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# Architects and the Circular Economy: Knud Lönberg-Holm, Buckminster Fuller, and the Structural Study Associates

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## Abstract

This position considers the role played by architects in theorizing regenerative fabrication – a critical concern for building in the Anthropocene. The idea of Spaceship Earth, popularized by Fuller and the economist Kenneth E. Boulding in the 1960s, inspired the fields of industrial metabolism, energy accounting, and cradle-to-cradle, or what is now called the circular economy. But Boulding's contemplation of the input and output of energy, matter, and information within the ecosphere was already essential to the SSA, a coalition of architects allied to Fuller during the Depression. Their unique cybernetic, ecological, and systemic vision of buildings as transformers of energy and transmitters of information allied them to Lewis Mumford, the economist Stuart Chase, and to other technocratic thinkers, who scrutinized the impact of machine production on labor and natural systems. By introducing resource chart-making that took into account the energy cost of fabrication and the problems of waste and obsolescence, these groups prophesied a vital standard for the consumer as producer. Moreover, Lönberg-Holm – a pioneering figure of the new objectivity and an SSA member – translated the biological functionalism and energetics of international constructivism to the question of performative shelter, by working in unrecognized spheres of practice at F.W. Dodge Corporation and as a CIAM delegate.

These sources of sustainable architecture – which have been obscured by prevailing ecological paradigms, received histories of the international style, and scholarship on Fuller – can be uncovered through a deep reading of concepts that emerged in technocratic circles in the 1930s when environmentalism, rather than challenging large-scale industrialization as in the 1960s, sought a confluence of the natural and technological. Social theories of technology offer tools for looking beyond conventional notions of design practice, by considering the role of micro-actors and day-to-day work in modifying practice, rather than great paradigm shifts. In formulating novel inscriptional methodologies for design cycles from research to renewal, Lönberg-Holm's vision of building as a form of environmental control transcends its apparently instrumental origins to offer a historic case of architects in the circular economy.

# How Did It Fail? Considering the Decline of Environmental Experiments

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## Abstract

This paper proposes a conceptual framework to study the decline of environmental experiments within architectural history. It is based on a case study: the trajectory of a solar heating device named Trombe wall. A key component of solar architecture, it was experimented during the post-war decades and became highly popular during the 1970s oil crisis, but it did not manage to be applied on a large scale, and its appeal ended up declining. The Trombe wall case is analysed using two main frameworks developed in the history and sociology of science and technology. Firstly, Bruno Latour's in-depth analysis of a technological failure (*Aramis, or the Love of Technology*) invites to beware of simplistic arguments focused on the efficiency of a given experiment, and instead to investigate the dynamics of social actors and cultural factors that are involved in innovations, contributing to their success or failure. Then, Jean-Baptiste Fressoz' proposition to interpret modernisation as a process of 'disinhibition' (*L'Apocalypse joyeuse*), by which environmental awareness and alerts have been bypassed, leads to interrogate the counterpart of the decline of environmental experiments within architecture, namely the domination and impact of building technologies and types that have become widespread.

## Keywords

Solar architecture, Trombe wall, history of technology, decline.

## Confronting Failure

On 24 November 1973, the French national television channel broadcast an enthusiastic report about the use of solar energy in architecture.<sup>1</sup> On the screen, scientist Félix Trombe detailed the research he was doing in his laboratory located in the Pyrenees mountains, in the very south of France. He presented a series of buildings equipped with a solar heating device he had invented two decades before and which came to bear his name: the Trombe wall (Figure 1). It was designed to catch the sun rays on a black wall placed behind a glassed south facade; the air located in between was warmed and naturally distributed to the room at the back by upper vents, while part of the energy was stored in the wall and released at night.

