Precedented Environmental Futures

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Skin and Substance

By

Colin Porteous

Cambridge
Scholars
Publishing

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This book first published 2019

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

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ACKNOWLEDGEMENTS AND THANKS

Since this book draws on many case studies, most of which have been visited and nearly all with extremely hospitable and informative guides or hosts, there are many people to thank. But since there are so many, and over a considerable span of time, I propose not to attempt to thank all such individuals in the hope that they will themselves know or guess who they are. For example, Karla Hopkins of HKP Architects stands out due to the excellent archive initiated by Henry Klein, the late founder and principal of her continuing practice in the Pacific North West of USA. Harold Page, who modernised Paul Hayden Kirk's dental surgery in HKP's home town, Mount Vernon, also secured a memorable tour of that building. Similarly, in Europe, architects Beat Kämpfen and Reto Miloni pump-primed a Swiss and south-German tour with works of their respective practices, while Garry Ormston of CH2 in Melbourne and Andy Kirk of Bennetts Associates back in Scotland also played primary roles in terms of case studies … and so on, not to forget those who enabled copyright permissions. For example, Pat Borer not only gave permission to use his office's aerial view of the WISE project in Wales, he also welcomed the use of my own internal photo for the front cover. Suffice to say, I am extremely grateful to all of the others who permitted use of a considerable range of images, not to forget indirect contributions of the international solar community.

Equally importantly, the book would not have occurred without the support of the Glasgow School of Art. Even though a Small Specialist Institution, it embraces many colleagues such as Colin Kirkpatrick, Head of Research and his team who have provided encouragement along the way. I would also like to particularly mention David Buri, the Academic Liaison Librarian, who has special responsibility to the Mackintosh School of Architecture, and has provided longstanding and unstinting support to sometimes-esoteric requests in relation to referencing. I would further thank Catherine Stevenson and her team for often-hidden administrative help, as Vivian Carvalho and Craig Laurie for their invaluable technical support. In my particular academic field, I have additionally appreciated the interest and encouragement from colleagues in The Mackintosh Environmental Research Unit (MEARU), such as Dr Grainne McGill and

PREAMBLE

'Skin and substance' focuses the title's generic thrust by counterpoising two aspects of materiality – say fragility versus solidity – tempered by past wisdom for a future, but undetermined, more open than a checklist. Such architectural discourse, perhaps conveyed as 'stuff matters', benefits from initial ordering involving people-centred principles associated with surfaces and elements in front of, within, behind and below occupants. It is also normal that production and uses of buildings contribute significantly to greenhouse gas emissions, and hence climate change with multiple potential negative consequences. Accordingly, precautionary action to reduce such impacts while lowering consumption of non-renewable resources is a 'good thing' regardless of persistent and vocal political sceptics. This current priority justifies excavating past views and theories of commentators, with direct or indirect relevance, as the underlying method to shed fresh light on the complex and interactive issues involved.

However useful taxonomies may be, they suggest a ghosting backcloth for which more thematic and explicitly non-deterministic insights should help to define the shape of this book, accounting for the volition of both designers and users of buildings. The agendas of key figures might also play a subliminal part. Charles Correa's four "forces that generate architecture", namely culture, aspirations, climate and technology, are close to concisely encapsulating concepts of a sustainable built environment today without pursuing overly particular personal agendas[1]. Alternatively, Hassan Fathy's six guiding principles bond with the notion of designing and building sustainably: humanism, universality, appropriate technology, cooperative building, tradition – as cyclical renewal of "the social analogy of personal habit" – and re-awakening cultural pride[2]. As the communicating issue revolves around what is termed green, ecological, environmental and sustainable architecture (among others), it may be productive to review in a more liberal investigatory or even indulgent way alongside reductive criteria. As Richard Neutra puts it, we need "through-illumination by rational inquiry"[3]. Pierre von Meiss cautions while architecture employs the sciences, it cannot be a science; this due to the

placing of "architecture between the world of physical realities and that of desire and the imaginary."[4] Hence, in order to excavate the twin themes of theory and praxis in such a context ('environmental architecture' perhaps the appropriate descriptor) over a period of time, a narrative will inevitably evolve its own energy – the end not fully known at the start. And the start for all buildings is their sheltering function to protect against the elements, interacting with built materiality and contained stuff within, such interaction mediated by the inhabitants with their disparate needs and desires.

