ornament in the realm of environmental psychology

As I said at the beginning, in reconceptualizing ornament what works best for me is laying down strata rather than thinking about it as a linear history. That's something of a defense for this particular chapter, my last lens, so to speak, which looks at ornament not as cultural construct but from the perspective of science.

Here's my point: whatever we believe or opine about ornament, in the realm of environmental psychology we may well need it. Ornament is natural to us. It's quite possibly good for you.

If research in environmental psychology and cognitive science is correct, we are genetically predisposed to ornament, or, more precisely, to imagery that has many of the qualities of ornament I have already laid out. Our proclivity for ornament is deeply embedded in our perceptual and emotive systems, and plays a critical role in helping us create coherent relationships among the objects inhabiting our environment. To some degree, we navigate our lives and our environments best in the presence of ornament; when we suppress and eradicate ornament, our ability to navigate decreases. Natural and successful human-made ornament creates visual "stickiness" in our environment so we don't mentally slide off an environment we have created that is too"slick" to grab onto. It knits, stitches and weaves our urban fabric together.

I'm going to start the discussion with a story about Woody Allen.

Given Allen's renowned passion for New York City, we might infer that Woody would not be John's Muir's choice as the ideal hiking companion. "I don't like nature," he says in his 1975 movie, *Love* *and Death*. "It's big plants eating little plants, small fish being eaten by big fish, big animals eating each other...it's like an enormous restaurant." Looking out from his apartment over Central Park is about as much nature as he can stand, according to his former wife. "Woody has no tolerance for the country," Mia Farrow said in a 1991 interview. "He gets very bored. Within half an hour after arriving he's walked around the lake and is ready to go home. … He's been seen in a beekeeper's hat at my [country] place when it's gnats time. He'll put it on and seriously stroll by the lake in it. Of course, he never goes in the lake. He wouldn't touch the lake. 'There are live things in there,' he says."[1]

For Allen, the city, not the country, provides emotional sustenance. The city, not the country, is "natural" to him. Whether is it streets filled with familiar rhythms, sights, and textures, or the majestic pattern of the distant skyline he immortalized in *Manhattan,* his personalized urban turf makes him feel both secure and engaged, while the so-called "natural" world seems foreign, incoherent, and altogether unpleasant.

Allen's groundedness in his city's skyline, if not his abhorrence of nature, may make more sense in terms of environmental psychology when we note a paper by a group of experimental psychologists which explores the visual impact of Manhattan on its inhabitants. "*Tall Buildings and the Urban Skyline*[2]" assesses both *silhouette complexity* (the shape of buildings) and *façade articulation* (surface patterning). The researchers confirmed one finding that seems obvious: There is a correspondence between the level of *silhouette complexity* in skyscrapers and the degree of pleasure and stimulation these buildings give their viewers. If that is so, it is no wonder that cities are exciting—even if

[1] Eric Lax, "Woody & Mia: A New York Story," *New York Times Magazine*, February 24, 1991.

[2] Tom Heath, Bill Lim, Sandy G. Smith, "2000, Tall Buildings and the Urban Skyline,'" *Environment and Behavior*, Vol. 32, No. 4, pp. 541-556.

Woody Allen and several million other people don't need an expert to know that New York's skyline is stimulating, let alone exhiliarating. It is the *why* that is more interesting.

When the researchers turned to the effect of *façade articulation* on a viewer, they found that it apparently did not have the same power to evoke pleasure. Perhaps this was because in this case, the viewers were looking at an image of a *distant* skyline, where such articulation is not as legible. That led the authors to caution architects to regulate their patterns according to the likely position of the potential viewer: *façade articulation* might well seem far more significant to a person nearer to a building. In circumstances where distant views might be more important, architects "would do better to concentrate on elaborating the silhouette rather than the façade if they wish their buildings to gain popular acceptance," the authors advised. Silhouettes are more important seen from a freeway or a vista of a city; suface pattening is more important from across the street. These simple observations, known by architects from Imhotep to cutting edge façade specialists, Front Inc., are part of a much larger and more refined understanding of how arrangements of buildings, even their cornice lines, can have a powerful emotional impact on people.[3]

Implicit throughout the well-known findings of many papers is an important thesis: perception and our emotional response to detail (small or secondary sections of a building) and scale (the kind of relationship across different levels of visible details whether at far, close, or intermediate range) are relative to distance. At a great distance, detail and scale are irrelevant, but within closer range, these two aspects of a building – the breeding ground of ornament – matter greatly. Woody's movies make

[3] The horizontal projection crowning the top of a building, though cornices can be smaller-scale projections in other architectural elements, as in the cornice line delineating a relationship between interior wall and ceiling. See Donald Appleyard, "Styles and Methods of Structuring a City," *Environment & Behavior*, Vol. 2, 1970, pp. 100-116. Also see his book *Livable Streets* (Berkeley, CA: University of California Press, 1981).

it clear that concerns such as silhouette complexity and surface articulation are involved in his conception of New York, even if he wouldn't ever use that language.

