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Bauhaus Translations from Material to Architecture

The influence of the German Bauhaus' Vorkurs (Preliminary Course) on schools of art, architecture and design in the 20th century has become so familiar that many come to think of it as a point of mythic origin. Yet, despite its renown, the aims for many of the exercises in the Vorkurs remain unclear. Originally conceived by Walter Gropius as an alternative to a normative Beaux Arts study of exemplars in antiquity, the Bauhaus promoted the education of artists and architects through exercises that explored the effect and affects of different materials. After the departure of Vorkurs director Johannes Itten in 1922, the appointment of Hungarian artist, László Moholy-Nagy as his replacement was predicated on Gropius' reorientation of the Bauhaus towards "Art and Technology – a New Unity" during its 1923 Bauhaus Ausstellung (Bauhaus Exhibition). Inspired by the Austrian born botanist and nature philosopher Raoul Francé's concept of 'bio-technique', Moholy-Nagy intended that students would extend a study of materials in the Vorkurs exercises to the creative imagination of "technische Form" (technical form) in different media. To demonstrate this new approach to design education in practice, Moholy-Nagy published The New Vision after his departure from the German Bauhaus in 1928. Nevertheless, despite the numerous examples of work produced by students, artist and architects in his book, one is hard-pressed to find concrete examples of the creative transfer of information from the Vorkurs studies to technical solutions in practice. This paper seeks to fill a gap in research on Moholy-Nagy's pedagogical exercises at the Bauhaus through a re-assessment of the historical and theoretical underpinnings for his creative translation of material studies to new technological design solutions for architecture.

Introduction

The story of the German Bauhaus, its beginnings and demise, is well known in architectural history. Frequently hailed as the beginning of contemporary architectural education, the Bauhaus' plea for thinking afresh about problems of building in terms of new materials and tools continues to resonate in architectural discourse today. Upon receiving the directorship of the *Großherzoglich-Sächsische Kunstgewerbeschule* (Grand Ducal Saxonian school of arts and crafts) and the *Großherzoglich-Sächsische Kunstschule* (Grand Ducal Saxonian school of arts) in February 1919, Walter Gropius proposed to merge the two programs into the renamed *Staatliches Bauhaus* (State Bauhaus).[1] Founded during the years immediately following the end of the First World War, the pedagogy developed at the Bauhaus was as much a response to Germany's changing political landscape as it was to new industrial practices.

Criticized for the "technical backwardness, aesthetic inferiority, and economic worthlessness" of its industrial production before the war, German manufacturers, designers and architects had formed the *Deutscher Werkbund* (German Association of Craftsmen), arguing that the quality of German goods would improve if artists familiar with industrial processes designed them.[2] Gropius took inspiration from many of these ideas and incorporated them into his new school that he proposed would embody a reconsideration of crafts-based training, calling for the unity of the creative arts under the primacy of architecture.[3] After completing a half-yearlong obligatory *Vorkurs* (preliminary of basic course) to unleash students' imagination while also introducing them to materials, students joined the Bauhaus workshop of their choice learning a language of technique and invention.

Fig 1. View of the International Architecture Exhibition at the 1923 Bauhaus Exhibition.

Because of its novelty but also because of its important role in preparing students for training in the different crafts, the *Vorkurs* became one of the Bauhaus' most defining pedagogical features.

1 Marcel Franciscono, *Walter Gropius and the Creation of the Bauhaus in Weimar* (Urbana et. al: University of Chicago Press, 1971), especially 127-52.

2 Wilhelm Waetzoldt, "Die Entwicklung des kunstgewerblichen Unterrichtswesens in Preussen," *Deutsche Rundschau* 176 (1918): 228-45; 365-80 after John V. Maciuika, *Before the Bauhaus* (Cambridge: Cambridge University Press 2005), 21, n. 60.

