's biocentric vision is *Das Buch des Lebens (The Doctrine of Life)*, which had been published in 1924 (Roth 2000). Moholy-

Nagy's understanding of architecture as "an organic component in living [and] as a governable creation for mastery of life" brings to mind Francé's biocentric approach, as does his conviction that "architecture will be brought to its fullest realisation only when the deepest knowledge of human life in the biological whole is available" (Moholy-Nagy 2012, 200). Moholy-Nagy's pedagogical approach at the New Bauhaus, the School of Design and the Illinois Institute of Technology (IIT), was based on his vision of pursuing a new way of life, as expressed in the following words:

It is the artist's duty today to penetrate yet-unseen ranges of the biological functions, to search the new dimensions of the industrial society and to translate the new findings into emotional orientation. The artist unconsciously disentangles the most essential strands of existence from the contorted and chaotic complexities of actuality, and weaves them into an emotional fabric of compelling validity, characteristic of himself as well as of his epoch (Moholy-Nagy cited in Sibyl Moholy-Nagy 1950, 236).

Raoul Francé developed his theory of *Biotechnik* in his book *The Plants as Inventors*, which had originally been published in German as *Die Pflanze als Erfinder* in 1920 (Francé 1923) (fig. 10). Moholy-Nagy, in *The New Vision*, refers to Francé's claim that "all technical forms can be deduced from forms in nature" (Moholy-Nagy 2012, 50). Following Francé's approach, he argues that "[i]ndividuals who are a part of a rational biological whole should find [...] a heightening and harmonious development of their powers" (ibid., 200). Moholy-Nagy's understanding of architecture, and especially of the interiors of residential architecture, as a means to enhance the feeling of harmony echoes Aalto's interpretation of psychological functionalism in his text entitled "The Humanizing of Architecture" (Aalto 1940a). Moholy-Nagy, in *The New Vision*, appraises Francé's notion of nature "as a constructional model in creative technique" (Moholy-Nagy 2012, 60). What attracted Moholy-Nagy most in Francé's understanding of *Biotechnik* was his claim that "[n]o technical form exists which cannot be traced to the forms of nature" (1923, 11). Moholy-Nagy also quotes the following passage from Francé's

capturing vernacular architecture and the rhythms of quotidian life.

⁵ Giedion had invited Moholy-Nagy to make this silent film, which includes not only scenes on board during the cruise, but also shots of the Greek islands,



Figure 9. Otto Neurath having a conversation with Alvar Aalto (centre) and László Moholy-Nagy (right). Credit: gta Archives/ETH Zurich, CIAM papers (42)

The Plants as Inventors in The New Vision: “Every bush, every tree, can instruct him, advise him, and show him inventions, apparatuses, technical appliances without number” (2012, 50).

Similar to Francé’s importance for Moholy-Nagy’s theory, Estonian-German biologist Jacob von

Uexküll’s understanding of *Umwelt* was crucial for Aalto’s conception of the relationship between nature and architecture (Uexküll 1920; 1926; 2010; Brentari 2015; Michelini, Köchy 2020). Uexküll contributed significantly to the establishment of the field of biosemiotics. His understanding of *Umwelt* – referring to a German term meaning “environment” or

“surrounding world” – held an important place in Aalto’s thought. Uexküll defined *Umwelt* as the “phenomenal world embracing each individual like a ‘soap bubble’” (Aalto cited in Charrington 2012, 106). A description by Aalto which is very close to Uexküll’s conception of *Umwelt* is the following: “Just as in nature every cell is related to the whole, so in architecture the parts must be ‘conscious of the whole’” (ibid.). Both Aalto and Moholy-Nagy understood design as a mode of shaping one’s individuality. They placed particular emphasis on the impact of design on one’s conception of freedom and everyday life and were convinced that biology and technique are closely connected. For this reason, they were interested in notions such as *Biotechnik* and *Umwelt*. In parallel, they both paid special attention to the interconnections between design, socio-economic aspects, and psychological aspects. They were convinced that design