The filmmaker's discomfort with "nature" raises a second question, that is, exactly how we define "nature" and "natural," which I will address later.

In environmental psychology, the function of natural ornament is to anchor us in the environment and render it intelligible, just as human-made ornament helps people organize and make sense of the environments they build for themselves. The difference is that in environmental psychology, people experience natural ornament as an almost involuntary unconscious or preconscious visual and emotional phenomenon. Thus, an especially successful human-made ornament would present itself *both* as a cultural intervention while also resonating with our genetic predisposition, helping us integrate into our physical environment.

But what *is* ornament in environmental psychological terms? ***Ornament can be described as the set of those hierarchical elements, visual cues, and subordinate accompanying qualities of the landscape that assist our sensory engagement with those natural settings. These elements and qualities include boundary, scale, complexity, movement, density, texture, richness, and order.*** This chapter explores the ways in which we are cognitively and genetically equipped for ornament. (There are a fair number of technical terms involved, and I'll do my lay best to keep them clear and forthright.) Further on, we will see how a reinvigorated fractal mathematics provides new ways to *understand* our primal connection to ornament, while at the same time providing some new tools to *accomplish* ornament.

In this arena, ornament acquires a meaning different from that in architecture, design, or the crafts. In a sense, ornament resides in our sensory-neural interaction with the environment. Our cognitive system is very far from being hard-wired in its ways of engagement as we might think—although it is always seeking engagement. But rather, that engagement is selected, guided, and sharpened through higher contributions from our sensory systems. Progressive, cutting-edge experimental neuroscientists today are more likely to say something like, our "experience of ornament is enacted in the perceptive relationship we have with our habitable environment." In other words, it's a dance of the environmental dialectic: brain-environment, environment-brain.

Although it may intially sound dogmatic or limiting, ornament made by the human hand is satisfying to us to the degree that it enables a level of engagement with the properties of natural environment, or to what may be called the "assistive" effects of "natural" ornament. Natural ornament engages us in a way that assists us to maintain a sensory *feedback loop*, or several feedback loops at once.

In the context of human behavior, a *feedback loop* expresses the idea that our experience in our world modifies our neural computation. And these loops can be very subtle, such as perceptual loops involved with controlling our posture, sexual arousal, eye fixations or pupillary contraction, for example. Human-made ornament does not have to resemble nature per se to accomplish this. "We are equipped for ornament in the sense that our perceptual machinery is always structuring the sensed world, segmenting its scenes and focusing directed attention along computational rules that have several of the qualities of ornament, and which have inherent meaning for us," says environmental psychologist James Wise. That is, our visual systems break down each scene into smaller pieces, such as clumping regions of brightness together to help us assimilate a cornice line. These "rules" are passed along genetically, down the stream of life. Wise writes,

> *The visual system of early organisms discovered ways of utilizing light, and those that worked were handed down as operational rules for more and more advanced visual systems. Visual systems of advanced organisms like ourselves are built from 'the bottom up', and we preserve lots of primitive characteristics, such as the presence of 'seawater' [tears] in our eyes, recalling ancient seas where eyes first evolved.*[4]

our predisposition to ornament

Our predisposition to ornament is tied to two different issues, seemingly disconnected but which are linked. The first is revealed in the *savanna hypothesis*, which involves the places, primarily East Africa, where human beings may have evolved most dramatically and where our early visual systems developed. The second issue deals with *scale*, with a different meaning than in the contexts discussed earlier. I'll be going back and forth between these two issues as they are not linear nor cause-and-effect but layered conceptually.

***The first issue*, the savanna hypothesis**, explains a basic premise that links a specific environment to our emotional well-being: "Positive affective [i.e., relating to the emotions] states of interest and pleasure, associated with preference, signal that an environment is likely to provide resources and supports that promote survival and well being, while negative affective states serve as warnings of potential harm or discomforts," according to environmental psychologist Judith Heerwagen.[5]

[4] Letter to author, 16 June 2007.
[5] Judith Heerwagen, "Bio-Inspired Design: What Can We Learn from Nature," posted 15 January 2003 on BioInspire website, http://ceae.colorado.edu/~amadei/CVEN4838/BioInspire.1_%2001.15.03.htm

The seminal "savanna hypothesis," is a concept in evolutionary biology that links a geographical setting and location to species survival and the preferences to which Heerwagen refers. The theory holds that our cognitive and perceptual systems adaptively evolved on the savannas of East Africa which emerged after the climate cooled and forests dried up, and where humans became bipedal in order to hunt out in the open.