3 Frank Whitford, *The Bauhaus: Masters & Students by Themselves* (London: Conran Octopus, 1992), 38-41.

Taught continuously from the fall of 1920 throughout the school's existence, the beginnings for the *Vorkurs* emerged less from a need to re-educate students with an existing training in the creative and applied arts than out of a necessity to raise the general level of talent exhibited by students enrolled in the first year.[4] As Gropius explained, the aim of the *Vorkurs* became a means to liberate the pupil "from the dead weight of conventions" so that they could approach the practical application of different materials and form in designing a new architecture that emerged from a process of manufacture.[5] Through carefully designed assignments which explored the visual and haptic qualities of materials, the *Vorkurs* sought to permit students to discover where their talent and latent aptitudes could blossom in the different workshops and inevitably architecture. However, when after four years of incubation, the Bauhaus opened the 1923 *Bauhaus Ausstellung* (Bauhaus Exhibition) to showcase its new industrial prototypes to the public, the architecture on display was comprised of a carefully selected array of international contemporary architecture and not that produced by the Bauhaus students themselves (fig. 1).[6] Compared to the other advanced courses in design, there was no workshop for architecture in which students could develop their own designs.[7] Students often complained that Gropius refused to teach architecture, which he argued was because students must "have first four years of training before [they are] able to go into conceiving architecture."[8]

On the occasion of the Bauhaus' fourth year of operation Gropius did not announce the beginning of a new architecture workshop, but the addition of a third programmatic goal "*Kunst und Technik – eine neue Einheit*" (art and technology – a new unity). Presented in a lecture for the Bauhaus Exhibition's opening reception, Gropius' change to the Bauhaus program was the resolution of a conflict between two radically different interpretations of the Bauhaus' pedagogical aims – those of Gropius and his at that time *Vorkurs* director, Johannes Itten. Itten's promotion of individual expression contrasted with Gropius' goal of an integrated architectonic vision, which he argued demanded that the Bauhaus start taking commercial commissions.[9] For Gropius, the ultimate goal for the Bauhaus programme remained in the conception of architecture, which he now characterized as walking "hand in hand with technology."[10]

On the appointment of the Hungarian Constructivist artist László Moholy-Nagy to director of the *Vorkurs* in October 1923, Gropius sought to reinforce the Bauhaus' new pedagogical unity with

4 Franciscono, *Walter Gropius and the Creation of the Bauhaus in Weimar*, 162, n. 32.

5 Walter Gropius, *The New Architecture and the Bauhaus*, trans. P. Morton Shand (London: Faber and Faber, 1935), 47.

6 Walter Passerge, "The Bauhaus Exhibition in Weimar," *Das Kunstblatt* 7 (1923): 309 ff. trans. Wolfgang Jabs and Basil Gilbert in Hans M. Wingler, The Bauhaus (Cambridge, Mass.; London, England: MIT Press, 1969), 67–68.

7 Wallis Miller, "Architecture, Building, and the Bauhaus," 64–69 in: *Bauhaus Culture: From Weimar to the Cold War* ed. Kathleen James-Chakraborty (Minneapolis, London: University of Minnesota Press, 2006).

8 George Baird, "Bauhaus Conflicts Seen Now," (BBC radio broadcast, transcript: 18 October 1968); transmission: 25 October 1968, 21:25 – 22:25), 12, after James-Chakraborty, 69, n. 20.

9 Walter Gropius "The Necessity of Commissioned Work for the Bauhaus (9 December 1921)," trans. Wolfgang Jabs and Basil Gilbert in Wingler, *The Bauhaus*, 51.

10 Walter Gropius, *Internationale Architektur* (Munich: Albert Langen Verlag, 1925), 71.

technology. What Itten had conceived as a metaphysical speculation of form and colour during the Bauhaus' first three years were reoriented towards an objective assessment of material effects and affects. Inspired by the Hungarian-born botanist and nature philosopher Raoul Francé's concept of 'bio-technique', Moholy-Nagy intended that students would translate the "typical possibilities" of different materials to the creative imagination of "technical forms" for arts, industry and – as the original German title: *Von Material zu Architektur* of his book *The New Vision*, suggests – architecture.[11] Yet, when Gropius finally established a building department in 1927, his replacement, Hannes Meyer broke with the original idea of a unified art school and sought to establish the architecture department as an autonomous entity. Under these circumstances, Moholy-Nagy left the Bauhaus with Gropius and moved to Berlin as a freelance designer and photographer until 1937, when he was called to Chicago by the Association of Arts and Industries to head a new design school based on the Bauhaus model.[12] Here, one must look for examples to the translations that Moholy-Nagy's intended for his pedagogical approach in practice. This paper explores how Moholy-Nagy's Vorkurs exercises at the Bauhaus sought to develop an architect's ability to think with the translation of material possibilities to new technologies for the arts and architecture such that each piece of work is built "solely form the elements which are required for its function."[13]