'The NEW eco-ARCHITECTURE', subtitle 'alternatives from the modern movement'[5], traces aspects of ecological or environmental architecture through the 20th century. The narrower focus of 'Solar Architecture in Cool Climates'[6] illuminates today's energy-led agenda more deeply, the Earth's sustaining adjective paired with architecture in a wide and focussed sense. Both books engage with opaque and transparent enclosure, as well as form, servicing and operational control, and, to some extent, structure. A well-worn human metaphor might suggest that they embrace the architectural equivalent of skin, shape and internal organs, including the brain, with some reference to the skeleton. Note that Hugo Häring said: "… the house may be looked upon as 'man's second skin' and hence as a bodily organ."[7] This in turn could imply that muscle and fat, as more variable elements, (more user-controlled) remain under-explored layers. Fat could correspond to insulation and muscle to thermal capacity. People are also used to treating clothing as an instant climatic modifier as well as signalling cultural identity, social affiliation and so on. Moreover in 1967, Raymond Studer claims that the built environment can be viewed as a prosthetic phenomenon, both physiologically and behaviourally[8]. Thus the anthropogenic analogy becomes more complex. Is there a building equivalent where some insulation is integrated behind a waterproof and vapour-permeable cutaneous layer, while some offers extra 'smart' flexibility inside or outside? And should adornment have a dual role – part ephemeral fashion, part function?

Such tension between wrapping and wrapped is not new. We still have not shed fossil-fuel reliance of recurring versions of a 20th century 'international style', even though 'new regionalism' and 'critical regionalism' gained ground, and then more recently nurtured a growing interest in surface ambiguity and illusion. This might or might not relate to prevailing weather, topography, terrain, neighbouring buildings, materiality, culture

etc. Peter Blundell Jones succinctly encapsulated the prosaic issue of envelope, underpinning the poetic:

"Wall construction has become increasingly layered due to the speed and convenience of frame assembly and the high level of thermal performance required. Today's buildings are therefore most often clad rather than showing load-bearing wall, and aesthetic attention is concentrated on surface and jointing rather than on substance or skeleton."[9]

Surface aesthetic or tectonic may also have a great deal or very little to do with much of the building that lies behind it, hence questioning environmental validity, depending how the interior is organized and serviced. Large buildings in tight urban settings inevitably heighten the challenges in this regard. Although such issues and questions evoke complexity, and suggest a continuing analytical need for carbon-sensitive design and indoor wellbeing, rationalism should attain concord with passion and imagination. We recognize varying proportionality for nurture (rationalism + empiricism) versus nature (innate ability), and ability versus creativity at both emotional and reason-based levels of thought. This suggests a synthesized design process, with decisions and actions based on sense-experience and reasoned rationale in harmonious partnership.

Without classical or feminist reference, the Italian cousin of Richard Rogers, Ernesto Nathan Rogers, prominent during the era of Congrès International d'Architecture Moderne (CIAM), states in the year that Le Corbusier's first Unité d'Habitation was completed: "From the more rigid forms of early rationalism, architecture is moulding for itself a more mobile physiognomy which is faithful to the technical exigencies and to the various circumstances of human life."[10] So he advocates flexible reasoning, deferring to the pressing demands of modern industry and the diversity of anthropogenic needs and sensibilities. It follows that if we accept functionalism as a specific doctrine of rationalism, it should similarly imbue empiricism. A teapot should pour without dribbling and scalding the pourer, its design based on logic, but also engaging with all the senses. Similarly buildings must meet their deemed need, even though such need invokes sublimity over and above utility. It seems necessary to consider where the functional-empirical balance is too far out of kilter. On one hand, there is a risk of formulaic environmental prescription with concomitant reaction and resentment. On another, hedonistic or sybaritic ambition fuelling the design process can provoke irreconcilable contradictions for an environmentally responsible resolution of a programme.

Otto Wagner stated that form follows purpose via construction[11]. This may usefully be compared with the Kantian notion of 'purposiveness' in architecture whereby subjective feelings are legitimate tools or motivators relative to formal outcomes[12]. It seems that both Otto Wagner and Richard Streiter looking from the end of the 19th century to the 20th, saw realism as a fundamental of modern life in opposition to "untruth and inauthenticity, the false pathos and empty phrase-making" of eclecticism[13]. Of course, eclecticism is a relative term, whether the subjective qualification of pathos is used in the original narrow sense of suffering and sadness or in the wider sense of exciting deep feelings.