Environmental psychologists Rachel and Stephen Kaplan are famous for their decades-long research into environmental preferences and especially the savanna. There are four basic qualities of Kaplanesque preference that can be measured in the environment: coherence, complexity, mystery and legibility. (They describe "preference" to mean "the expression of the evaluation of one's possibilities," a lovely definition..[1] Complexity is a measure for how much is going on in a particular scene: how much comprehension will it take to understand it? Mystery "refers to settings in which the available information promises acquiring more information when further entering the scene."[1] Understanding the environment is further facilitated by two other qualities, coherence and legibility. "Coherence implies the presence of visual features that contribute to the organization, understanding and structuring of the image, such as symmetries, elements and unifying textures," they write, while legibility concerns the "interpretation of spaces, and refers to the capacity to predict and maintain orientation in the landscape as one further explores it."[1] We need a balance of those four qualities to flourish. People appear most comfortable with an intermediate level of complexity (without discussing fractals, the Kaplan analysis nonetheless is reminiscent of the "medium strength" fractal D of 1.3.): just enough stimuli to hold our interest, without our becoming bored on one hand or overwhelmed on the other. Moderation in all things, so to speak.

Savannas are transitional landscapes that contain both lightly forested land and open plains, so early hominid perceptual systems had to adapt coming out of a generally arboreal life in the dense, dark forests. In order to survive and thrive, these human systems adapted to the more open, dispersed character of the savanna's landscape of scattered copses of trees and tall grasses. Our genetic ancestors experienced what could be described as a particular kind of visual character and order on the savannas; that is, they saw and interacted with specific natural arrangements of forms, objects, and creatures in the landscape that in turn encouraged the development of certain neural connections and pathways that, over time, our species "selected" genetically because they nourished survival. That genetic link and those opportunistic pathways, or (more ominously) the potential for those pathways to be manipulated, remains operative in our brains to this day.

I should note that this theory has been challenged in the last 25 years by hypotheses that argue for a more varied landscape, since the factors that drove human evolution are still the subject of controversy. However, what's important to know is that none dispute that our human ancestors adapted their visual systems to the natural "ornament" around them as a survival strategy. That ancient adaptation enables us to respond swiftly to change, helping to ensure species survival. Without a fairly ordered, generally comprehensible backdrop to respond to – that early natural environment, the savanna, which was fairly predictable in its range of uncertainties – we might waste too much mental and physical energy on maintaining a (gratuitous) guarded and alert posture, stressing our nervous systems. Not a great survival strategy. Cognitively, we need to be able to "throw away," or overlook, such predictable elements, so we can use our brain power to better ends, and turn our minds to unexpected and atypical elements that stand out from the background as new information.[6]

A significant body of research argues that we have an innate preference for certain kinds of forest and park-like settings (think mature American golf courses) because that savanna landscape accompanied us through several of the most important phases in our cognitive development through our evolutionary history. The way we learned to decode this evolutionary backdrop afforded us the best possible chance to survive and to reproduce. According to environmental psychologist Wise, this is because a savanna-like landscape in particular is the "archetypal residue of the natural

6 Yannick Joye, "Organic Architecture as an Expression of Innate Environmental Preferences," *Communication & Cognition*, Vol. 36, No. 3 and 4, 2003, pp. 391-429. Joye points out that insofar as this constant "environmental evaluation" that we continuously perform is unconscious and automatic, it "does not require much processing capacity" while allowing the "continuous extraction of new environmental information."

environment we have occupied in our species history … ."[7] Other research suggests that our emotional states may to some degree be affected or even induced by certain natural phenomena. People tend to believe that scenes of bodies of water, flowers, plants, etc., are beneficial to us and in fact this has been quantified; for example, such images can improve recovery from illness by slowing the heart rate, lowering blood pressure, and pushing more oxygen to cells. In such environments, natural or human-made, we feel more competent, more coherent, less out of control, and more connected to our world. As cognitive scientist Steven Pinker put it in *How the Mind Works*, "The brain strives to put its owner in circumstances like those that caused its ancestors to reproduce. When it comes to what we need and want from the places where we live and work, it is all about survival—but not necessarily about the present."[8]

The savanna hypothesis and its competitors, with its obvious implications for the interaction between the the brain, our senses, and the environment, have long been one of the cornerstones of environmental psychology.[9] The hypothesis is critical to this book because I believe this theory identifies a human predilection for pattern and scale that may be the wellspring of ornament, whether natural or artificial.