Moholy-Nagy, the Development of a Pedagogical Approach

Born in Hungary during the turn of the twentieth century, Moholy-Nagy's self-education as a teacher and artist had a decisive influence on his aesthetic approach to materials. Originally trained in law, Moholy-Nagy's earliest creative experiments were in portraiture and landscape painting.[14] Here, Moholy-Nagy began to experiment with a more abstract emphasis on expressing the lines of his paintings "where ordinarily no lines are used".[15] When he left Hungry a few months after the short-lived Communist Republic of Bela Kun had collapsed in August 1919, Moholy-Nagy at first immigrated to Vienna for six weeks.[16] As he recalled years later, Moholy-Nagy moved to Berlin because "I was less intrigued with the baroque pompousness of the Austrian capital than with the highly developed technology of industrial Germany."[17] This new interest coincided with a sudden change in Moholy-Nagy's work: the "network of lines" gained more prominence in Perpe (1919) as wheels, machine belts and trusses – images of industrial Germany. These objects were prominently figured in the works produced by two Berlin artists during the same year: Francis Picabia's depiction

11 László Moholy-Nagy, *The New Vision: Fundamentals of Bauhaus Design, Painting, Sculpture, and Architecture* (Mineola, NY: Dover Publications, 2012), 21 and 60.

12 Krisztina Passuth, *Moholy Nagy* (London: Thames Hudson, 1985), 61–65.

13 Moholy-Nagy, *The New Vision*, 61.

14 Passuth, *Moholy Nagy*, 13–14.

15 László Moholy-Nagy, "Abstract of an Artist," in *The New Vision*, 212.

16 Moholy-Nagy, *The New Vision*, 16.

17 Moholy-Nagy, "Abstract of an Artist," in *The New Vision*, 216.

of gears and wheels in a number of drawing and paintings including Réveil matin I (Alarm Clock I) on the May 1919 cover of DADA magazine and the Merz artist, Kurt Schwitters' drawing, *Konstruktion* (Construction) in the 10 July 1919 issue of the popular Berlin avant-garde journal *Der Sturm*. It is hard to imagine that Moholy-Nagy was not already familiar with the work of Schwitters whose exhibition he visited at the Sturm gallery within a month after arriving in Berlin during March of 1920.

Fig. 2. László Moholy-Nagy, h Construction, 1921.

Despite an initially critical reaction to the painted and assembled found objects of Schwitters' Merz art, Moholy-Nagy's own exploration of assemblage was essential to his appreciation of the "typical possibilities" of materials at the Bauhaus. After visiting Schitters' Sturm exhibition, Mohly-Nagy complained in a letter to a Hungarian colleague, Iván Hevesy that: "[a] man called Kurt Schwitters makes pictures from newspaper articles, luggage labels, hairs and hoops. What's the point?"[18] Nevertheless, Moholy-Nagy quickly exchanged paint for assemblage, gluing and nailing screws, bolts, sections of T-squares, and machine pieces to wooden boards covered with paint or drawings. Schwitters' Merz-use of found objects to create art and architecture introduced Moholy-Nagy to a method for going beyond normative practices of creating art and architecture by finding inspiration in the constructive potential of materials. As Schwitters explained in the first issue of his magazine *Merz*, the use of found objects to create art was the result of a unique approach towards his artistic materials: "These things are inserted into the picture either as they are or else modified in accordance with what the picture requires. They lost their individual character, their own poison, by being evaluated against one another, by being *entmaterialisiert* (dematerialized) they become material for the picture."[19] For Schwitters, the process by which a found object's culturally attributed identity was 'dematerialized' in its imaginative transformation as an element of art or architecture was likened to a mill. Schwitters relentlessly depicted wheels and mills in his

18 Moholy-Nagy, letter to writer Iván Hevesy, Berlin, April 1920, collection of the Documentation Center of the Art History Research Group of the Hungarian Academy of Sciences, Budapest, reproduced in Passuth, *Moholy Nagy*, 338.