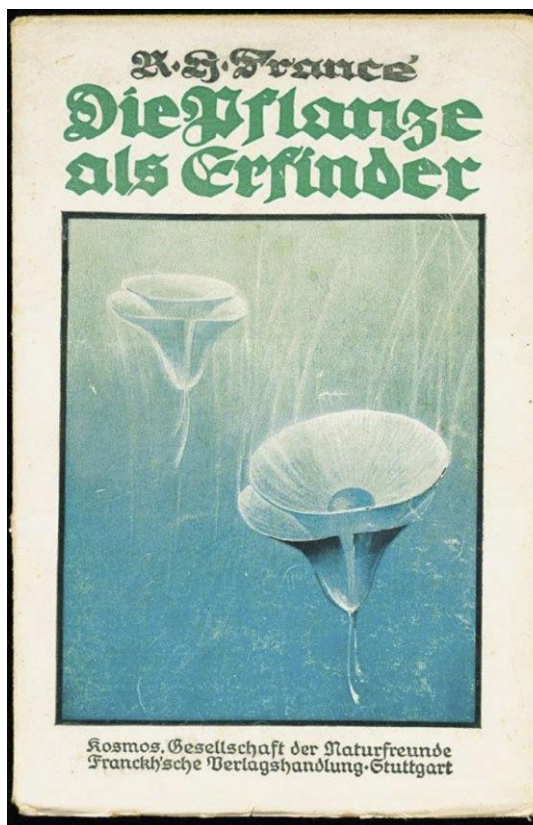


Figure 10. Front cover of Raoul Heinrich Francé, *Die Pflanze als Erfinder* (Stuttgart: Kosmos, Gesellschaft der Naturfreunde, 1920).

and social conditions are interrelated.

Conclusion

The main objective of the article was to render explicit why Aalto’s belief in the capacity of design to broaden “humane, socio-economic, and psychological decisions” (Aalto in Schildt 1997, 99) is close to Moholy-Nagy’s understanding of design and its teaching as “a coherent purposeful unity focused on socio-biological ends” (Moholy-Nagy 1947, 360). Aalto was critical vis-à-vis the importation, into the discipline of architecture, of a model of standardization developed by the automobile industry. He supported a standardization based on biology and nature, sharing with Moholy-Nagy an admiration for natural and biological forms. In a similar way that Francé’s work on *Biotechnik* was pivotal for Moholy-Nagy’s theory, Jacob von Uexküll’s understanding of *Umwelt* was crucial for Aalto’s conception of the relationship between nature and architecture. Both men supported, through their writings and practice, the connection between biology and technique. Uexküll’s conception of *Umwelt* as the “phenomenal world embracing each individual like a ‘soap bubble’” (Aalto cited in Charrington 2012, 106) is useful for realising what is at stake in Aalto’s endeavour to relate every cell to the whole and to transpose the variety encountered in nature to his design and manufacturing of furniture. Uexküll contributed significantly to the establishment of the field of biosemiotics. Uexküll’s distinction between *Innenwelt* and *Umwelt*, that is to say between inner and outer subjective worlds, was based on the idea that “the body takes an active part in the production of mental objects” (Barbieri 2008, 105). Aalto’s rejection of the models of standardization developed by the automobile industry brings to mind Uexküll’s opposition to mechanism and his “non-mechanistic approach to life” (ibid., 106). One should, however, bear in mind that “[o]rganicism and non-mechanism [...] are not equivalent at all” (ibid.). A description by Aalto which is very close to Uexküll’s conception of *Umwelt* is the following: “Just as in nature every cell is related to the whole, so in architecture the parts must be ‘conscious of the whole’” (ibid.). Moholy-Nagy’s artistic and pedagogical vision was based on Francé’s concept of *Biotechnik*, and on his understanding of “objective philosophy” (Botar 2007). Moholy-Nagy was particularly interested in Francé’s intention to apply biotechnic principles in the fields of art and engineering. The impact of Francé’s biocentric approach on Moholy-Nagy is evident in his claim that “an organic component in living [and] as a governable creation for mastery of life” (Moholy-Nagy 2012, 200). Moholy-

Nagy's holistic biocentric vision and his understanding of *Gesamtkunstwerk*, which is usually translated as a "total work of art", should be interpreted within the broader context of the *Lebensphilosophie*, and its emphasis on the meaning, value and purpose of life as the foremost focus of philosophy (Jain 1993; Teranova, Tromble 2016).

