# AN AMERICAN WARTIME DREAM: *THE PACKAGED HOUSE* SYSTEM OF KONRAD WACHSMANN AND WALTER GROPIUS

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## INTRODUCTION

The "Packaged House" is an extraordinary example of a prefabricated modular construction system designed by Konrad Wachsmann and Walter Gropius, German emigres who came to the United States during World War II. Its lyricism inspired László Moholy-Nagy to include a photograph of the prefabricated parts *packaged* for delivery in his groundbreaking book *Art and Vision* of 1946. The "Packaged House" project is best known for its conceptual richness, but was never fully executed nor a commercial success.

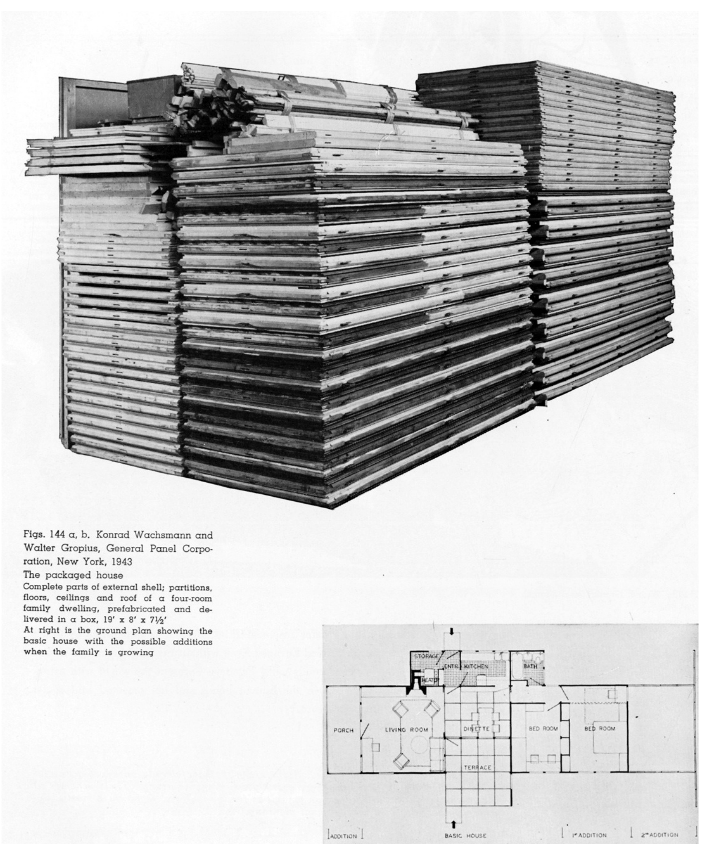


Figure 1. *The Packaged House System* in László Moholy-Nagy, *Art and Vision*, 1946.

Wachsmann did not have a preconception of the perfect or final house—it remained an *open system* of 10 types of 40" x 120" panels on a 40" module. This paper explores the relationship between System Theory that was developed during World War II and the "Packaged House" as an architectural Building System.

Wachsmann spent years developing the project and slowed down the design development and fabrication phases of the project as he sought to perfect the system: mundane concerns for fabrication repeatedly threatened to undermine the *universality* of the SYSTEM which was of utmost concern for him. The title of the book, *The Dream of the Factory-Made House: Konrad Wachsmann and Walter Gropius*, is telling in that the "Packaged House" remained a *dream* in that it never did in fact go into production. This is a shame, as the system was an incredible achievement that deserves attention today.

## SYSTEM THEORY AND BUILDING SYSTEMS

The confluence of system theory and the production of architectural building systems in the U.S. are related through the adaptation of pre-World War II techniques and knowledge that were transformed during the war and in the immediate postwar period. After discussing the theoretical implications of system theory, this paper explores The "Packaged House" by Konrad Wachsmann and Walter Gropius, a building system developed during the war. This building system illustrates the unique manner in which systems theory as a concept that linked vastly different fields would be explored in the field of architecture.