19 With my inclusion of *entmaterialisiert* from the original German text, this English translation by Werner Schmalenbach, *Kurt Schwitters* (Köln, DuMont Schauberg, 1967), 94.

drawings and sculptures during this time to describe his new artistic method. In 1920, Schwitters extended his artistic method to architecture, creating a small cathedral model with gears in its nave entitled *Haus Merz* (House Merz) as alternative to Gropius' use of the crystal metaphor for the *Zukunftskathedrale*.[20] Moholy-Nagy, who had no formal training in art, shared a studio with Schwitters in Berlin from 1921–23. The sudden exploration of assemblage in his own artwork throughout 1921 illustrates the strong influence that Schwitters had on him (fig. 2).[21] Free from any academic fixations that might have hindered innovation, Moholy-Nagy was able to go beyond artistic boundaries and traditional concepts of art and design.[22]

From 1922 on, Moholy-Nagy began to synthesize Schwitters' influence with Constructivism, the machine and new technology – not only in formal terms but also by experimenting with new techniques and materials. It was at this time that Moholy-Nagy's co-authored the *Buch neuer Künstler* (Book of New Artists) in which he included Schwitters' *House Merz*, continued his celebration of the machine and participated in the 1922 Dada-Constructivist Congress in Weimar.[23] From Schwitters, Moholy-Nagy was introduced to a method for exploiting the objective principles of everyday materials in art. In Constructivism, Moholy-Nagy embraced the machine as a model for the purity of art and its emphasis upon the relationship of compositional elements that were void of representational references, arguing with Raoul Hausmann, Hans Arp and Ivan Puni that "[t]o be an artist is to surrender to the elements that give form."[24] Inspired by these approaches, Moholy-Nagy increasingly concentrated throughout the twenties on an exploration of direct light in photographs, photograms and three-dimensional compositions of wood, glass, and mirror-polished metals[25] "in which the movement of the viewer reveals the first state of free play of light in space that is produced by the mirror-like, reflecting material."[26]

A New Vision for Technical and Artistic Education

In early 1923, Gropius invited Moholy-Nagy to replace Itten at the Bauhaus and in the spring of the same year he took over the *Vorkurs* from the Bauhaus apprentice Joseph Albers. By that time, Gropius had become convinced that creative work at the Bauhaus had to be connected

20 Matthew Mindrup, "The Merz Mill and the Cathedral of the Future," *Interstices* 14 (November 2013): 52–55.

21 Moholy-Nagy, "Abstract of an Artist," in *The New Vision*, 216.

22 Irene-Charlotte Lusk, *Montagen ins Blaue: László Moholy-Nagy, Fotomontagen und -collagen 1922–43* (Giessen: Anabas, 1980), 68–69; Elizabeth Otto, "A 'Schooling of the Senses': Post-Dada Visual Experiments in the Bauhaus Photomontages of László Moholy-Nagy; Marianne Brandt," *New German Critique* 107 (Summer 2009) after Elizabeth Otto, "Designing Men," in: *Bauhaus Construct*, 188, n. 24.

23 Ludwig Kassak and László Moholy-Nagy, *Buch neuer Künstler* (1922), reprint ed. (Baden: Verlag Lars Müller, 1991).

24 Raoul Hausmann, Hans Arp, Ivan Puni, László Moholy-Nagy, *"Aufruf zur Elementaren Kunst," De Stijl*, no. 10 (1921): 156. Translated as "*Manifesto of Elemental Art,*" in: *Moholy-Nagy*, ed. Krisztina Passuth (New York: Thames and Hudson, 1985), 286.

25 László Moholy-Nagy created around sixty photomontages from circa 1922 while sharing a studio with Kurt Schwitters.

26 Hannah Weitemeier, "László Moholy-Nagy: Leben und Werk," in László Moholy-Nagy, exhibition catalogue (Stuttgart: Hatje, 1974), 71; after Rainer K. Wick, *Teaching at the Bauhaus* (Stuttgart: Hatje Cantz, 2001), 137, n. 36.

with industrial design if the school was to enact reform. Although Moholy-Nagy exhibited at the Expressionist Sturm Gallery in 1922 and was convinced that the creation of new forms could assist with the development of an improved world order, the twenty-seven-year-old Hungarian Émigré was thought to represent the new direction of Russian Constructivism.[27] Where Expressionism tried to develop "with the boundlessness of individual moments of feeling and visions", Constructivism was imbued "with the will to the most outward objectivity, economy, and conscious precision" that could be merged with industrial production.[28] The contrast to Itten's metaphysical and individualistic tendencies could not be stronger than in Moholy-Nagy's embrace of the machine, new technologies and Constructivism's objective purity. For Moholy-Nagy thought, the creation of this new unity between art and technology was not dependent upon students engaging in systematic work towards "standardized production". [29] Rather, Moholy-Nagy sought to provide students with opportunities during their first years of study for "amassing of impressions" that could establish a solid foundation for the "handling of materials in technical and artistic work."[30]