References

- Aalto, Alvar, "The Humanizing of Architecture", in *The Technology Review* 43, no. 1 (1940): 14-16.
- _____. *Post-war Reconstruction: Rehousing Research in Finland* (New York: Finnish Consulate in New York, 1940), n. p.
- _____. "Euroopan jalleenrakentaminen tuo pinnalle aikamme rakennustaiteen keskeisimman probleemin", in *Arkkitehti-Arkitekten*, no. 5 (1941): 75-80.
- _____. "Architettura e arte concreta" ("The Trout and the Stream"), in *Domus*, 223-225 (1947): 103-115.
- _____. "Culture and Technology" ("Kulttuuri ja tekniikka"), in *Suomi Finland*, no. 3 (1947): 20-21.
- _____. "The Trout and the Stream", in *Arkkitehti-Arkitekten* (1948): 7-10. _____.
- _____. "Rationalism and Man"; excerpt pub. in English in Juhani Pallasmaa, ed. *Alvar Aalto Furniture* (Helsinki: Museum of Finnish Architecture, 1984), 115-116.
- Aalto Museum, *Alvar Aalto: Points of Contact* (Helsinki: Alvar Aalto Museum, 1994)
- Ballantyne, Andrew, "Architecture, life, and habit", in *Journal of Aesthetics and Art Criticism*, 69 (1), (2011): 43-49.
- Barbieri, Marcello, *Introduction to Biosemiotics: The New Biological Synthesis* (Springer, 2008).
- Blencowe, Chris, Judith Levine, *Moholy's Edit: CIAM 1933: The Avant-Garde at Sea* (Zurich: Lars Müller Publishers, 2018).
- Borchardt-Hume, Achim, "Two Bauhaus Histories", in idem., ed., *Albers and Moholy-Nagy: From the Bauhaus to the New World* (New Haven: Yale University Press, 2006).
- Botar, Oliver A. I., "The Origins of László Moholy-Nagy's Biocentric Constructivism", in Eduardo Kac, ed., *Signs of Life* (Cambridge, Mass.: The MIT Press, 2007), 315-344.
- Brentari, Carlo, *Jakob von Uexküll: The Discovery of the Umwelt between Biosemiotics and Theoretical Biology* (Dordrecht: Springer, 2015).
- Carnap, Rudolf, *Der Raum: ein Beitrag zur Wissenschaftslehre* Vol. 56 of Kant Studies Ergänzungshefte (Berlin: Reuther & Reichard, 1922).
- _____. *The Collected Works of Rudolf Carnap. Vol. 1, Early Writings, 1922-1927*, edited by A. W. Carus et al (Oxford: Oxford University Press, 2019), 22-208.
- _____. *Der Logische Aufbau der Welt* (Berlin: Weltkreis Verlag, 1928).
- _____. *The Logical Structure of the World and Pseudoproblems in Philosophy* (London: Routledge K. Paul, 1967).
- Charrington, Harry, *The Makings of a Surrounding World: The Public Spaces of the Aalto Atelier* (PhD Dissertation submitted to the Department of Sociology of the London School of Economics, 2008).
- _____. "Alvar Aalto and the Ambience of History", in Paul Emmons, John Shannon Hendrix, Jane Lomholt, eds., *The Cultural Role of Architecture* (London; New York: Routledge, 2012).
- Enajarvi, Elsa, interview with Alvar Aalto (trans. Juhani Pallasmaa), in *Tulenkantajat*, no. 3 (1929).
- Francé, Raoul Heinrich, *Die Pflanze als Erfinder* (Stuttgart: Kosmos, Gesellschaft der Naturfreunde, 1920).
- _____. *The Plants as Inventors* (New York: Albert and Charles Boni, 1923).
- _____. *Das Buch des Lebens: ein Weltbild der Gegenwart* (Berlin: Ullstein, 1924).
- Galison, Peter, "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism", in *Critical Inquiry* 16(4) (1990): 709-752.
- Giedion, Sigfried, "L'immeuble du journal 'Turun sanomat' à Abo (Finlande) Architecte Alvar Aalto", in *Cahiers d'Art*, 4 (1931): 217-22.
- _____. "Über finnische Architektur", in *Bauwelt*, 25 (1931): 34-35.