A question to be asked here is not only how does the Greek grouping of logos, pathos and ethos relate to eclecticism today, but also how do all four relate to sustainable environmental architecture? Few will deny the case that intellectual reasoning, aided by knowledge or information, must mesh with morality in order to promote common good. Reasoning also engages with perception psychology, including emotions that signify intensity of feeling. Eclectic architectural syntax remains potent, despite the warnings of more than a century ago, and despite Serge Chermayeff confidently asserting: "I have seen Eclectic Architecture respectfully buried."[14].

Meanwhile, Peter Zumthor in 'Atmospheres' that are perceived rapidly "through our emotional sensibility" extols "the magic of the real" and the role for "craft and graft" in "creating architectural atmosphere" in text that is as elegantly spare as his buildings[15]. Adam Caruso wills an "expanded environmental field", not "defined in narrow materialist terms" in 'The Feeling of Things'[16]. Dean Hawkes tackles similar themes in 'The Environmental Imagination'[17]. Apropos the last, I recall a lecture Hawkes delivered to students at the Mackintosh School of Architecture in which he equated his feelings about certain buildings to music. His intellectual mastery of such interpretations, exploring emotional impacts of architectural design method and performance, underpins the 'skin-and-substance' quest here – its take on psychophysics and search for quantitative evidence in support of qualitative argument, with the agenda of climate change ever more pressing. On that last aspect, Hawkes provides a fascinating historical investigation into the climatic theory and practice of architecture from the beginning of the 16th to the end of the 20th centuries[18]. This includes a fair amount of hard dimensional data together with softer anecdotal or conjectural discussion on performance relative to expectations and culture in different periods.

Although the need for 'post-occupancy evaluation' (POE) is becoming more apparent, retrospective, as opposed to predictive, 'what if?' analysis to stimulate environmentally sustainable action is generally less explored and disseminated in books, with greater reliance on conference or journal papers. The key benefit of hindsight is partly that of knowing how occupants use buildings and respond to control systems in terms of immediate comfort and wellbeing – all assumptions in pre-contract thermal modelling. But it is also how they react perceptually and emotionally to their surroundings on a wider, long-term basis. Tadao Ando talks about buildings after completion having a human purpose: "… the role of a building after its completion needs to be part of its design; we must create living boxes."[19] In such post-occupancy situations, a relatively primitive mix of hard and soft information can be very revealing in terms of misguided or flawed design decisions, illuminating the field of unintended consequences. Even if decisions come about with conscious optimization of logic, ethics and emotional sensibility relative to people, prosperity and place, it is hard to predict the paths of outcomes[20]. This general area remains an under-researched crux for architecture that seeks to minimize its carbon footprint without compromising aesthetic content and intent.

Thus, whether or not an anatomical metaphor is descriptively useful for buildings, we must not ignore the real bipartite engagement humans have with them – mental and physical. Indeed Harry Francis Mallgrave cites authors who suggest: "… metaphors … are the essential rudiments out of which we conceptualize or think about the world."[21] Be that as it may, the critical subtitle, 'skin and substance', alludes to more than the two sets of more usually paired words – 'skin and bones' and 'style and substance'. Skin inevitably represents the physical interface between the contained and tempered interior of buildings and their ambient context. Here, it also represents both haptic sensory engagement via the human skin and the more abstract sense of a person's life or welfare. Substance conveys the essence or ultimate nature of a thing or being. Philosophically, 'ultimate reality' includes something that exists in abstract or immaterial form and conveys the direction of the architectural content in a holistic manner. For substance, therefore, place is relevant in the same way as for skin. Atmosphere takes us back to psychology and perception. Just as we now know that a prolonged sense of hopelessness is linked to premature death from a number of organic causes, we can connect reality or existence with sensory perception, including the dimensions of imagination and emotion. So the atmosphere of a building may be thus experienced, whether

through conscious thoughts or sub-conscious instincts, at the same time as physically via temperature, sound, light and so forth.