Upon his appointment at the Bauhaus, Moholy-Nagy made subtle changes to the *Vorkurs* in order to align it with Gropius' new aim for a unity between art and technology. In the same spirit as Itten, Moholy-Nagy viewed the *Vorkurs* as a pedagogical necessity for undoing the errors of academic education and to liberate the creative potential of the students. Under the belief that in highly developed industrial societies, modernity posed a threat to tactile experience, Moholy-Nagy saw their principal task as sharpening their students' perceptiveness – to become more 'aware' – be it to the qualities of a particular material or the pressing questions of their time. In this, Moholy-Nagy became essentially concerned with the training of the sense of touch, "a grasp of materials through actual experience [...] such as is never attained through book knowledge in the usual school exercises and the traditional courses of instruction."[31] Thus, he continued Itten's practice of introducing the students to a variety of media and materials through exercises that sought to train the tactile and optical senses of the students. Yet, whereas the tactile exercises created under Itten are marked by a farcical charm and humorous witticism, those under Moholy-Nagy were directed at the systematic study of the materials through chart-like *Tasttafeln* (touch panels) (fig. 3). For Moholy-Nagy, these data-gathering tools were intended to record the psychological reactions of individuals to different textures by means of "tactile diagrams" to objectify what was subjectively felt to make them accessible to inter-subjective reconstructions, i.e. translations.[32]

27 Rose-Carol Washton-Long explores the selection and impact Moholy-Nagy had upon the Bauhaus in Rose-Carol Washton-Long, "From Metaphysics to Material Culture," in James-Chakraborty, 49–58.

28 Emö Kallai, "Konstruktivismus," *Jahrbuch der Jungen Kunst* (1924), in Wechselwirkungen, ed. Gassner, 163–67 after: Victor Margolin, Struggle for Utopia (Chicago and London: The University of Chicago Press,. 1997), 77, n. 104.

29 Moholy-Nagy, *The New Vision* 23–24.

30 Moholy-Nagy, *The New Vision,* 23–24.

31 Moholy-Nagy, *The New Vision,* 18–19.

32 Wick, *Teaching at the Bauhaus*, 149–54.

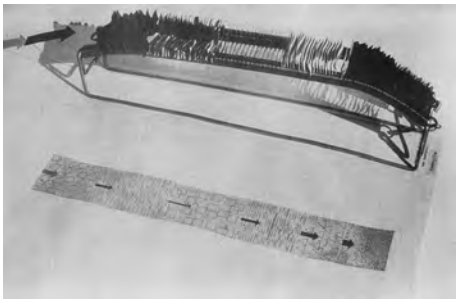

Fig. 3. Gustav Hassenpflug, Tactile study and diagram for Moholy-Nagy's Vorkurs, 1927.

Albers had already established a curriculum that combined the exploration of property values with simple functional construction methods. From 1923 until the end of the Weimar Bauhaus in 1925, Albers was responsible for the so-called work studies that formed part of the *Vorkurs*, then still just one semester that was officially led by Moholy-Nagy. In 1925 Moholy-Nagy expanded this course into a second semester where the basic knowledge of matter and method, acquired earlier, was applied to the inventive creation of form. Experiment, the free play of intuition and material knowledge, was valued higher than the finished result. "Education by process" became the motto of the *Vorkurs*.[33]

One is hard pressed to find differences between the methodology and pedagogical aims of Moholy-Nagy and Albers that emerge only in nuances between their terminology and use of *Vorkurs*' 'material studies'. Moholy-Nagy and Albers both adapted the characteristic Constructivist emphasis on truth to materials. To this end, Moholy-Nagy sought to establish unambiguous descriptions for terms like "structure", "texture" and what the Constructivists called *faktura* (facture). Moholy-Nagy defined the "structure" of a thing as the "unalterable manner in which the material is built up", while "texture" is the "organically resulting outward surface". Texture though, should not be confused with the "surface aspect" or facture that Moholy-Nagy defined as "the manner and the appearance of the surface, the sensorially perceptible result (the effect) of the working process."[34] Borrowing Moholy-Nagy's terminological distinction, Albers built up his instruction upon two pillars: on the exercises with *matière* or surface appearance and materials or structural properties. Unlike the *matière* exercises, which aimed to help develop sensory recognition of the surface of materials, the material exercises were concerned with exploring immanent features of the material, such as stability, load-bearing capacity, strength, and so on, that is, to examine their "inner energies".[35] Compared to the picturesque Dada-inspired assemblages of discarded objects under Itten's direction, those produced in Albers' course used industrial products and were more