_____. "Irrationalität und Standard: Bemerkungen zu Alvar Aaltos Reise in die Schweiz", in *Die Weltwoche* (1941):

_____. *Space, Time and Architecture: Towards a New Tradition* (Cambridge Mass.: Harvard University Press, 1941).

_____. *Space, Time and Architecture: Towards a New Tradition*, second edition (Cambridge, Mass.: Harvard University Press, 1949).

Grüttemeier, Ralf, Klaus Beekman, Ben Rebel, eds., *Neue Sachlichkeit and Avant-Garde* (Amsterdam; New York, Rodopi, 2013).

Harwood, Pam, "Examining Line as a Heuristic Device in the Design Ethos of Alvar Aalto", in Geoffrey Broadbent, Carlos A Brebbia, eds., *Eco-architecture: Harmonisation Between Architecture and Nature* (Southampton: WIT Press, 2006).

Jain, Elenor, *Das Prinzip Leben, Lebensphilosophie und ästhetische Erziehung* (Frankfurt/Main: Peter Lang, 1993).

Kallis, Aristotle, "From 'Minimum Dwelling' to 'Functional City': Reappraising Scale Transitions in the Early History of CIAM (1928–33)", in *Planning Perspectives* (2020), 7.
<https://doi.org/10.1080/02665433.2019.1711446>

Launonen, Marjaana, "Aino Aalto as a Photographer", in Ulia Kinnunen, ed., *Aino Aalto* (Helsinki: Alvar Aalto Foundation, Alvar Aalto Museum, 2004), 136–92.

Menin, Sarah, Flora Samuel, *Nature and Space: Aalto and Le Corbusier* (London; New York: Routledge, 2003).

Michellini, Francesca, Kristian Köchy, eds., *Jakob von Uexküll and Philosophy: Life, Environments, Anthropology* (London; New York: Routledge, 2020).

Moholy-Nagy, László, *Malerei, Photographie, Film*, Bauhausbücher no. 8 (Munich: Albert Langen, 1925).

_____. *Von Material zu Architektur*, Bauhausbücher no. 14 (Munich: Albert Langen, 1929).

_____. *The New Vision: From Material to Architecture*, trans. Daphne M. Hoffmann (New York: Brewer, Warren & Putnam, 1932).

_____. "How Photography Revolutionises Vision", trans. Philip Morton Shand, in *The Listener*, 8 November 1933, 688-90 ._____.

_____. "From Pigment to Light", in *Telehor* 1, No. 1-2, (1936): 32-34.

_____. *Vision in Motion* (Chicago: Paul Theobald, 1947).

_____. *The New Vision: Fundamentals of Bauhaus Design, Painting, Sculpture, and Architecture* (Mineola, New York: Dover Publications, 2012).

_____. *Painting, Photography, Film* (Zurich: Lars Müller Publishers, 2019).

Moholy-Nagy, Sibyl, *Moholy-Nagy: Experiment in Totality*, foreword by Walter Gropius (New York: Harper, 1950).

Moholy-Nagy, László, Moholy-Nagy, Oskar Schlemmer, Farkas Moinar, *Die Bühne im Bauhaus*, Bauhausbücher no. 4 (Munich: Albert Langen, 1924).

Moravánszky, Ákos, *Re-Humanizing Architecture: New Forms of Community, 1950-1970* (Basel: Birkhäuser, 2017), 30.

_____. *Metamorphism: Material Change in Architecture* (Basel: Birkhäuser, 2018).

Morton-Shand, Philip, "A Tuberculosis Sanatorium Finland", in *The Architectural Review* 74 (442) (1933): 85-90.

Mumford, Eric, *Designing the Modern City: Urbanism Since 1850* (New Haven, Conn.: Yale University Press, 2018).