Caroline Benton, in her 2009 monograph on the Maisons Jaoul attributes a similar understanding, referring to a "quest for substance" in the young 1960s generation of architects who exalted the "visual and tactile characteristics of materials" and thereby contributed to "aspects of comfort and a sense of wellbeing" – all this in reaction to rationalism as manifested in large industrialized prefabrication programmes[22]. It was in the 1960s that seminal figures such as Ian McHarg and John McHale first aired serious concerns about ecological damage and risks wrought by the built environment. Much earlier, Alvar Aalto's thesis of 1935 stressed that rational practice required rigorous analytical expansion leading to a wider scale or metaphorical 'spectrum' of criteria, "where perhaps the rationally undefinable requirements, still invisible to us, which exist in the individual human being, are hidden."[23] Three quarters of a century later, there is more talk about such a holistic approach than there is action. Often architects and other members of multi-disciplinary design teams are content to prioritize only part of such a spectrum.

Here, the playfully ambiguous, nevertheless serious, framing of the subtitle sharpens the main title's aspirational 'Precedented Environmental Futures', conveying the need for architects to learn more from past experience, and past theory. It may be argued that functionality is a new environmental purposiveness, architecturally interpreting key outdoor or indoor landscape features ecologically as 'affordances'[24]. This entails exploiting natural ambient sources of energy passively and actively in a manner that stimulates a mental feel-good factor as well as physical and economic wellbeing. The precedent of experience similarly means taking account of both human and automated vagaries and frailties, with interactions and consequences seldom satisfying intentions aimed at a more sustainable environmental future. It also implies moving well beyond green-wash with undue reliance on a tick-box culture, its flexible inclusiveness often resulting in undeserved merit or credit. Excellence has become a devalued word in such circles.

The pervasiveness of such palliative processes, coincidentally or not, corresponds with the globalization of expectations for environmental comfort. A tangible countermovement to such ubiquity is expressed in books such as 'Environmental Diversity in Architecture', where Elizabeth Shove, as a contributor, challenges: "Do buildings 'script' their

inhabitants' understandings of comfort?"[25] This and similar questions posed by Steven Groák[26] (paraphrased): How far may the built environment control perception? Would a concept of sensory experience be more useful to architects than one based on comfort? Accepting the validity of the premise that a return to more diverse and adaptive environmental expectations can both reduce carbon emissions and improve wellbeing, this book seeks to augment the case. In part it will be done by reference to significant work in the psycho-sensory field, as well as to a wide range of architectural theory with associative environmental relevance.

Accordingly, the scene is set for convincing insight, including architectonic critique of different categories of buildings that vary in climatic setting and are directly experienced, with a consequent influence on my commentary. The aim is to identify key directions and dilemmas for a low carbon architectural future that inspires the psyche as well sustains the planet – at a critical juncture in varied manifestations of 'globalism'.

The first chapter centres on proactive psychological mediation between concrete percepts and abstract concepts to underpin a more sustainable, environmentally considerate, energy-effective, architectural design approach. Successive parts and chapters build on this essential premise, each one considering both theory and practice relative to specific design issues that influence the environmental outcomes. The text includes a cocktail of past theory and commentary, liberally quoting key figures in order to distil relevance in a 21st century quest for an authentic environmental architecture. Case studies are dispersed throughout to provide tangible ballast. The length and weight of chapters varies, for example the first chapter addressing the influences of phenomenology and psychological experience meriting numerous sub-headings, and others such as the one that follows having many fewer. Ultimately this book is intended as a discourse on where environmental, green or sustainable architecture is heading, and might head, driven by a range of concerns and motives in some order of prioritization. It is not aimed at hard-edged guidelines or paradigms.

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SYNOPSIS

Compared with the generic 'Precedented Environmental Futures', the subtitle 'skin and substance' feels specific but deliberately implies ambiguity between what is literal versus metaphorical, and concrete versus abstract. The underlying aim is to sift past and present ideas, theories and commentary through the lens of 'environmental architecture', this in expectation that such a process will raise a reader's consciousness of applicability. The sources emanate from diverse disciplines – architects, historians, theoreticians, psychologists, philosophers and so forth. In other words, the intention is more to stimulate questions, doubts, ideas, approaches or perhaps refreshed rationale for the reader, assumed to have an interest in architecture and the environment, than to attempt definitive guidance or orthodoxy. The book thus conforms to the cliché of looking back in order to gain a forward insight that is inevitably subject to unpredictability, the discourse structured, but without expectation of solid conclusions.