[7] James Wise, letter to author, July 23, 2006.

[8] Debra Wierenga, Betty Hase, and Roger B. Call quote Steven Pinker in "*Evolutionary Psychology and Workplace Design: Doing What Comes Naturally*" *AIA Academy Journal*, October 27, 2004.

[9] Eminent researchers include well-known names such as Gordon Orians, Roger Ulrich, Stephen and Rachel Kaplan, James Wise, Judith Heerwagen, and many others.

In a way, it is as if that landscape informed our brain in how to develop and how to see. For example, our visual system, like those of birds and animals, apprehends moving objects (e.g., potential predators) more quickly than stationary ones. This ability is an early, relatively primitive conserved operational aspect of visual systems (e.g., necessary equipment maintained throughout evolution); this apprehension of movement utilizes "low spatial frequency" information that is computationally non-demanding. (*Low spatial frequency* is a neural distinction at a low level of detail. We "sample" an incoming light/dark pattern of whatever it is we are looking at, broadly and fairly crudely. After sampling, we makes a broad sweep of the overall pattern. Only after sampling and sweeping do we begin—if the situation calls for it—a more refined *high spatial frequency* analysis of extracting more nuanced information from that visual field, a process that takes more neural energy and more time.)

Ornament and Mediation

Ornament mediates between different fields, or "complex wholes," in cognitive science, while emphasizing edges and boundaries, as Bloomer has point out in a cultural context. (Being a mediator, after all, is a complex role, requiring one element to address two opposing or disparate parties and then providing them ways of communicating without compromising either party or merging the two. As an adjective, "mediate" is defined as "acting through or dependent on an intervening agency; being neither at the beginning nor at the end in a series." As a verb, "to mediate" is defined as "to act between parties with a view to reconciling differences or to occupy an intermediate or middle position or form a connecting link or stage between two others, e.g., to "mediate between the old and the new.")

Each organism has a different degree of sensitivity to spatial frequency distinctions, depending on its natural environment and what it needs, how it's "making a living" in that environment. It was the openness of the savanna that helped select the form of human pattern vision—most of our retinas are devoted to low-frequency receptors for the periphery of the eye, while high-frequency receptors handles detail and fixed attention in the center of our visual fields. (Receptors are part of the physical eye and are located as a layer on the retina.)

We "prefer" a degree of openness in land- (or urban) scape that approximates a savanna in terms of its distribution of visible features. Savannas also contain the rhythmic swaying of grass tops, which becomes disturbed by a predator prowling through them. This, in turn, may explain our preference for this type of "heraclitean motion" (constant, gentle motion) and our arousal when that pattern is broken, perhaps by some predator that has dropped to hide and watch us. So it is not surprising that we've developed equipment to visually search out an object's edges first, that is, an object's boundaries, because these edges may contain information urgent to our survival. Only then does our brain attend to organizing the fill-in information in a more relaxed, leisurely fashion (although it feels instant to us.) Processing a boundary is necessary, the fill-in is, in a way, a luxury of modern man. As Salingaros notes,

> *First response depends on an incomplete image that somehow has enough detail for recognition. With more processing time, the image progresses to evolutionary higher levels of the midbrain, where single neurons can recognize complex wholes. Islands of such neurons capable of sophisticated pattern recognition exist at the same level as islands of neurons responsible for seeing fine detail. Detail is thus an evolutionary advanced skill that the brain has developed over time.*[10]

Wise writes,

> *Sometimes a strong emotional response to such detail presents itself first and in ways that have nothing to do with the advanced brain, e.g., recognizing faces or acknowledging symmetry, because they are so primal and so important.*[11]

Thus, the *physiological* ability to see a copse of trees or a life-threatening predator are tied to *psychological* states such as pleasure or fear.