Prefabricated, quickly deployable building systems were necessary during the war to house troops and strategic equipment. Prefabricated building systems were also needed to house large numbers of migrant workers adjacent to the factories producing aircraft, equipment, and weapons. Even during the war, there was the notion of 194X, or the unknown, but eventual end year of the war, in which the stepped-up wartime factory could be retooled to produce low-cost prefabricated housing for returning veterans and their families.

Advancements made in technology and industrial fabrication during the war share a symbiotic relationship with a systems approach in architecture. Architectural building systems provide a concrete manifestation of the conceptual framework of system theory.

*System theory* was developed in tandem in the biological and physical sciences, challenging the previous held conceptions about organization. According to the laws of thermodynamics, a physical experiment is a "closed" system, in which a finite set of elements are in interaction and will tend towards a condition of "entropy" or loss of information as the system advances towards equilibrium. In contrast, argued through a "system" approach, organic and non-organic phenomena are considered as "open" systems– with interactions back to and from the environment.[1]

A system *may be any kind of entity, physical or theoretical, that is composed of interrelated parts.* There are common characteristics that systems share. There is a structure to how the component parts are arranged and a function or functions that each part performs within the larger environment of the system. *Input* is taken in from the environment and follows a *process* or set of procedures to produce an *output.* The output then acts to *feedback* information into the system from outside the system and acts to influence changes in the system.[2]

The publication in 1948 of Norbert Wiener's *Cybernetics: or Control and Communication in the Animal and the Machine*, following his 1943 *Behavior, Purpose and Teleology* with Julian Bigelow and Arturo Rosenblueth, was grounded in his involvement in and exposure to the development of mechanical control systems such as servomechanisms earlier in his career, and artillery targeting systems during World War II. A major challenge for the Allies was the incapacity of antiaircraft guns to make their target on Nazi aircraft during bombing raids. The aircraft had gained maneuverability and speed since World War I, and a new approach was desperately needed to predict how far ahead of the aircraft to aim the weapon. The weapons were fitted with "gun directors," a kind of analog computer which would calculate the plane's future position, and "servomechanisms," which would control the guns based on the "gun director's" output signals.[3]

Trajectory tables were created which calculated the variables of the gun caliber, size of the shell, and type of fuse. These tables were calculated by hand by mathematicians, who were known as "computers." Wiener's wartime work in ballistics would lead him to develop the theory of *cybernetics* and he would by 1948 discuss its application in diverse fields: from the prediction of flight paths, to computing machines, electrical networks, and neuromuscular behavior, among others. Whether mechanical or biological, the cybernetic system depends on *feedback*, which requires the communication of information within the system. The theme of self-organization and feedback mechanisms in the control of an organism or machine are clear similarities in cybernetics and system theory and demonstrate striking contrast to the received notions of science up until that point.

Concurrent to Wiener's work in cybernetics, biologist Ludwig von Bertalanffy had organized a group of thinkers around his notion of a *General System Theory*. This theory sought to develop a unified science of principles that could be applied in analysis of any manner of an open, evolving system, whether natural, physical, or social. A key feature of Bertalanffy's theory was that it would be applicable (as Wiener had thought of cybernetics) to any kind of subject—exhibiting the quality of *isomorphism*. Bertalanffy's text "*The Theory of Open Systems in Physics and Biology*," seeks to clarify the distinction between physical models and the organism:

> The only goal of science appeared to be analytical, i.e., the splitting up of reality into ever smaller units and the isolation of individual causal trains. Thus, physical reality was split up into mass points or atoms, the living organism into cells, behavior into reflexes, perception into punctual sensations, etc….
>
> We may state as characteristic of modern science that this scheme of isolable units acting in one-way causality has proved to be insufficient. Hence the appearance, in all fields of science, of notions like wholeness, holistic, organismic, gestalt, etc., which all signify that, in the last resort, we must think in terms of systems of elements in mutual interaction."[4]

Bertalanffy's phrase, "systems of elements in mutual interaction," in keeping with both Wiener's and Bertalanffy's belief in system theory being applicable to diverse fields as an isomorphic leap is demonstrated in the design of The "Packaged House." While this direct correlation cannot be documented we may view the "Packaged House" through this lens.