The structure involves four parts – I Reasoning and Emotion, II Transitions, Energetics, Containment and Permeability, III Environmental Criteria and IV Environmental Modulation. The first, third and fourth parts also each contain three chapters. The second, embracing a number of crucial areas involving people – in their largely solar and greenhouse-gas dependant environment – with space, place and time, has five. The four parts are given introductory context in the above Preamble, written in advance of the main text, while an Afterword, self-evidently written after it, brings the book to a final close.

The first chapter in Part I, 'Thinking, doing, feeling modalities', embeds a re-balancing of the phenomenology of Martin Heidegger with the psychophysical rationale of James Jerome Gibson. The aim is to elicit an awareness of our perceptual systems relative to conceptual imagination that can usefully impinge on holistic environmentally aware designing. The second chapter then moves to matters of societal dependence on, and advances in, technology embraced by the term 'technopolis', while Part I's third and final chapter is devoted to critique of the Reid Building at The Glasgow School of Art.

Part II focuses on human-oriented aspects underpinning built form relative to programme and environmental context. Chapter Four deals with routes and destinations; Chapter Five, the natural fields of force to which the built environment is subjected; Chapter Six the issue of plan and section via two case studies by a notable practice – each of a very different scale and context; Chapter Seven explores the issue of space and place; and Chapter Eight delves deeper into associations, dimensions and form.

Part III, taking Susannah Hagan's three criteria of symbiosis, differentiation and visibility from her 2001 'Taking Shape' as a starting point, explores such issues further in its three chapters – 'Ecological equilibrium', which ends with retrospection of the author's student design of 1962, 'From place to region', and 'Role of tectonics'. The last of these takes us towards a potential theory of environmental architectural detail and hence on to Part IV.

The three chapters under Environmental Modulation in the final part then address various aspects of control – all with considerable reference to the performance of existing buildings: Chapter Twelve 'Outside-in surface synergy'; Chapter Thirteen 'Interior climatic tuning'; and Chapter Fourteen 'Mitigation and adaptation'. Although representing a very different end from the beginning in Part I, Part IV reveals issues of environmental substance that may seem as mysterious and complex as Part I's percept-concept issues, but are also part of a critical political debate globally. The case studies in Part IV present significant concrete differences – both compared with predictions and similar built characteristics. But, with adequate scrutiny, they tend to yield rational explanations.

PART I

REASONING AND EMOTION

CHAPTER ONE

THINKING, DOING, FEELING MODALITIES

The polarities of conception-perception, abstract-concrete, rationalism-empiricism are aired relative to environmental architecture. This necessitates exploration of theory and evidence for a complex interactive continuum rather than opposition, taking into account disconnections of place and time interlaced with memory and imagination. It also involves numerous interrelated sub-topics and a wide-ranging literature search, in terms of both discipline (e.g. philosophy, logic, politics and architecture) and chronology, and finding common ground on which architects may build. Authors include James Jerome Gibson, Juhani Pallasmaa and Harry Francis Mallgrave.

Psychophysiology and architecture

Considering their book on modern architectural theory, Harry Francis Mallgrave and David Goodman stress: "The architect now has at his or her command a bounty of new insights into the psychological and physiological nature of the human organism"[1]. This statement encapsulates a field termed 'biophilic design' whereby the health and wellbeing of human inhabitants of buildings moves into the mainstream of 'environmental' or 'sustainable' architecture, generally absent from the established range of 'tick-box' metrics other than by indirect implication. Mallgrave and Goodman note "a number of habitation theories suggesting a particular fondness for environmental conditions that in an evolutionary sense have favored our biological survival"[2], citing for example the 'prospect and refuge' theory of Jay Appleton[3]. They also mention earlier work by American sociobiologist Edward O Wilson who used the term 'biophilia'[4], and who stressed the importance of "exposure to natural landscapes" and so forth to health and wellbeing. Finally, Mallgrave and Goodman refer to modern 'neuroaesthetics', where analytical techniques such as fMRI brain-scanning improve our understanding of such psychophysical interfaces[5]. So they re-examine past theories and findings in order to take us forward in tandem with modern scientific knowledge – what this book is about with a focus on

identifying areas of missed opportunities when designing consciously for human and natural ecological benefit.