Many scientists agree that the savannas with their scattered forests were likely our species' prime habitat during the two historical periods when the size of the human brain suddenly grew larger, not only multiplying the number of neurons and neural pathways, but more importantly, exponentially creating a myriad of possible new connections among those neurons and pathways. *Homo habilis*, living between 2.4 and 1.5 million years ago, experienced the first dramatic brain increase from 500

[10] Nikos A. Salingaros, "The Sensory Value of Ornament," *Communication & Cognition, 2003.* http://www.math.utsa.edu/sphere/salingar/sensoryornament.html. Retrieved 2004.
[11] Wise, op.cit.

cc (cubic centimeters, a measure of volume) to 800 cc around the end of the period, when a rapid cycling of heating and cooling in the Earth's climate between glacial epochs occurred; scientists suggest needing to adapt to climatic and environmental change drove the brain's expansion at this time. Brain size increased dramatically again around 700,000 years ago[12] during the period of *Homo erectus* (1.8 million to 300,000 years ago), when the brain grew to almost 1300 cc. This is very close to the 1350 cc. size of contemporary human brains belonging to *Homo sapiens*, who first appeared about 120,000 years ago.

The savannas, therefore, are our genetic home turf. How we operate in contemporary environments is a mere blip in our evolutionary history.

Insofar as our brains have changed relatively little since those two growth spurts, we could interpret the savanna hypothesis as suggesting that our thought processes thrive on that imagery in the various landscapes we inhabit today, whether natural or artificial, that is not too dissimilar to that of the original "template."

feedback loops and affordance

How did these clues become so deeply embedded in our minds? After millions of years of exposure to a natural world over which we had little control, and in which our ancestors often felt themselves vulnerable to forces more powerful than themselves, we have developed visual and acoustical systems that are "structurally coupled" to the environment through sensory motor feedback loops.

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[12] See http://www.talkorigins.org/faqs/homs/, retrieved 31 May 2005.

For example, in tests, human infants will stare at monkey or ape faces as much as they will human ones. But by the time they are six months old, neural wirings to a brain nucleus called the "fusiform facial area" are complete enough to make human faces their overwhelming preference. There is also a special emotive response given to human forms, such as the preferred "waist-to-hip" ratio in women's silhouettes. Basically, certain perceptible characteristics are called out and responded to emotionally first, even as the more elaborate process of visual perception along major pathways proceeds. This feedback loop relies on certain neural configurations being in place, at the ready, so to speak, but is then "completed," or comes into being, through our experience. Those loops permit us to become "structurally coupled"[13] to the appearance of things, especially those critical for our survival such as like parents' faces that denote food and care. We also learned to rely on natural ornament that provided loops that predicated a stable environment and that reminded us of the *affordances*, i.e., nascent possibilities, that were inherent in our habitats.[14]

Wise tells a good Zen story that demonstrates a feedback loop. An aristocrat bought an expensive plot of land with beautiful views. He hired a master Zen gardener to enrich his experience of those views. When the architect announced the project was complete, the aristocrat was outraged to see trees planted in ways that, perversely, blocked the very views he had just bought. But his gardener said, "Come with me." Dipping through an opening in the branches, he led the aristocrat into the foliage to a small stream. Near the stream was a rock. "Stand there," the gardener said. The only way to avoid falling into the stream and stay precariously balanced, the aristocrat quickly learned, was to bend down a little. "Now what do you see?" The gardener watched his face closely. The aristocrat gasped. A most beautiful scene unfolded before him. There was his view, exquisitely framed. Every

[13] "Structural coupling" "refers to a system's structural relationship with its environment. This relationship will determine a system's responses to environmental disturbances or triggers.
[14] An *affordance* is defined as a critical cognitive clue or intuition as to the way an object might be of use to human beings, and as such suggests a range of possible activities with that object. The more experienced with, or attuned to, a particular object we are, the more *affordances* that object stimulates in our minds.

leaf, mountain outline and cloud seemed sharper, more intense, than he had ever seen it. *Here* was the quality of experience he bought, one in which behavioural modification was necessary for him to appreciate.

The gardener had listened to a request and responded with a new environment, which in turn the aristocrat experienced with a profoundly new appreciation for his view. That is an example of a feedback loop. Such superb design by and large always blends alert compassion and authoritarianism, because a good designer, like the gardener, can anticipate a better, richer, more satisfying feedback loop – a different opportunity/affordance – than most clients or laypersons can imagine; sometimes accomplishing that particular feedback loop demands seduction laced with a little ruthlessness. In other cases, the agenda might be quite different: the goal might be the deliberate interruption of a feedback loop, the undermining of assumptions to force us to pay attention, to really engage afresh. That might not be a great approach for a hospice, for example, or for most of our urban fabric, already alienating enough, but might be ideal for a museum, where the goal is to interject new ideas about the collusion between art and museum.