### THE *PACKAGED HOUSE:* BACKGROUND

Originally apprenticed as a cabinetmaker, Konrad Wachsmann studied at the Arts-and-Crafts schools of Berlin and Dresden and at the Berlin Academy of Arts (under the Expressionist architect Hans Poelzig). He worked for the timber building company Christof and Unmäck, where he was designer for wood prefabricated houses. In 1929 he persuaded Albert Einstein to use the Christof and Unmäck system for the house offered to Einstein by the city of Berlin. Wachsmann was held in an internment camp in France and on May 16, 1941, his fortieth birthday in Marseille, he received a visa to go to the U.S. He arrived in New York City by boat and Gropius wired money for him to get to Boston, where they collaborated for several months on various projects including a recreation center in Key West, when that work was abruptly stopped by the attacks on Pearl Harbor on December 7, 1941.[5] Wachsmann relates those days and the impact the attack would have on The "Packaged House" system in his autobiography *TIMEBRIDGE*:

> The next day Roosevelt declared war on Japan and within a few days Germany and Italy declared war on the United States.
>
> "This ends everything," Gropius said.
>
> "No," I answered, "this will be the beginning. Now people will come to their senses. They will be forced to be rational."[6]

Wachsmann continues,

> "Walter Gropius was quite desperate, but I cannot explain why I sensed that now the great opportunity had arrived. That evening on

> December 7, returning home, I told Gropius for the first time that I had developed during time in the internment camp in France a universal system of industrialized building components, of course in the metric system. I had 13 small ink drawings with me of that project as well as 12 sketches of the tubular steel structure system which I began to develop in Grenoble and continued "aux Cambreniers". When I had arrived in New York, my friends suggested to throw these drawings into the Hudson River, since they were sure that nobody was waiting for my ideas and designs. Those drawings were the only precious things I had brought over from the Old World, and I certainly was not going to throw them away.
>
> We talked after dinner until late in the night about it, and he became so interested that he said he would like to help, in fact to participate. And we decided to start to work at it immediately and together."

So in this way, Wachsmann and Gropius, both German emigrés to the United States, began to collaborate on a project for industrialized modular housing, The "Packaged House." Wachsmann's "universal Joint" would give great structural stability to the joining of prefabricated panels. Again, the jointing system was based on 2-, 3-, and 4-way connections between panels. All of the building surfaces were to be created from the same panels: exterior walls, interior partitions, floors, ceilings and the roof.

In February of 1942, the National Housing Agency allocated $153 million for the housing of displaced defense workers. There was a production target of 42,000 houses, and in September of 1942, the General Panel Corporation was set up to begin the manufacture of the "Packaged House". The test house that Wachsmann and Gropius showed in Somerville, Massachusetts, followed the guidelines of the TU1 house.

The house system is quite simple, and architecturally modest. In general it is conceived as a single-story, with a rectangular plan, with a shallow pitched roof and inset porch. What is interesting about the house is that the entire house is not conceived as a single repetitive unit, but that using the modular bay of 3'-4", infinite configurations could be made of the system, adapting to various climatic and site conditions, and to the taste of the architect and the owner. An impressive aspect of the project lies in the "abstract" qualities of the house, in its uniformity and precision. Great lengths were taken to make the system known to the public. A publicity campaign was undertaken in both the professional and lay press.