Philosophical discussion, and within it what motivates architectural design, includes a number of semantic opposites – abstract vs. concrete; theoretical vs. empirical; conceptual vs. perceptual; rational vs. irrational; reasoned vs. intuitive; cerebral vs. emotional; etc. For architects, important bridges between such pairings are imagination and memory. Central, is a bipartite subliminal hypothesis concerning the value of gaining a fuller understanding of psychophysical perception. This is initially that the understanding and role of memory as a bonding between perception and conception can nurture a more effective environmental design process by architects and their specialist consultants. Consequently, such a holistically oriented cognition will also foster buildings that exploit 'adaptive design', and 'adaptive opportunity' within it, more fully than has been the norm. The aim is to engender a participatory shift in the culture of environmental comfort in order to achieve the twin benefits of enhanced wellbeing and energy efficiency.

Influential, but not usually linked explicitly with environmental architecture, is phenomenology. This entered the architectural realm mainly through the influence of the politically controversial German philosopher, Martin Heidegger[6], whereby phenomenology in its promotion of subjective experience is dismissive of objective logic. Unsurprisingly, excavating architectural and non-architectural thinking in this arena in order to support an environmental proposition is serendipitous. Therefore, readers should not necessarily expect to follow a coherent thread, but rather to pick up a broad sense of relevance.

Le Corbusier, in his late inter-war stage, stresses " … the benefit of excellent psycho-physiological conditions …", including in parenthesis "(quiet and pure air)"[7]. After the Second World War (WWII) he phrases it as the "psychophysiology of feelings"[8,9].

These thoughts predate a body of theory around 'environmental psychology', which Claude Levy-Leboyer introduces as a distinct discipline within psychology from the 1960s. However, she relates it strongly to perception, which has a much longer research history[10]. In particular she models, concepts and methods, including evaluation of the environment relative to perception, discusses environmental stressors and provides useful explanations of apparently anomalous findings and excessive scatter of one variable expressed as a function of another. These include arousal being

higher at the extremes around a neutral mean – e.g. comfort[11]. Psychological state of stress is not simply a matter of the individual or the ambient environment, but rather the more complex issue of the inadequacy of an individual's needs and resources relative to characteristics of the environment[12]. Information overload from the environment can cause prioritisation, and hence individual variability in reaction, on the part of the user[13]. And environments that users cannot control can lead to giving up on other situations where control is possible[14]. Levy-Leboyer suggests that 'environmental planning' should not be deterministic, but allow "individuals to make a more or less limited choice within a range of possible behaviours compatible with the surroundings." This is aligned to 'congruence' existing "when the spatial parameters are not likely to prevent the desired behaviour."[15]

Frank A Geldard[16] finds "… compelling reasons for believing that we deal with two systems of heat sensitivity, one for warmth and one for cold."[17] Then, given whole-body irradiation by heat and levels from weak to strong, feelings of warmth change little despite skin temperature increasing[18]. Mapping of warm and cold spots seems fickle[19]. Slightly warm and warm vary in a thermally neutral environment. Infrared irradiation affects skin only to depth of 0.1 mm[20], and "a threshold sensation is obtained when the temperature of the warmth receptors is increased by a certain amount"[21]. Geldard posits: "Adaptation is readily demonstrated for both warmth and cold"[22]; the "temperature to which a response of neither warmth nor cold can be aroused is known as physiological zero"[23]; pain is felt above 52°C, "constricting elements in dilating muscles" at 45°C, and 'cold-pain' at 3°C[24]. "Thermal sensitivity was also found to be higher in the forehead, lips and conjunctiva of the eye than in the cornea."[25]

Lisa Heschong "began with the hypothesis that the thermal function of a building could be used as an effective element of design."[26] She then challenges the mainstream attitude of undesirable thermal stress due to changeability and difference:

> "A constant temperature is maintained in order to save people from the effort and the distraction of adjusting to different thermal conditions. And yet, in spite of the extra physiological effort required to adjust to thermal stimuli, people certainly seem to enjoy a range of temperatures."[27]