A feedback loop implies the creation of *affordance*, a concept that can be a bit tricky. There is a lot written about affordances and whether they exist ”in the object” or ”in the observer.” Rather, it might be more accurate to see *affordances* as properties of the ”controlled quantities” that create the feedback loops linking observer and environment. For example, say you walk by a big rock every day. Then, one sunny day, when you have a sack lunch and think, hey, that's a great place to sit and have lunch. Suddenly, the rock, the controlled quantity, “affords” this pleasure and a feedback loop is created. Every time you have lunch there, that loop is strenthened.

What does all this have to do with ornament? According to environmental psychologist Wise, we perceive and assimilate natural ornament at a

> *"… very basic level of cognition. Since we are genetically linked to having an ease in interpreting visual forms, and our brains are wired to understand and assimilate certain patterns, the relationship between object (natural or artificial ornament) and brain/mind enhances the role of whatever that object is in the world by giving it a wider range of affordances."* [15]

In this light, clearly one goal of design would be to provide the widest possible range of appropriate affordances for a building, whether we are talking about how we use it or what its façade looks like. Or perhaps the architect's goal is to take away an impoverished range of affordances, there only because of unexamined precedency, and replace them with a rich, engaging, new set of affordances.

Those new affordances might involve some new bridging mechanism to create some new "stickiness" of possibility and more feedback loops. Some writers have observed that ornament mediates the differences between one element and another by providing a transition between the two, a transition sometimes built, real and physical; other times obtained intellectually. As Wise suggests, natural ornament creates a similar relationship between our cognitive processes and the natural environment, such as the savanna's canopy of trees against the sky. Natural ornament assists us in defining, for example, the separation of earth and sky, orienting us in place and time, and provides transitions of scale between such vast spaces, helping us to ascertain distance.

pavlov vs./and experience

I appreciate that this may all sound a bit too Pavlovian. However, we cannot forget about individual experience. It is vital to keep in mind that our "hard-wiring" is both softer and far more complex than the non-neuro scientist might think. We have the powerful and capacity to learn, to change, and to have unique and personal responses. The capacity means that individual learning is inevitable. Sure,

[15] Wise, communication with author, Dec. 1 2007.

although much of our propensity for a certain kind of ancient landscape, the savanna, was wired into our genes as *homo sapiens* developed and as "cultural evolution became increasingly important, and the plastic brain of humans learned to cope successfully with virtually all environments from pole to pole."[16] We adapt: the *phenotype* (observed landscape preference) will be a "function" of both the "genotype," or innate landscape preference, combined with *our own personal environmental experience*. We are creators, inventors and explorers, the "premier generalist species which can and does adapt to virtually any environment."[17]

Our landscape today may be a city sidewalk, a forest, a desert, suburbia, the interior of a building or outdoors. Whatever it is, that ancient landscape is part of the primordial soupy context for our messy emotional lives. If ornament is present and "performs" in ways I have discussed, if artificial ornament evokes the sensory qualities of a biologically preferred natural landscape, it may be considered successful, at least in the world of environmental psychology. The ability to gauge change against a stable environment is the legacy of species survival on the savanna.

Now I want to return to more specific aspects of that setting.

the savanna and the horizon, edges and boundaries

What, then, are the features of the savanna that are so compelling to us, and what do they reveal about the origins of our need for ornament? These features are:

1. Visual access to a horizon line or a portion of it. In other words, an edge condition.

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16 John D. Balling and John H. Falk, "Development of Visual Preference for Natural Environments," *Environment and Behavior*, Vol. 4, No. 1, January 1982, pp. 5-28.
17 Ibid., p. 10.

2. Views of trees that are located individually or in groups, not dense and compact. A corollary is views of nature near, nature mid-range, and nature distant that help us gauge change in scale in an expanse we can examine.

3. A relatively smooth ground plane.

4. Scattered bodies of water: ponds, lakes and streams.

I'm going to focus on horizons and trees, as those two issues can emcompass the other two.

"We must rediscover the straight line wedding the axis of fundamental laws: biology, nature, cosmos, the Inflexible straight line like the horizon of the sea."
Le Corbusier, Last Works, 1970, 177.

Frederich Nietzsche wrote that " … a living thing can be healthy, strong and fruitful only when bounded by a horizon ... A man ... sickens and collapses [if] the lines of his horizon are always restlessly changing."[18] The horizon line is fundamental to human experience. The famous historian of religion, Karen Armstrong, has explored the horizon line and its role in early religious thought, where such distinctions were given sacred meanings. Creation itself was a question of division for Judaism, Christianity and Islam, and other religions, whether from *ex nihilo*, as in the Christian religion, or from a boundary-less swamp, as in the Babylonian tradition. Such distinctions, whether heaven/earth, human/divine, evil/good, etc., ground many origin stories. When the word *horizontal* entered the English language in 1555, it originally meant "relating to or near the horizon," and later, parallel to it, or flat. Etymologically, it is variously traced from "O.Fr. *orizon* (14c.), earlier *orizonte* (13c.); from the Latin: *horizontem* (nom. horizon); from the Greek: *horizōn* (kyklos) "bounding circle," from *horizein* "bound, limit, divide, separate," from *horos* "boundary."

[18] Friedrich Nietzsche, "On the uses and disadvantages of history for life," *Untimely Meditations* trans. R. J. Hollingdale (Cambridge: Cambridge University Press, 1983), p. 63. Quoted by Beatriz Colomina in her essay "Battle Lines E. 1027," http://www.architecture.auckland.ac.nz/publications/interstices/i4/THEHTML/keynotes/colomina/main.htm

A boundary, Martin Heidegger reminds us in his 1951 essay *Building Dwelling Thinking,* "is not that at which something stops but, as the Greeks recognized, the boundary is that from which something begins its presencing."[19] A boundary need not confine or contain; rather, it defines. It is as if we *need* to see the horizon line. It makes the world finite and orders us within space and in time because of the positions of sun, moon and stars as primal clocks and calendars. While the horizon line marks that most profound boundary of heaven and earth, the natural ornament of clouds, trees, plants, rocks, bushes, etc. also expresses well-defined boundaries by clarifying a fuzzy relationship of different elements. In a similar way ornament in architecture clarifies boundaries of two adjacent conditions in its task of dissolving or melding those conditions, as I've already discussed in a cultural context. In this context, the Greek meaning of ornament – *horizein*, to bound, limit, divide -- especially disposes itself, more so than the Latin allusions to flatness and levelness of *horizontem*, a meaning embraced by the Modernists. Wright, for example, declared that the "horizontal line is the line of domesticity—the Earthline of human life";[20] that it represented the American ideal of democracy, symbolized in our endless waves of Midwest prairies; and that horizontality was "the line of repose," in contrast to Victorian verticality. When lines were sustained continuously running parallel to the ground, they emphasized the continuity of space itself in the

Refuge and Prospect

The decision to cross that line depends on how safe we feel, which leads us to the idea of refuge and prospect. This pairing of words is the work of Jay Appleton, the author of Symbolism of Habitat: An Interpretation of Landscape in the Arts, and The Experience of Landscape. He argues that aesthetic values in landscape are based neither on a high-brow "philosophy of aesthetics" or on culturally defined symbols, but are grounded in the biological and behavioral needs that we share with other animals. Thus, the human experience of landscape can be studied through a variety of scientific disciplines. In Appleton's vocabulary, refuge is simply a place where we feel safe, unexposed, and well-defended. Prospect refers to an elevated place from which we can see our surroundings (hence its links to the cognitive structure of ornament in our predilection to edges and boundaries, peripheral vision, etc.). As anthropologist Lionel Tiger has asserted, today's suburban front lawn manifests our ancient need for prospect. The wide swath of grass we cultivate at such effort and great expense, unless we've gone drought tolerant native or slow food gardens, are stand-ins for the savanna. Even more surprisingly, the preference for closely cropped grass is argued to be a genetic memory of the time when such a condition meant that a large herd of herbivores had recently been through the area, which meant that prey animals were close by.

[19] Martin Heidegger, "Building Dwelling Thinking, in *Poetry, Language, Thought* (New York: Harper Colophon Books, New York, 1971.)
[20] *New York Times Book Review*, "The Tyranny of the Skyscraper," May 31, 1931.

interior or exterior landscapes of a building. He wrote, "Continuity represents energized repose, like the untapped strength of a recumbent river god."[21]

But boundary is the sense that has more significance with the development for our visual systems. The fictional fawn, Bambi, and the real animals of the Serengeti understand instinctively that crossing the edge dividing bright meadow from dark forest is a monumental decision. Felix Salten's lovely 1923 book, *Bambi,* is not only an anti-hunting manifesto: to me it is a poetical essay on taking a risk with and at the edge. As the musician Edge doubtless appreciates, the edge defines that tension-filled threshold: on one side, womb-like protection (trees too dense for predators to easily spot the spotted brown deer against the dappled light, for example), on the other, the grasslands/meadow—freedom!: to race, kick up your legs, feel the sun and wind, smell sweet clean air. This is not free, but has a price. The same meadow requires exposure. The edge is a fearsome thing dividing the forest and the plain. It defines the line between life and death.