33 Sibyl Moholy-Nagy, *Moholy-Nagy: Experiment in Totality* (Cambridge, Mass.: MIT Press, 1969, 2nd edition), 39.

34 Moholy-Nagy, *The New Vision*, 30–37.

35 Moholy-Nagy, *The New Vision*, 179–80, n. 56.

sober and functional to demonstrate the effects of the *matière* To put it in terms of art, Albers and Moholy-Nagy encouraged "[a]n art that presents rather than represents."[36]

The aim of refining the haptic and optical senses of students enrolled in the *Vorkurs* was to act as a source of inspiration for practical applications in design. Throughout *The New Vision*, Moholy-Nagy speculated upon the applications that the *Vorkus* exercises could have for art and technology. However, without concrete examples from the students, Moholy-Nagy resorted to descriptive illustrations of the work's potential. In reference to paper, Moholy-Nagy argued how studies with the surface treatment of paper could be used to create attractive patterns for manufacturers of chocolate or cookie wrappers. Similarly, the examples produced by Albers' paper folding exercises were proposed as a source for inventions of building constructions, household appliances, packaging, book-binding while the study of virtual volumes by rotating pieces of wire could anticipate the movement of parts in appliances and machines.[37] As Moholy-Nagy explained, "[t]he problem will be, of course, as everywhere else, to find the right ways of application."[38] These "ways" were dependent upon a conception of technology that had its beginnings in nature.

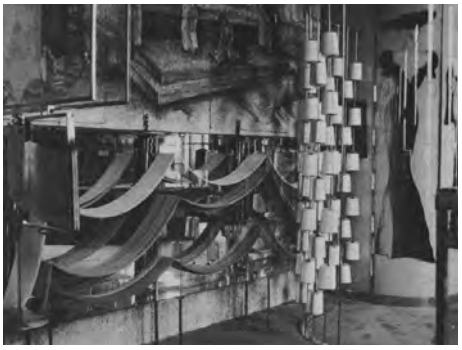

Fig. 4. Moholy-Nagy, Dutch Rayon Manufacturers Exhibition, Utrecht, 1934..

Translations From Material to Architecture

Moholy-Nagy argued at length in *The New Vision*, that the 'Bauhaus idea' was to delve into a given medium in order to extract the key properties of its structure and translate them as productive principles for finding technological solutions to practical problems. Moholy-Nagy identified the intellectual underpinnings for this approach in Francé's concept of 'bio-technique' as "the possibilities of using nature as a constructional model in creative technique."[39] Two months after the publication of a chapter of Francé's book, *Die Pflanze als Erfinder* (Plants as Inventors) in the Berlin

36 Albers quoted in Herzogenrath, "Joseph Albers und der 'Vorkurs' am Bauhaus, 1919–1933," *Wallraf-Richartz-Jahrbuch: Westdeutsches Jahrbuch für Kunstgeschichte* 41 (1979–80): 252; after Wick, 179, n. 53.

37 Moholy-Nagy, *The New Vision*, 129.

38 Moholy-Nagy, *The New Vision*, 54.

39 Moholy-Nagy, *The New Vision*, 60.

art journal Das Kunstblatt, Moholy-Nagy was hired to the Bauhaus. In *The New Vision*, Moholy-Nagy reiterated Francé's premise for the application of natural processes to technical artefacts in an understanding of "form follows function" such that: "[e]very process has its necessary form, which always results in functional forms. They follow the law of shortest distance between two points; cooling occurs only on surfaces exposed to cooling; pressure only on points of pressure; tension on lines of tension; motion creates for itself forms of movement – for each energy there is a form of energy."[40] For Moholy-Nagy, man has used functional suggestions of nature innumerable times, and he argued that many of our utensils, appliances, containers, tools, are based upon observations of nature. In reference to laws of economy and least resistance, Moholy-Nagy reasons that "[a]ll technical forms can be deduced from forms in nature" since "similar activities shall always lead to similar forms."[41] An example of this creative transfer of information garnered from the material studies can found in Moholy-Nagy's 1934 Dutch Rayon Industry exhibition design for the Commercial Fair in Utrecht and the World's Fair in Brussels. As Moholy-Nagy's wife Sibyl recalls, Moholy-Nagy hung tables from the wall and employed the very materials that were being displayed to create the architecture. Similar to the touch panels of Bauhaus students, Moholy-Nagy took inspiration from a study of the natural gradations of sound for the composition of a harp of colourful rayon spools for a screen wall (fig. 4).[42] Solutions to technical problems though, were to be found in biology and the laws of physics.