She refers to "thermal aediculae" designed to have a "special thermal purpose" within a larger whole – e.g. inglenooks and gazebos.[28] Reyner Banham describes an outdoor situation around a camp-fire in a way redolent of Heschong's 'thermal aediculae': "… the size and shape of the useful

environment are defined by no structure, simply by the heat of the fire, the strength and direction of the wind, the physiology of the individuals involved and the activities they are performing."[29] I am reminded that the thermal cocoon (up-draught) of a robust camp-fire can also divert rainfall just as well as an umbrella. Banham's example seems to have applicability indoors in that any heat source will tend to generate a specific thermal environment around it, even if its boundaries are fluid. Heschong's view is attuned to Walter Gropius: "For it is a fact that a human being needs frequently changing impressions in order to keep his receptive abilities alert. Unchanging conditions, perfect as they may be, have a dulling and lulling effect."[30] Gropius extends his point to all environmental conditions, affecting all the senses. Similarly, in 'Survival Through Design', Richard Neutra stresses sensory differentiation of touch, taste and hearing: "Architecture is illuminated not only by light, but by sound as well; in fact it is brought into relief through all the senses."[31] Then he presages Heschong in addressing thermal comfort and design: "One can, from the very start, design a room, its orientation and material selection, in such a manner that temperature losses, irradiation and air currents are salient parts of the scheme."[32] After Neutra's seminal text, George Perec refers to "an apartment whose layout was based on the functioning of the senses", this as an alternative to traditional rooms with traditional labels[33]. Peter Cook also asserts that in buildings or spaces where occupation is relatively transitory, sensory tolerance increases – "heavier decoration, louder noise, more hybrid condition than we would like to live with"[34]. He gives an experiential chart of Place, Feeling and Quality, each associated with five different aspects or conditions. Philip Johnson cites the importance of fire, water and light to the senses, especially the "flicker" from candles, fire and water in light – sound as well – and enjoys variation in comfort moving from one part of his living room to another[35].

Colin St John (Sandy) Wilson discusses the contrast between formal confrontation offered by some imposing facades compared to that of envelopment within, in particular citing the role of an aedicule in this regard: " ... the miniature shelter or canopy that creates a personal domain within a major or dominant space – a space within a space. … thereby giving rise to a play between inside-outside and the real outside."[36] Not only does this quote have correspondence with Heschong's 'thermal aediculae', it places holistic sensory experience in a psychological or emotional context[37].

The role of language and metaphor

Louis Kahn assigns human emotions to the dynamics of light: "And natural light has all the moods of the time of the day, the seasons of the year, [which] year for year and day for day are different from the day preceding."[38] Even though lighting engineers may now claim an ability to match natural light with modern electrical and electronic technology, that from sun, moon, lightning, or a human-contrived live fire has a primal quality that digs deep into the psyche. It should also go without saying that optimizing use of daylight in buildings constitutes an opportunity to reduce greenhouse gas emissions.

Nevertheless, it is the poetic qualities of light that have architectural dominance. Similar to Kahn, Sverre Fehn is quoted by Per Olaf Fjeld: "The fire invents light and heat, and through this light the darkness gains new importance: it creates the story, it entertains. The fire invents a room where there is light. The fire is a producer of space and in a shadow mystery is born."[39] Later, in relation to his 1970s design for Skådalen School, Fehn states: "It is the eye and sound that completes one's sense of space. It is your reflections that form space, and you discover its identity through sound and light." And: "As daylight and fresh air began to be considered components with material qualities, a search for a new type of spatial lightness entered architectural discourse."[40] Fjeld again talks of sound, attributing it the same degree of physicality, quoting Fehn: "Sound is like an object and one regards it as a tactile mass" [41]. Fehn clearly enjoys the mobility of such a 'mass' as well as being able to move within it, as in Aldo van Eyck's remark of 1986 quoted by Fjeld: "The world is around me, not in front of me."[42]

Fehn habitually moves from metaphors into poetical metaphysics, for example in relation to the Nordic Pavilion in Venice, 1958-62: "The column takes away the sky, The treetop removes heaven"[43]. And the masking of sky vault implied by 'removes heaven' is also poetic licence imbued with hyperbole and spirituality. Architects are used to semantics with semiotics, but the risk is that it can obscure interpretation by readers or listeners. In Fehn's case, it is more a matter of adjusting to a romantic mood than of bafflement.