Mussari, Mark, *Danish Modern: Between Art and Design* (London; New York: Bloomsbury Academic, 2016).

Norvasuo, Markku, "Natural and Artificial Light in Alvar Aalto's Architecture", in Jochen Eisenbrand, Mateo Kries, eds., *Alvar Aalto: Second Nature* (Weil am Rhein: Vitra Design Museum, 2014), 178-201.

_____. "Designing Properly Lit Homes: The Question of Daylight and Electric Light in the Housing Architecture of Alvar Aalto between 1927 and 1935", in *Icon* 16 (2010): 179-200.

Pallasmaa, Juhani, "Alvar Aalto: Toward a Synthetic Functionalism", in Peter Reed, ed. *Alvar Aalto*:

Between Humanism and Materialism (New York: The Museum of Modern Art, 1998).

Pallasmaa, Juhani, Tomoko Sato, *Alvar Aalto: Through the Eyes of Shigeru Ban* (London: Black Dog Publishing, 2007).

Pelkonen, Eeva-Liisa, *Alvar Aalto: Architecture, Modernity and Geopolitics* (New Haven: Yale University Press, 2009). _____.

_____. "Alvar Aalto: Planning Finland, c. 1940", paper presented at the conference "Front to Rear: Architecture and Planning during World War II", Institute of Fine Arts, New York University, March 7-8, 2009.

_____. "Aalto's Entangled Geographies", in idem., Silvia Micheli, eds., *Aalto Beyond Finland: Projects, Buildings and Networks* (Helsinki: Rakennustieto Publishing, 2015).

_____. "Reading Aalto through the Baroque: Constituent Facts, Dynamic Pluralities, and Formal Latencies", in Andrew Leach, John Macarthur, Maarten Delbeke, eds., *The Baroque in Architectural Culture, 1880-1980* (London; New York: Routledge, 2015).

Plumb, Steve, *Neue Sachlichkeit 1918-33: Unity and Diversity of an Art Movement* (Amsterdam; New York, Rodopi, 2006).

Potochnik, Angela, Audrey Yap, "Revisiting Galison's 'Aufbau/Bauhaus' in light of Neurath's philosophical projects", in *Studies in History and Philosophy of Science* 37 (2006): 469-488.

Roth, Romain, *Raoul H. Francé and the Doctrine of Life* (Bloomington: First Books Library, 2000).

Rudberg, Eva, *The Stockholm Exhibition 1930: Modernism's Breakthrough in Swedish Architecture* (Stockholm: Stockholmia, 1999).

Ruusuvuori, Aarno, ed., *Alvar Aalto 1898-1976* (Helsinki: Museum of Finnish Architecture, 1978).

Schildt, Göran, *Sketches: Alvar Aalto* (Cambridge, Mass.: The MIT Press, 1978).

Schildt, Göran, ed., *Alvar Aalto in his Own Words*, trans. Timothy Binham (New York: Rizzoli, 1997).

Suominen-Kokkonen, Renja, *Aino and Alvar Aalto: A Shared Journey: Interpretations of an Everyday*

Modernism (Jyväskylä: Alvar Aalto Foundation, 2007).

Terranova, Charissa N., Meredith Tromble, eds., *The Routledge Companion to Biology in Art and Architecture* (London; New York: Routledge, 2016).

Tsai, Joyce, "Reconfiguring the Eye: László Moholy-Nagy", in Gordon Hughes, Phillip Blom, eds., *Nothing but the Clouds Unchanged: Artists in World War I* (Los Angeles: Getty Research Institute, 2014).

_____. *László Moholy-Nagy: Painting After Photography* (Oakland: California University Press, 2018).

von Uexküll, Jakob, *Theoretische Biologie* (Berlin: Gebrüder Paetel, 1920);

_____. *Theoretical Biology*, trans. D. L. MacKinnon (London: Kegan Paul, Trench, Trubner & Co, 1926).

_____. *A Foray into the Worlds of Animals and Humans: with A Theory of Meaning* (Minneapolis: University of Minnesota Press, 2010).