### THE *PACKAGED HOUSE* AS SYSTEM

Gilbert Herbert discusses how the concept of "system" was beginning to enter into the "architect's thinking at the time, although the term itself was not then in common usage."[7] He attributes its emergence to the intellectual climate of the 1920s and 1930s and the work of Alfred North Whitehead and his "analogous theory of organic mechanism," von Bertalanffy's foundation of a general systems theory, Arthur Tansley's concept of an ecosystem and also to Gropius's *Idea and Organization*, his philosophy of total architecture, which Herbert believes is in essence "a comprehensive systems theory of architecture."

One could easily say that the "Packaged House" system was in fact a closed system, in that there are a finite number of elements that can be manipulated within the system. It is true that the Packaged House would certainly be considered a closed system from this point of view. In prefabricated building systems, closed systems are made of proprietary building materials designed for that system only. Often, as was with the case of the "Packaged House," even the metrical organization is not aligned with building industry standards. The Packaged House panels, for example are 3'–4" wide x 10' high (vertical heights could be determined in 3'–4" increments, 3 of which make the 10' module), while logical within the system, does not correspond to the industry standard of 4'x8' plywood panels and other modular elements. Thus windows, doors, and all other architectural fittings would be modular only to the system. An open system is one in which the metrical dimensions would coordinate with a vast array of industrially produced materials and equipment.

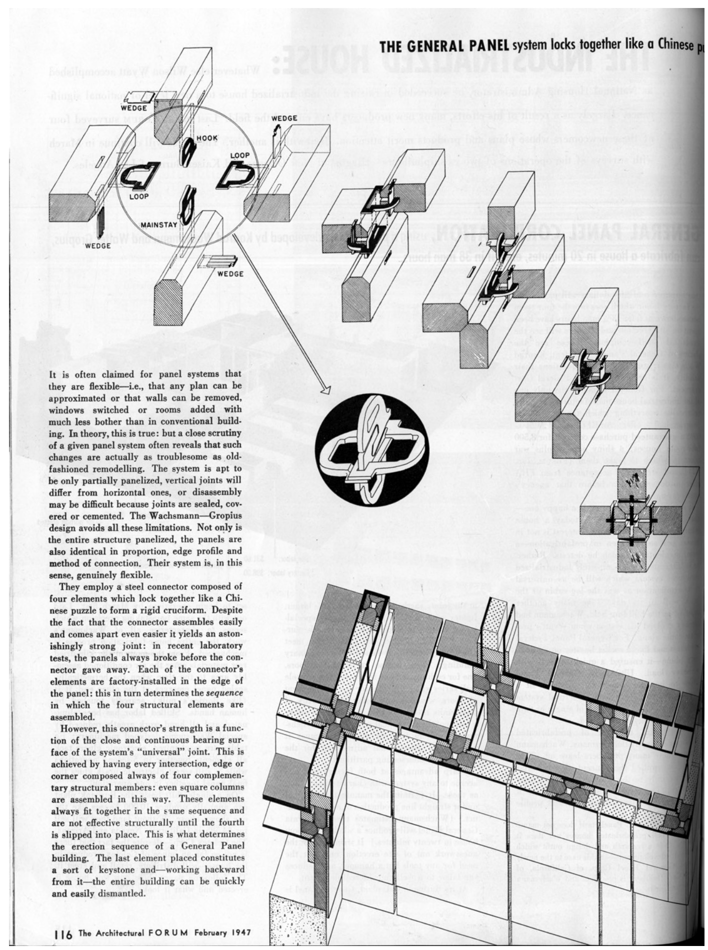


Figure 2. "The GENERAL PANEL system locks together like a Chinese puzzle." From (*Architectural Forum*, February, 1947): 116.

The" Packaged House," while closed in the finite elements (in design and coordination, but not in number), is actually an open system in that its goal, is not determined in advance, but only in the hands of each designer, and a particular time and place. And in this sense, it is an organic model, one that exhibits properties as Bertalanffy had outlined. The "Packaged House" system serves as a perfect case study with which to discuss the role of prefabricated building during World War II and to enunciate the extension of systems theories into construction.