Referencing Francé, Moholy-Nagy reasoned that in all fields of creation, designers are striving to find functional solutions of a technical biological kind. For those designers who seek to build up a work solely form the elements which are required for its function, Moholy-Nagy claimed "[n]o technical form exists which cannot be traced to the forms of nature."[43] Similarly Francé argued "[t]he laws of the least resistance and economy of action force equal actions to lead to the same forms, and force all processes in the world to develop according to the law of the seven fundamental forms"[44] including the crystal, sphere, cone, plate, strip, rod, and spiral (screw). With particular attention towards the spiral (screw), Moholy-Nagy illustrated how these are the basic technical elements in diverse forms of aesthetic and industrial manufacture.[45] As demonstrated by one example, Moholy-Nagy sought to show how Francé's technical forms had diverse properties by which the spiral of a screw could become a spring carrying an entire structure.[46] At Moholy-Nagy's "New

40 Raoul Francé, *Die Pflanzen als Erfinder (Stuttgart: Kosmos, 1920), 82 translated as Plants as Inventors* (New York: A. and C. Boni, 1923), 12–13.

41 Moholy-Nagy, *The New Vision*, 60.

42 Sibyl Moholy-Nagy, *Moholy-Nagy: Experiment in Totality*, 111–12.

43 Moholy-Nagy, *The New Vision*, 18-19.

44 Francé, *Die Pflanzen als Erfinder*, 23.

45 Moholy-Nagy, *The New Vision*, 122.

46 The work is produced by Korona Krause in 1924. In *The New Vision* Moholy-Nagy describes it as "An attempt at constructive application of the spiral, which carries the whole structure." Moholy-Nagy, fig. 132, 125.

Bauhaus" school in Chicago the translation of spring's lever-like function led to the design of one of its the most celebrated projects, a wood spring mattress.

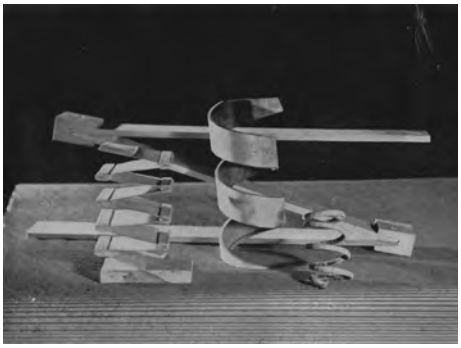

Fig. 5. Charles Niedringhaus and Jack Waldheim, Four Types of Wood springs, c. 1941-42...

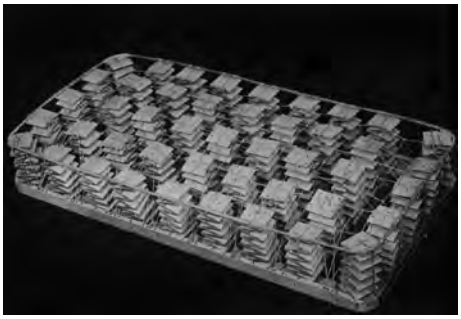

Fig. 6. Charles Niedringhaus and Jack Waldheim, Woodspring Mattress, 1942..

Already in Germany, Moholy-Nagy observed how the manipulation of flat sheets of paper into three-dimensional structures could be adaptable to the work with any flat sheet or slab, such as cardboard, plywood, metal, wire mesh, and plastics[47] (figs. 5 and 6). When working in wood (blocks, dowels, slabs), Moholy-Nagy remarked how cuttings and sawing's made by hand and machine, made a rigid board "rubber-like".[48] From a study of twenty-four different types of wood springs, Jack Waldheim and Kalman Toman arrived at the technological solution of a wooden spring design which could be easily produced and provide the comfortable elasticity of a metal box spring.

The ability for a designer to use of the constructive principles of natural or man-made objects in one location to solve technical problems of design in another is clearly the interconnectivity of solutions that Moholy-Nagy aimed. Similar to a metaphor in its Greek etymological beginnings as *metapherien* in the *traslatio* (transportation) of sensory information from one modality to another, the efficacy of a constructive technique in one location would thus depend upon how well it solves

47 László Moholy-Nagy, *Vision in Motion* (Chicago: P. Theobald, 1961), 81.

48 Moholy-Nagy, T*he New Vision*, 54.

that of a designed object in another. The Italian writer and literary philosopher, Umberto Eco places a great amount of importance upon the creative function of these 'translations' within and between semiotic systems.

Eco's exploration of the Russian-American linguist, Roman Jakobson's definition of intra- and intersystemic translations provides valuable insight into the creative transfer of technical solution Moholy-Nagy intended at the Bauhaus. As Eco explains, intrasystemic translations include the "interpretation of verbal signs by means of signs of some other language" while intersystemic translations occur when there is "an interpretation of verbal signs by means of signs of non-verbal sign systems."[49] For Eco, one can consider how the 'intrasystemic' translation of a map for the Crown Prince Islands on the west coast of Greenland remains within the same semiotic system when one reproduces it at a larger scale while the translation of the same map to three-dimensions by an Eskimo hunter using sealskin and driftwood is 'intersystemic.'[50] Compared to the intrasystemic variations of the sculptor Richard Serra's torqued arc sculptures, there is a decided step from purporting that Spanish architect, Santiago Calatrava's intersystemetic translation of the human spine to his Turning Torso skyscraper in Malmo, Sweden "is always creatively enriching the first item."[51]

Moholy-Nagy's pedagogical approach towards the intra- and intersystemic translations of *Vorkurs* materials studies was dependent upon the ability of a designer to find appropriate applications for them. The knowledge a student garnered about the principles of structure, texture, and surface treatment created by working with various materials in the *Vorkurs* were to be used for finding solutions to design problems that Moholy-Nagy viewed as the organization of space, form, material and processes in the most productive, economic way for solving a certain function.[52] The designer's choices were not based upon interchangeable considerations of single elements but as Moholy-Nagy's Rayon exhibition and wood spring mattress project at the New Bauhaus illustrate, how inter- and intrasystemic translations of material studies can inspire new solutions.

Conclusion

Throughout his career, Moholy-Nagy sought to justify his approach to the education of architects in learning the creative translation of sensory experience to solving problems of technical form. Already at the beginning of his book *The New Vision*, Moholy-Nagy asserted a universality of experience claiming that: "[e]veryone is equipped by nature to receive and assimilate sensory experiences. Everyone is sensitive to tones and colours, has sure touch and space reactions,

49 Umberto Eco, *Experiences in Translation*, trans. Alastair McEwen (Toronto, et al.: University of Toronto Press, 2001), 67.

50 Eco, *Experiences in Translation*, 103 and 118.

51 Umberto Eco, "The influence of Roman Jakobson in the Development of Semiotics," in *Roman Jakobson: Echoes of His Scholarship* (Lisse, The Netherlands: Peter de Ridder Press, 1977), 53.

52 Moholy-Nagy, *The New Vision*, 156–57.

etc. This means that by nature everyone is able to participate in all the pleasures of sensory experience."[53] One of the Bauhaus' most defining pedagogical features, the *Vorkurs*, had its goal in training a student's ability to make translations from one technological solution to another, from nature to machine and machine to machine. With material exercises in the *Vorkurs* directed toward sensory experiences, the enrichment of emotional values, and the development of thought, a student at the Bauhaus was intended to amass impressions that may appear unimportant at first. For his New Bauhaus curriculum, Moholy-Nagy drew heavily on the Bauhaus model in Germany, starting off with a one-year *Vorkurs* followed by three years of specialized workshop training. The *Vorkurs* was intended to stimulate the students' senses and imagination. It was not intended as an introduction to the practice of industrial design but to train a new generation of designers to grasp the relationship between form and function as a kind of wholeness. This was to be achieved not by a textural study of historical precedents but by "looking again" at material and constructive properties so that the student would be endowed with a knowledge of materials and the sapience for making intuitive translations of their principles to the technical solution of practical problems of design.

53 Moholy-Nagy, *The New Vision*, 15.