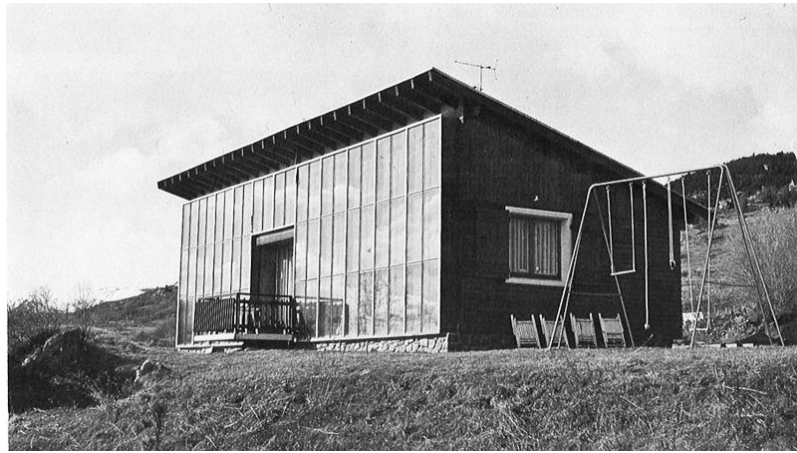


Figure 1. Experimental house equipped with a Trombe wall, Odeillo (France), 1967.  
Source: Detail.

Developed by scientists in collaboration with modernist architects in the post-war decades, the Trombe wall became a highly popular technology during the oil crisis, being internationally celebrated. As in the television report of November 1973, it was presented as a device capable of heating buildings without fossil fuels, while reducing pollution and increasing the inhabitants' awareness of climate and nature. In countless discourses, the Trombe wall and solar architecture were promoted as major solutions to solve energy and environmental problems, in present and future alike.<sup>2</sup>

Today, nearly half a century after this report, the Trombe wall is almost forgotten, relegated in some bioclimatic architecture handbooks, little discussed and rarely used. The Trombe wall, and more broadly solar architecture, after having been intensely investigated in the 1970s, declined and did not manage to become widespread. How did they fail?

The Trombe wall and solar architecture are not isolated cases. As historians gradually bring to light the ways environmental concerns emerged within architecture, and gave rise to various experiments, they have to confront the fact that most of them somehow failed: they did not manage to be applied on a large scale and their appeal ended up declining.<sup>3</sup> In this paper I propose a conceptual framework to study the decline of environmental experiments. I discuss how frameworks developed in the history and sociology of science and technology – fields of research that have long addressed these issues – can be used to analyse the Trombe wall case and contribute to the comprehension of environmental issues within architectural history. I discuss two main propositions: Bruno Latour's plea to go beyond efficiency arguments to explain failure, and Jean-Baptiste Fressoz' outlook that leads to consider decline symmetrically to the domination of other technological paths.

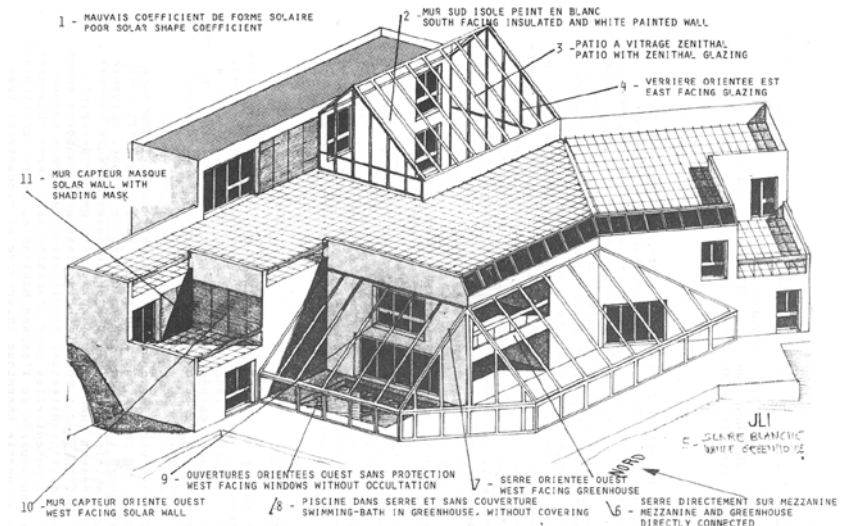


Figure 2. Jean-Louis Izard, 'Monstre bioclimatique montrant les principales erreurs visibles', 1982. Source: *Architecture solaire: Compte-rendu de la conférence internationale tenue à Cannes, France, du 13 au 16 septembre 1982* (Paris, New York: Lavoisier, American Energy Society, 1983) 470.

### Beyond Efficiency Arguments

A common reason that immediately comes to the fore to explain the failure of environmental experiments is efficiency: if a device or a method did not manage to be adopted on a large scale, it is because it was not efficient enough, and was thus abandoned. At various stages of its trajectory, the Trombe wall did face many problems. As it was developed in the 1950s and 1960s, difficulties of two sorts appeared.<sup>4</sup> On the one hand, the first experiments were subject to technical problems: it appeared difficult to properly regulate the warmth provided by the Trombe wall, causing overheating during hot summer days, and insufficient heating during long period of bad weather in the winter. On the other hand, the Trombe wall generated aesthetic questionings and problems of cultural acceptance: the first houses built by scientists with engineers were criticised for their repetitive design and the strangeness of their south facade, fully glassed but with a dark wall placed just behind the major part of it. It is to solve these problems that Félix Trombe collaborated with architect Jacques Michel, a disciple of Le Corbusier, who realised a series of buildings meant to improve the Trombe wall design and its integration within architecture. Then, during its phase of diffusion, the Trombe wall also caused problems: builders insufficiently aware of its requirements implemented it improperly, as a drawing from 1982 emphasises, showing the main errors made in solar buildings (Figure 2).

But are efficiency problems sufficient for explaining failure? In his book *Aramis, or the Love of Technology*, Bruno Latour argues that efficiency plays only a relative role in the process of failure.<sup>5</sup> Studying the case of a transportation system developed in the post-war decades, and meant to revolutionise mobility within cities and suburbs, he shows how this innovation faced a series of difficulties, ranging from technical complications to economic obstacles. But according to Latour, none of these difficulties are responsible for Aramis' abortion in the end of the 1980s. Indeed, a series of compromises were made to adapt the initial design to the successive requirements that appeared – just as for the Trombe wall, which was improved and turned out to be able to heat houses when well designed.<sup>6</sup> Latour thus argues that to be successful, an innovation must not only evolve and adapt, but most importantly generate support and create demand in order to bypass the scepticism it may generate at some points. To do so, the persons in charge of its development – whom Latour calls 'spokespersons' – have to convince more and more people of the technology benefits, turning them into 'allies'. Beyond efficiency arguments, Latour thus puts at the fore the importance of the social and cultural dynamics that are involved in an experiment.<sup>7</sup>

#### Decline as Marginalisation

This theory should lead us to adopt a larger scope and to consider a given experiment within the field of forces and interests in which it evolves. Returning to the Trombe wall and solar architecture, it implies wondering who their supporters and opponents were, and how they confronted each other.

During the 1970s, the Trombe wall was first involved in a controversy about the role of technology within solar architecture. It became a symbol of passive solar architecture, as opposed to the active one. The partisans of passive solar architecture considered that a good use of basic elements, such as glazing and thermal masses, were sufficient for harnessing the sun's energy, and were the only vehicle for transforming the housing design and the inhabitants' way of life.<sup>8</sup> In the meantime, they opposed to the active technologies, which required electricity to work and were conceived so as to be industrialised. As a caricature by a well-known French cartoonist and environmentalist incisively pointed out<sup>9</sup>, the passive solar partisans accused active solar technologies of being responsible for a bad perception of solar architecture as a whole, as they most often consisted in adding technical equipment onto standard buildings, without much cultural consideration and with bad performances. But this intense controversy between passive and active solar architecture was then brushed aside by a major shift of context in the first half of the 1980s. At that moment, oil prices declined, and the rise of other energy sources wiped out the hopes that had been placed in solar heating. In France, the domination of nuclear power, combined with

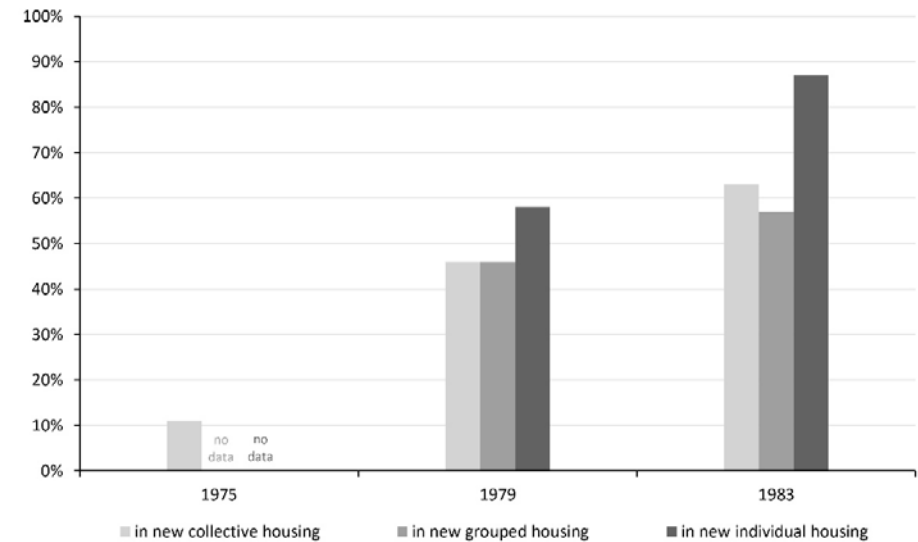


Table 1. Proportion of electric heating installed in different types of new housing in France in 1975, 1979 and 1983. *Source:* Paul Bouet, 2018; data from: Ministère de l'urbanisme et du logement, "L'équipement énergétique des logements neufs", *Statistiques et études générales* 107 (1984).

the effects of thermal regulations decided in the aftermath of the oil crisis, led to the generalisation of a building model based on high consumption of materials for insulation and full dependency on electricity and gas (Table 1), while environmental issues were lastingly marginalised in architectural debates. From that moment on, the Trombe wall and solar architecture brutally declined.

Such twin phenomenon of rise and decline can be related to the work of Jean-Baptiste Fressoz. In his book *L'Apocalypse joyeuse*, Fressoz studies a series of environmental controversies provoked by the development of technologies during the industrial revolution.<sup>10</sup> He argues that despite awareness and alerts about the deleterious effects that these technologies caused on health and nature, they imposed themselves, and softer alternatives were belittled. Fressoz thus proposes to consider modernisation as a process of 'disinhibition', in which 'devices', such as forms of regulation and ideologies, were invented to knowingly bypass environmental alerts and alternatives. In other words, if environmental consciousness and experiments emerged at certain points in history, they were marginalised by dominant forces – in this case, industrial capitalism. Following Fressoz' theory, understanding the decline of environmental knowledge and experiments implies shedding light on their contrary, with which they are tightly interwoven. If solar architecture failed, then what type of building came to dominate, and with what consequences on the environment? Answering this kind of question would certainly lead to a more 'anonymous

history', to paraphrase the subtitle of Sigfried Giedion's *Mechanization Takes Command*,<sup>11</sup> and to explore the less regarded although ubiquitous 'B-side' of environmental experiments. It would imply investigating the genealogy of common building technologies and types, the discourses that accompanied their spreading, and their major environmental impact.<sup>12</sup> If such an inquiry seems to bring us to the limits of the traditional scope of architectural and art history, is it not the condition to really, materially, understand the role architecture and the built environment have been playing in what researchers named the Anthropocene to describe the effects of centuries of human activities on the Earth?<sup>13</sup>

Whatever the ways we choose to explore, as historians shed light on the emergence of environmental experiments, considering their decline seems of primary importance. It is not only a condition to avoid an instrumental use of the history of environmental architecture, that would only search for efficient designs in the past to be transplanted in the present situation. It is also a necessity in order to better understand architecture's involvement in the Anthropocene, highlighting the paths that were followed through the options that were dismissed.

### Notes

- 1 Michel Péricard and Louis Bériot (presenters), television report on solar energy, *La France défigurée*, Première chaîne de l'ORTF, 24 November 1973.
- 2 I developed this case study in *Le mur Trombe, 1952-1986: Expérimentation et marginalisation d'une énergie alternative* (master thesis, École des hautes études en sciences sociales, 2017).
- 3 Just to mention a few examples, neither the ecological design methods developed by former Bauhaus members and studied by Peder Anker in *From Bauhaus to Ecohouse: A History of Ecological Design* (Baton Rouge: Louisiana State University Press, 2010), nor the solar devices experimented by American scientists and architects analysed by Daniel A. Barber in *A House in the Sun: Modern Architecture and Solar Energy in the Cold War* (New York: Oxford University Press, 2016), nor the prolific investigations of the 1970s in North America highlighted in *Sorry Out of Gas: Architecture's Response to the 1973 Oil Crisis* (Montréal, Montova: CCA, Corraini Edizioni, 2007), managed to be applied on a large scale.
- 4 For a summary of these difficulties, see Jacques Michel, 'Utilisation de l'énergie solaire', *L'Architecture d'aujourd'hui* 167 (May-June 1973), 88-96.
- 5 Bruno Latour, *Aramis, or the Love of Technology* (Cambridge: Harvard University Press, 1996), first published as *Aramis ou l'amour des techniques* (Paris: La Découverte, 1992).
- 6 Although its performances were a matter of debate, the Trombe wall provided between 50 and 95 % of total heating in the houses where it was tested, depending on the location and design. The rest was provided by an auxiliary system, most often electric heating.
- 7 Latour formulated his argument, typical of the social construction of technology theory, together with his colleagues of the Centre de sociologie de l'innovation, in an article published in two parts: Madeleine Akrich, Michel Callon and Bruno Latour, 'À quoi tient le succès des innovations ? 1. L'art de l'intéressement', '2. Le choix des porte-parole', *Gérer et comprendre: Annales des Mines* 11 and 12 (1988), 4-17 and 14-29.
- 8 For arguments in favour of passive solar

architecture, see for instance: Edward Mazria, *The Passive Solar Energy Book: A Complete Guide to Passive Solar Home, Greenhouse and Building Design* (Emmaus: Rodal Press, 1979); Patrick Bardou and Arzoumanian Varoujan, *Archi de soleil* (Roquevaire: Parenthèses, 1978), 108.

- 9 Reiser (Jean-Marc), *Le solaire, c'est moche et ça marche pas !* (ca. 1975). Reiser was relaying a common critic opposed to an experiment conducted by the state company Électricité de France (EDF). In 1974, EDF had implemented solar heating panels, inspired by the American research of the 1950s, on standard suburban houses in both Le Havre (north of France) and Aramon, near Montpellier (south). The active systems they were equipped with soon malfunctioned, and the houses were discredited by architects for their lack of formal quality.
- 10 Jean-Baptiste Fressoz, *L'Apocalypse joyeuse* (Paris: Seuil, 2012).
- 11 Sigfried Giedion, *Mechanization Takes Command: A Contribution to Anonymous History* (New York: Oxford University Press, 1948).
- 12 Examples of such inquiries can be found in the close research field of urban environmental history. See in particular Adam Rome, *The Bulldozer in the Countryside: Suburban Sprawl and the Rise of Environmentalism* (New York: Cambridge University Press, 2001), and William Cronon's major book on the co-construction of city and countryside, *Nature's Metropolis: Chicago and the Great West* (New York/London: W.W. Norton & Co, 1991). The idea of considering common architectural technologies and types can also be related to historian David Edgerton's work. In his book *The Shock of the Old: Technology and Global History since 1900* (New York: Oxford University Press, 2007), he criticises historians' obsession for innovation, for starting points, which mask the fact that most of the technologies in use throughout the world are very common and old ones.
- 13 For a critical discussion on the consequences of the Anthropocene concept for humanities, and especially

history, see Christophe Bonneuil and Jean-Baptiste Fressoz, *The Shock of the Anthropocene: The Earth, History and Us* (New York: Verso, 2016), first published as *L'Événement Anthropocène: La Terre, l'histoire et nous* (Paris: Seuil, 2013).