The "Packaged House" system is a perfectly coordinated set of parts that can be brought together in myriad ways. The JOINTING SYSTEM was based on 2, 3, and 4 way connections between panels. All of the building surfaces were to be created from the same panels: exterior walls, interior partitions, floors, ceilings and the roof. Using the modular bay of 3'-4", seemingly infinite configurations could be made of the system. An impressive aspect of the project lies in the "abstract" qualities of the house, in its uniformity and precision. The "Packaged House" provided a new level of three-dimensional sophistication.

This is where a systems reading of Wachsmann and Gropius's "Packaged House" can be particularly revealing. While one could say that it is in fact a closed system and one that is utterly constrained to the use of the component parts, it is simultaneously also exemplary as an open system. To follow Wiener's notion of a closed system, one would have to have the end-goal in sight. That is, as a physical model of a system, the goal would be determined by the performance of the system. The missile would make its mark; the house would be determined at the outset by the system of parts.

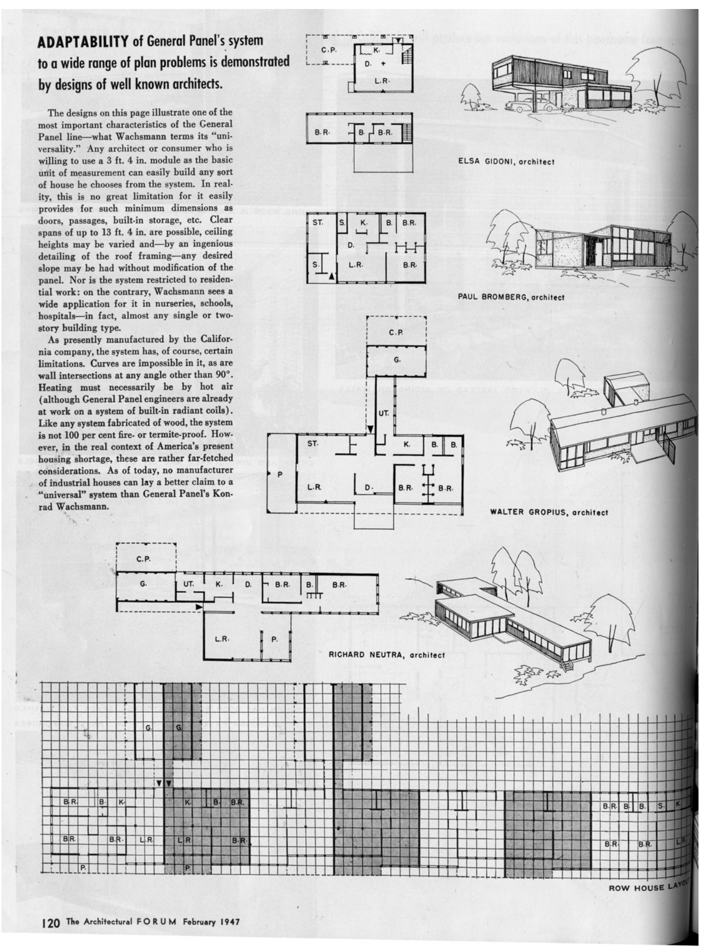


Figure 3. "Adaptability of General Panel's system to a wide range of plan problems is demonstrated by design of well-known architects." From (*Architectural Forum*, February, 1947): 120.

This is not the case. The system of parts exhibits pure potentiality: they do not predict a fixed outcome of the "organism" that is the building. Rather, the goal, or the teleological drive is in fact introduced case by case, with each architect who designed with the modular component parts that would be manufactured offsite. It could be argued that the goal of the system is to create enclosure, and that is certainly present. But unlike other prefabricated building systems of the time in which the unit was conceived at the room-scale, the room as cell, the "Packaged House" provides an almost unlimited variety of ways to enclose space, without the preconceived design of the room. In addition, the system, with its panels and edging pieces could enclose or make punctuated elements like columns.