Just as Fehn ascribes physical 'solidity' to light and sound, part of his allegory is to give materials or objects human qualities including feelings, for example, in relation to the Hedmark County Museum, 1967-2005: "The time an artwork can feel that it is great is when it no longer has any form of reference."[44] This is more correctly an example of hypallage or transferred

epithet, as it is the artist or viewer that has the feelings. In a manner that may be more usual to architects, bounding materials in rooms interact with the occupants, for example of Skådalen School: "The wall is the partner that returns the ball to the child and gives shadow to the elderly."[45] It is normal for architects speaking of environmental behaviour to use scientifically inaccurate terms such as 'breathing walls' to convey a sense useful to understanding the passage of water vapour – at least in the UK. The same metaphor in the USA is used to signify a body of air moving from outside to inside through a porous construction, operating counter to the normal diffusion of water vapour from inside to outside[46]. Thus architectural metaphors may be a matter of individual or collective interpretation, but, in general, one can make a reasonable argument that verbalising metaphorical living attributes to inanimate objects may help to convey an understanding of the holistic nature of ecological interactions with buildings.

Kenneth Frampton, discussing another work and citing Mark Johnson, claims: "Metaphor, rather than being solely a linguistic or historical trope, constitutes a human process by which we understand and structure one domain of experience in terms of another of a different kind."[47] Peter Blundell Jones also cites Mark Johnson, this time with George Lakoff, and goes further with the human dimension in a paragraph entitled: "Bodily movements as the foundation of metaphors"[48].

The mention of Lakoff and Johnson by noted architectural academics merits further metaphoric illumination, beginning their 1980 'Metaphors We Live By' with a primary hypothesis: "Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature."[49] They propose what amounts to a secondary hypothesis, the 'experientialist alternative' to objectivism and subjectivism, which they examine in terms of myths[50]. They argue for their alternative as a third way whereby metaphor is 'imaginative reality': "Since the categories of our everyday thought are largely metaphorical and our everyday reasoning involves metaphorical entailments and inferences, ordinary rationality is therefore imaginative by its nature."[51] They relate environmental mutuality or symbiosis[52] to their experientialist alternative: "It views this interaction with the environment as involving mutual change. You cannot function within the environment without changing it or being changed by it."[53] They conclude: "Metaphor is as much part of our functioning as our sense of touch, and as precious."[54] In between their opening hypothesis and final chapters around imaginative reality mediating between objective and subjective mythology, the authors take us through categories of metaphor – self-evident orientational metaphors[55]. Ontological metaphors are "ways of viewing events, activities,

emotions, and so on, as entities and substances" such as "The Mind is a Machine"[56]. Structural metaphors occur where one "clearly delineated concept" is used "to structure another"[57]. They take the reader towards phenomenology by elaborating Frampton's point about metaphors as understanding one 'basic domain of experience' – conceptualized as 'experiential gestalt' – in terms of another. These indicate wholes that are more fundamental than parts, with the 'perceptual and motor apparatus' of our bodies leading the way as intimated by Blundell Jones[58].

Moving on from linguistic philosophy to neuroscience applied to architectural theory, Harry Francis Mallgrave adds his voice to the credence and importance of metaphorical thinking for architects, and, for example, cites Rudolph Arnheim's view that 'sensory symbols' were the most profound architectural metaphors fundamental to everyday experience – for example, sunlight "streaming through a window"[59].

Herb Greene is again emphatic on metaphoric value: "We can know objects only by seeing them in terms of our knowledge of other things, using metaphor as a tool for understanding. Metaphor… is also the bedrock of imagination, and image makers cannot function without its support."[60] Greene elaborates that any object is "a disposition of many cues", to be grasped in a "unifying gestalt", each cue "capable of initiating a metaphoric response"[61]. He tells us that experiential remembrances may be stimulated by a sensory cue during perception, this "guided by both conscious and unconscious motivations"[62]; and states: "Contradictions and ambiguities produced by metaphors are not necessarily chaotic."[63] He concludes: "Metaphor can make us more sensitive to our ties with the phenomenal world and deepen our understanding of those ties."[64] Comparably, Louis Kahn metaphorically encapsulates 'knowledge' and 'thought' in a quotable sentence: "Knowledge is a servant of thought and thought is a satellite of feeling."[65]

The notion of architects and artists evolving their work at least partly via metaphorical thinking, as well as the linking of such thinking to sensory meaning, raises two further questions. Firstly, as metaphors are absorbed into everyday language and embodied as secondary or tertiary definitions in dictionaries (as 'streaming' applied to light), does their validity as metaphors cease? Fumihiko Maki used two common words as metaphors, clock and cloud, with meanings not only not found in dictionaries, but also potent enough to denote an architectural theory concerning parts and the whole: