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Marco Cimillo

Ralph Knowles and the Rise of Solar Architecture

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Abstract

Ralph Knowles and the Rise of Solar Architecture

The contribution outlines Ralph Lewis Knowles' role in the rise of solar architecture, and his pioneering research ethos and methods which harbingered green building, performance-base and parametric design decades in advance of their establishment as mainstream concepts in architecture. Through his concept of the 'solar envelope' and an experimental approach to environmental design, Knowles redefined the relationship between natural forces and built form. His work laid a conceptual and methodological foundation for climate-responsive architecture and urbanism, fostering a paradigm shift toward integrating solar geometry, energy flows, and spatial organization. While the significance of his contribution is undisputable, their contemporary implications may be yet to fully unfold.

Ralph Knowles and the Rise of Solar Architecture

Il contributo delinea l'apporto di Ralph Lewis Knowles all'ascesa dell'architettura solare, insieme al suo approccio etico e metodologico alla ricerca, di natura pionieristica, che preannunciò l'edilizia sostenibile, la progettazione parametrica, con decenni di anticipo rispetto alla loro affermazione come concetti popolari dell'architettura. Attraverso il concetto di "involucro solare" e un approccio sperimentale al progetto ambientale, Knowles ha ridefinito la relazione tra le forze naturali e la forma costruita. Il suo lavoro ha posto le fondamenta concettuali e metodologiche per un'architettura e una progettazione urbana climaticamente reattivi, promuovendo un cambiamento di paradigma verso l'integrazione tra geometria solare, flussi energetici e organizzazione spaziale. Sebbene la rilevanza del suo contributo sia indiscutibile, le sue implicazioni contemporanee potrebbero non essersi ancora pienamente dispiegate.

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Vesper è una rivista scientifica semestrale, multidisciplinare e bilingue, si occupa delle relazioni tra forme e processi del progetto e del pensiero. Ponendo lo sguardo al crepuscolo, quando la luce si confonde con il buio e l'oggetto illuminante non è più visibile, *Vesper* intende leggere l'atto progettuale seguendo e rendendo evidente il moto della trasformazione. Pitagora identificò nel pianeta Venere sia la stella della sera (*Hesperos*) che quella del mattino (*Phosphoros*), i due nomi si riferiscono allo stesso astro ma posto in condizioni temporali differenti. *Vesper* dichiara quindi una posizione più che un oggetto e privilegia il situarsi che ne profila lo statuto. Non è qui accesa la luce tagliente dell'alba, che promette giorni completamente nuovi e alti sol dell'avvenire, ma quella che fa intravedere nella penombra una possibilità nell'esistente.

Richiamando e rinnovando la tradizione delle riviste cartacee italiane, *Vesper* ospita un paesaggio articolato di modalità narrative, accoglie forme di scrittura e stili differenti, privilegia l'intelligenza visiva del progetto, dell'espressione grafica, dell'immagine e delle contaminazioni tra linguaggi. La rivista è pensata nella sua successione di numeri tematici come discorso sulla contemporaneità, nello spazio di ogni singolo numero è articolata in un insieme di rubriche che gettano luci differenti sul tema. Nel procedere delle diverse sezioni – editoriale, citazione, progetto, racconto, lezione, saggio, inserto, traduzione, archivio, viaggio, ring, tutorial, fundamentals – mutano i riverberi tra idee e realtà, si accende l'intreccio tra evidenze concrete e loro potenzialità, potenziali trasformativi, immaginari. Le rubriche sono pensate non per aggiornare istantaneamente ma per indagare condizioni progettuali e per fornire strumenti e materiali dall'*ombra lunga*.

Vesper
Journal of Architecture, Arts & Theory

Vesper is a six-monthly, multidisciplinary and bilingual scientific journal which deals with the relationships between forms and processes of thought and of design. Gazing into the dusk, when light slowly merges with darkness and the illuminating object is no longer visible, *Vesper* aims to interpret the act of designing through tracing and revealing the movement of transformation. Pythagoras identified in the planet Venus both the evening star (*Hesperos*) and the morning star (*Phosphoros*), assigning the two names to the same star observed in different temporal conditions. *Vesper* thus states a perspective rather than an object, privileging the condition that defines its status. Rather than the sharp light of dawn, heralding a brand-new day and promising a brighter future, it is the twilight that allows you to have a glimpse at the potential of what is already there.

Following the tradition of Italian paper journals, *Vesper* revives it by hosting a wide spectrum of narratives, welcoming different writings and styles, privileging the visual intelligence of design, of graphic expression, of images and contaminations between different languages. The journal is conceived as a series of thematic issues that build a discourse on the contemporary. Each issue is divided into sections that offer a range of diverse perspectives on the theme analysed: editorial, quote, project, tale, lecture, essay, extra, translation, archive, journey, ring, tutorial, fundamentals. Throughout the different sections, reverberations between ideas and reality change, connections emerge between tangible facts and their potentials, transformative prospects, collective perception. The principal aim of these sections is not to provide instant news, but to offer an in-depth investigation of different instances of design and to provide tools and materials that have a long-lasting effect.

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Ralph Knowles and the Rise of Solar Architecture



Ralph Knowles using his *Heliodon*. Ph. Douglas Noble. CC BY-SA 4.0.

AN AUTHOR

Marco Cimillo

One of the fathers of solar architecture died in August 2024, but his legacy lingers on and will continue to shape our way of thinking about form, buildings, and cities in connection with, and through the lenses of, energy and nature. Professor Ralph Lewis Knowles was a monument to passive design and, together with a handful of fellow scholars, laid the foundation for contemporary architectural research in this area. He established himself as a leading research architect between the 1960s and 1970s, under the influence of Buckminster Fuller, his supervisor during his studies at North Carolina State University, James Marston Fitch (Marston Fitch 1948), Victor Olgyay (Olgyay 1963) and Kevin Lynch (Lynch 1960), whose landmark publications on environmental design, bioclimatic architecture and urbanism informed and inspired his research. Concurrently in the US, the environmental movement was emerging amidst raging urban sprawl, widespread pesticide contamination at home and chemical warfare in Vietnam, nuclear fallout from domestic military experiments and the looming international energy crisis. An ominous scenario in which hope, however, was not completely lost. Showing the way, among others, were Rachel Carson's *Silent Spring* (Carson 1962), the Club of Rome and MIT's Limits to Growth, Bucky's Spaceship Earth (Buckminster Fuller 1969). These works provided a fundamental contribution to establishing the cultural awareness and the scientific foundation for what later became known as the aspiration to 'Sustainable Development' – still the greatest challenge of our time.

At that juncture, the young Knowles took up a post at the University of Southern California in search of an academic setting more open to experimentation than the East Coast schools dominated by more formalist research lines (Knowles 2012). Given his upbringing, it does not surprise he held different ideas, and that the title of his first important publication was, emblematically, *Energy and Form* (Knowles 1978). The book summarised a decade of research. One line of inquiry investigated how solar geometry shaped the ancient 'Pueblos' (villages) built between New Mexico and Colorado and how those long-extinct civilisations evolved from reacting adaptively to natural forces to pre-organising their constructions once they could foresee those dynamics and predict their effects. Modern analysis tools revealed how both processes led to spatial configurations that were able to mitigate the seasonal rigours of the local climate. A second line of research looked into the contemporary applications of similar principles. Given the momentous context described above, Knowles and his colleagues started affirming the idea that context matters in architecture and in architectural education and that the natural forces exerting their power on cities and buildings should also contribute to shaping them (Witt, Reznich 2018; Knowles 2012). It may sound obvious now, but at the time, committing to those principles by applying rigorous research methods to design revolutionised their architecture studio, making a name for the school thanks to the novelty of their approach. Between 1966 and 1968, he worked in a team with Pierre Koenig, another architect, who focused on wind, and Emmer Wemple, a landscape architect, who focused on water. They started inventing and building devices with the students to simulate solar energy, land erosion and wind dynamics. The wind tunnels were so effective that they were later used in aerospace research, while the outdoor large-scale water tables became a sensation on the USC Campus. Meanwhile, yet another disciplinary boundary was pushed, as they devised immersive installations to simulate spatial experience and environmental dynamics in an astounding anticipation of digital simulations and extended reality. Concurrently, Knowles directed his attention to the most powerful of the natural forces under consideration – the sun – and one of his best-known achievements became the conceptualisation of the 'solar envelope'. Defined by imaginary boundaries derived from the sun's relative motion (Knowles 2003) and calculated algorithmically to guarantee fair solar access to all neighbouring structures, it enables the extensive use of solar technologies in urban settings. In short, solar geometry applied to zoning. The size and form of such boundaries are defined as a function of 'performance' and vary according to 'parameters': the desired performance itself, the latitude, the slope angle, the size of the plots, etc. Its first applications were tested in collaboration with the local city council, but the concept was not broadly adopted. Perhaps, architects and planners were not ready at the time, but, unsurprisingly for Knowles enthusiasts, the method was recently translated into computational plug-ins for Grasshopper decades after they were first developed. What previously required specialist knowledge and a laborious manual process can now be automatically generated within the same tool and workflow employed for general design. Asked in 2012 about the current application of his tool in zoning, Knowles, citing examples in the US, Germany and Israel, commented: 'It's starting […] it takes time for society to adapt to new ideas' (Knowles 2012).

Indeed, his pioneering work has influenced generations of academics and designers worldwide but has never managed to deploy its full potential and produce the widespread impact on urban development its author had hoped for. One possible reason, cited by Knowles himself, is the dominance of models dictated by the aspiration to instant economic gain rather than long-term vision and the common good. Another reason might have to do with the very nature of his innovations. Climate-responsive, dynamic, parametric, algorithmic, multi-scalar… Present-day buzzwords that are often overused and misunderstood perfectly define the approach and the tools he developed. Perhaps they also partially explain why such innovations were not widely adopted in his lifetime and why they might still experience a second youth now: they were too far ahead of their time.

What might have been then can still be today – and in what forms? The currency of his lesson is demonstrated by its lasting presence in research, in teaching, and in the cultural debate. His work (among others') was featured in the exhibition *Emerging Ecologies. Architecture and the Rise of Environmentalism* at the New York Museum of Modern Art in 2023-2024; Harvard University's Office for Urbanisation themed its inaugural conference in 2016 on *Heliomorphism* based on Knowles' solar envelope; new research articles are still published today to analyse and further develop his methods. The simplifications brought about by the new digital tools and (even more) the changes in the contemporary design paradigms are certainly significant strides, but other substantial obstacles still lie ahead on the way to the solar future envisioned by Knowles. Not least is the fact that common architectural and planning practices possess enormous inertia and that large-scale changes remain slow even when a consensus is formed in theory. And yet, in his later works, the American professor intended to further advance and complicate his theoretical framework. First, providing a more comprehensive model for solar design, epitomised by: location sets rhythm, rhythm set form, form sets metabolism (Knowles 1981). Then, introducing analogies to biological structures characterised by dynamism and flexibility and emphasising the idea of aesthetic experience and intents linked to a design process originally conceived for performance (*ibid.*; Knowles 2003). One could compare his vision with the prevalent direction parametric design took more recently. In its best-known formulation as 'Parametricism', Patrik Schumacher defines a style with 'dogmas' and 'taboos' (Schumacher 2009). The theorization incorporates functional principles but never mentions environmental forces, which are introduced in later updates as elements informing one of the possible stylistic variations (Schumacher 2020). These are paradigms in stark contrast, outlining a tension on one side of which, Ralph Knowles still has something to say and still embodies an alternative. Not so dissimilarly to the time he started his academic journey, we are still, and more than ever, in an environmental emergency, still short of energy, and still looking for a better way forward. Solar architecture and urbanism are still very much part of the solution, and Professor Knowles' lesson still shines brightly.

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Autori | Authors
Tommaso Bartoloni, *dottorando in Composizione architettonica e urbana*, Università Iuav di Venezia.
Francesca Belloni, *professoressa associata in Composizione architettonica e urbana*, Politecnico di Milano.
Giulia Bersani, *dottoranda in Culture del progetto*, Università Iuav di Venezia.
Silvia Berselli, *ricercatrice in Storia dell'architettura*, Università degli Studi di Parma.
Jacopo Bonat, *dottorando in Ingegneria Civile-ambientale e Architettura*, Università degli Studi di Trieste.
Silvia Camporesi, *fotografa e artista*, Forlì.
Marco Cimillo, *Senior Associate Professor in Architecture*, XJTLU Xi'an Jiaotong-Liverpool University.
Hugo de Almeida Pinho, *artist*, Lisboa.
Agostino De Rosa, *professore ordinario in Disegno*, Università Iuav di Venezia.
Anna Livia Friel, *Research Associate in Architecture*, TU Wien.
Simone Gobbo, *ricercatore in Composizione architettonica e urbana*, Università Iuav di Venezia.
Pierluigi Grandinetti, *già professore ordinario in Composizione architettonica e urbana*, Università Iuav di Venezia.
Inter-, *Architectural Research and Design Studio*, Zürich.
Francesco Jodice, *artista visivo*, Milano.
Andreas Körner, *Assistant Professor in Experimental Architecture*, University of Innsbruck; *Lecturer in Bio-integrated Design*, University College London.
Gabriella Liva, *professoressa associata in Disegno*, Università Iuav di Venezia.
Živilė Mantrimaitė, *Indipendent Researcher*, Vilnius.
Tim Matts, *Writer and Visual Artist*, London-Los Angeles.
Pier Franco Midali, *già sindaco di Viganella*, Verbano-Cusio-Ossola.
Cristina Moraru, *Lecturer in Visual Arts*, National University of the Arts "George Enescu".
Filippo Perfetti, *dottorando in Storia dell'arte, cinema, media audiovisivi e musica*, Università degli Studi di Udine.
Alberto Petracchin, *assegnista di ricerca in Composizione architettonica e urbana*, Università Iuav di Venezia.
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Sandro Rolla, *Associate Professor in Architecture*, XJTLU Xi'an Jiaotong-Liverpool University.
Valter Scelsi, *professore ordinario in Composizione architettonica e urbana*, Università degli Studi di Genova.
Giovanna Silva, *fotografa*, Milano; *docente*, Isia Urbino.
Studio Other Spaces, *Arts and Architecture Studio*, founded by Ólafur Elíasson and Sebastian Behmann, Berlin.
Vincenzo Valentino, *assegnista di ricerca in Composizione architettonica e urbana*, Università degli Studi di Napoli Federico II.
Andrea Vescovini, *Ludens architetti*, Reggio Emilia.
Matteo Zambon, *dottorando in Ingegneria Civile-ambientale e Architettura*, Università degli Studi di Trieste.
Davide Zaupa, *dottorando in Culture del progetto*, Università Iuav di Venezia.

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Per qualsiasi altra informazione | For any further information:
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