The lesson to be taken from systems theory and cybernetics can be used to test the physical component systems of the "Packaged House." The panels are prefabricated, and are thus already complete entities, and are brought together to make the body of the structure through the locking together of the joints on the lateral edges of the panels. This is very different than a space frame in which linear elements are brought together at the extreme ends of the steel tubes at a joint. The space frame structure must then be clad with other kinds of covering whether metal panels, glass, or other kind of materials. While the space frame does provide a new level of three-dimensional sophistication, the "Packaged House" does this in a different and more compelling manner.

**THE UNFULFILLED DREAM**

The title of the 1984 book by Gilbert Herbert, *The Dream of the Factory-Made House*, is telling in that the "Packaged House" remained a dream in that it never did in fact go into production to satisfy the housing need. But by May 1945 with the end of WWII, the house was still not in production, despite enthusiasm for the project. But the house could have a second chance, in the enormous postwar demand for returning GI's and their families.

The General Panel Corporation raised funds to be able to take over the former Lockheed Factory in Burbank, California, which had been built to fabricate wartime aircraft for government contracts. Factories that made armaments were retooled to make houses, and there were incentives of Federal grants made available. Wachsmann took the leading role and set out to design the factory production line, which was ready by mid-1947, but the project erred in its timing again. By that time the Veterans Emergency Housing program was cancelled, and the Government withdrew its support.

Colin Davies, in his recent book *The Prefabricated House* points out that in the same period in which Wachsmann and Gropius were developing the "Packaged House," more than seventy companies produced over 200,000 prefabricated houses.  Davies places the blame on Wachsmann (and on architects in general) in that he was more concerned (bordering on a disciplinary obsession) with an abstract geometrical system that tended towards mathematical perfection. He was obsessed with the system and never stopped trying to improve it. For example, as soon as his ingenious 4-way connector was ready to go into production, Wachsmann retracted the design, slowing down the process. When they finally were able to go into production, it became clear that the product was too expensive, so the panels were simplified by replacing the "universal panels" with standard joist and framing.

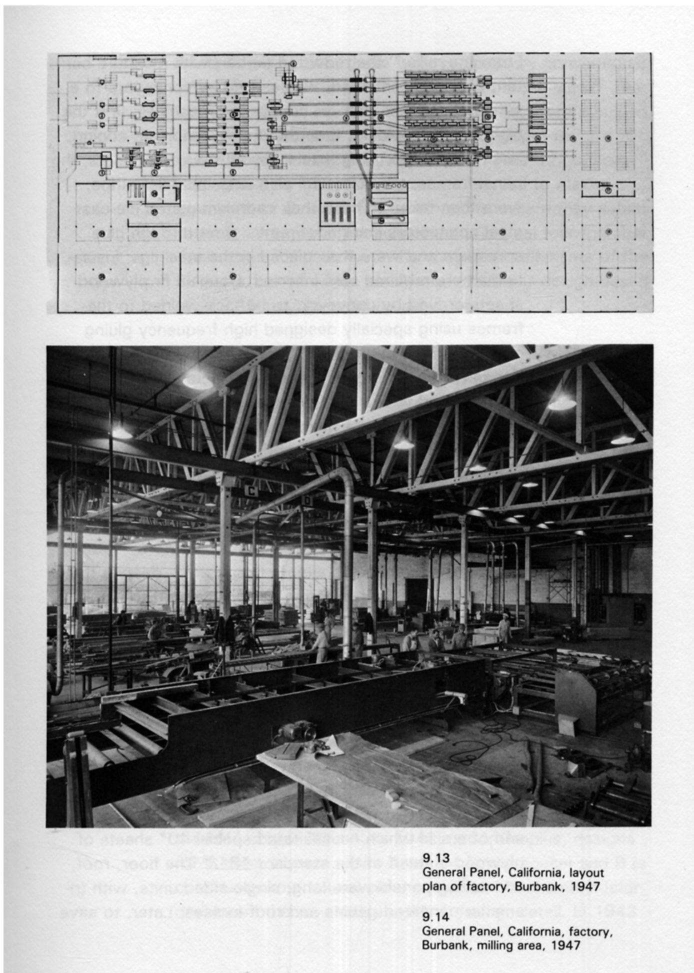


Figure 4. The General Panel Factory in Burbank, California, 1947. From Herbert Gilbert The Dream of the Factory-Made House (Cambridge, Mass.: MIT Press, 1984), 291.

This was too much for Wachsmann, because it completely undermined the UNIVERSALITY of the SYSTEM, which was of utmost concern for him.

> Even after I had left General Panel, I was sent to the Atomic Energy Commission site in Los Alamos. They needed 3000 houses immediately. They could only issue a letter of intent if the company was able to produce a bank credit. But the bank in turn said that since this was a very unorthodox case, they wanted a letter of intent first. It was a vicious circle which never could be resolved. And thus the 3000 houses were never produced.
>
> I had started the basic design for this housing system under obscure conditions in Europe but also as a result of my experiences at Christoph and Unmäck, always being convinced that this approach represented the only possible way to deal with modern housing I had come to the United States and re-designed the whole system in Lincoln with Walter Gropius. We had built several test houses and finally a gigantic factory. I had learned enough to understand that the principle in itself was wrong. And when I wanted to create the real product, it was too late.
>
> In 1949 I left General Panel Corporation without regret. I felt my life had been enriched by a formidable experience."[8]

The title of the 1984 book by Gilbert Herbert, *The Dream of the Factory-Made House: Konrad Wachsmann and Walter Gropius*, is telling in that the "Packaged House" remained a *dream* in that it never did in fact go into production. It is perhaps at this point, when the system that Wachsmann had designed was so open, that it was destined to fall apart.

## ENDNOTES

1. Bertalanffy, *General System Theory,* (New York: George Braziller, Inc., 1968), 33-44.
2. Catanese, Anthony J. and Alan W. Steiss, "Systematic Planning – The Challenge of the New Generation of Planners," *Ekistics: Reviews on the Problems and Science of Human Settlements, Volume 26, number 153,* (August 1968): 179.
3. Paul E. Edwards*, The Closed World: Computers and the Politics of Discourse in Cold War America*, (Cambridge: MIT Press, 1996), 45.
4. Bertalanffy, *General System Theory, 45.*
5. Konrad Wachsmann: An Autobiography "TIMEBRIDGE" 1901 TIMEBRIDGE 2001, 1981 Graham Foundation. Introduction by John Entenza. Unpublished manuscript consulted in the Getty Research Institute Library, 107.
6. *"TIMEBRIDGE,"* 119.
7. Gilbert Herbert, *The Dream of the factory-made house: Walter Gropius and Konrad Wachsmann*. (Cambridge, Mass.: MIT Press, 1984), 7-8. Herbert cites his own work, *Holism, the Ecosystem and Architecture: Towards a Philosophy of Architectural Design* of 1975 as a summary of the emergence of the idea of systems. I have not been able to identify a location to consult this work.
   Herbert's book is the most comprehensive study of the Packaged House, but other references are Konrad Wachsmann *The Turning Point in Architecture,* 1959-1961 English translation; Michael Tower's reprints  and description of the original drawings in *Perspecta* Vol. 34 (2003); Peter Cook's *Experimental Architecture*; and various publications from the time such as *L'Architecture d'Aujourd hui*, *Architectural Review* and *New Pencil Points.* It is also discussed from a point of view which examines and emphasizes Walter Gropius's role in the project in doctoral dissertation by Dora Epstein Jones in the chapter "Case Study 2: "A Fusion of Art, Science and Business" Walter Gropius and the Packaged House System, 1942-46. *Architecture on the Move: Modernism and Mobility in the Postwar* (U.C. Los Angeles, 2004).
8. "*TIMEBRIDGE,"* 119.