Likewise, in *The Nature of Ornament,* Bloomer illuminates this role of ornament in marking the edges of things, also recalling the horizon separating earth and sky. Using the example of Gothic church architecture, he shows how the medieval master builders connected earth to Heaven symbolically in an exuberant stone embrace. Like planted trees, the regularly placed columns spring from the ground and spread like branches as ribbed vaults, producing a canopy when the branches reach out to join at the center height of the nave. The ratio of stone to windows with their elaborate tracery symbolizes the change from secular/lower to sacred/higher Christian thoughts. The tracery plays two roles: it connects but also defines the differences between two contrasting materials,

[21] John Conlin, "Graycliff," http://graycliff.bfn.org/conlinspree.html. From an article first printed in Buffalo Spree Magazine, September 1997.

opaque, heavy, solid, textured stone, and smooth, colored, transparent, fragile glass. Thus, heaven and earth are delineated even while they are utterly connected.

edges and fear

When discerning an edge, the ancient and powerful amygdala in the midbrain, home to fear and aggression, operates first. It engenders fear, our most basic emotion (not love), because its primary role is to ensure our survival. Its job is to provide very fast emotional processing of the major visual contrasts in the environment. This is why when people look at a building they are quite unconsciously having an emotional response, beyond the more nuanced responses that experience of a building can bring, say, for architecture cognoscenti.

The amygdala is only part of the visual processing we do. That is a direct connection, but we have other, more sophisticated ways through "feedback," to generate a more multivalent emotional response. If we add ornament to an unadorned cornice, requiring more attention, we change the primal emotional response to one more nuanced. The ornament allows other feedback circuits from the cortical region of the brain to kick in, modulating and enriching our response. For example, since one of the amygdala's "favorite" subjects is big and slow-moving objects (and buildings are very big and very very slow-moving), walking near a massive cornice might generate attention and a fleeting sense of unease before we understand that the building is not out to eat us, a moment that may pass without even perceiving it consciously. So once we've passed the building a few times, a feedback loop ackowledging that the building is benign has been established and our neural systems are quiescent.

Humans are well equipped not only to detect movement preconsciously, but also to discern whether an element approximates plumb and/or level. Our brains are also pre-equipped or predisposed for the very shapes that successive cultures have used for ornament since prehistoric times, as psychologist Gerald Oster pointed out in a 1970 article in *Scientific American*.[22] Many of these ornamental shapes come from phosphenes, which are the spontaneous firing of a retinal receptor in the absence of a photopic event. This firing is "entopic," meaning within the eye. These spontaneous firings often appear as ornamental shapes of light as the brain seeks to make sense of them; similar shapes appear in many early decorative elements and prehistoric cave drawings, as Oster has observed. In fact, the seven most common categories of phosphenes should strike a familiar chord in ornament terminology: grids, parallel lines, dots, zigzags, nested curves, meanders, and spirals.[23] Salingaros attempts to underscore this mental predisposition to certain shapes by framing a narrative that begins with the physiology of sight and ends with cognition. He describes the motion of neurons in an area of the cerebral cortex devoted to vision (which takes up a lot of room, about one-third of the cortex) that appear to be particularly receptive in response to particular geometric shapes:

> *Experiments show that such cells preferentially fire when presented with complex symmetrical figures such as concentric circles, crosses with an outline, stars of various complexity, and other concentrically organized areas of contrast. Furthermore, these neurons coexist with "silent surrounds", which help the neuron to recognize a complex figure better when that figure stands out in a plain background. From all appearances, our brain has ornament recognition built right into it.*[24]

Summing up so far, our environment has shaped the way we see, or, to put it more precisely, we have internalized our environment to some degree. The horizon visible through the open savanna landscape anchored us in time and space. The landscape of the savanna, meanwhile, fostered a unique predilection for the naturally ornamented natural features that have become part of the brain's own landscape and a record of our interaction with those ancient surroundings. The landscape of the savanna leads to the tree, to scale, to fractals and back again.

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22 G. Oster, "Phosphenes." *Scientific American*, Vol. 222, No. 2, 1970, pp. 83-87
23 This phenomenon has also been explored by the mathematician Hermann Weyl in his book, *Symmetry*.
24 Nikos A. Salingaros, "The Sensory Value of Ornament," *Communication & Cognition*, Vol. 36, No. 3-4, 2003, pp. 331-351.

scale, fractals and the savanna

The second issue that helps explain our predisposition to ornament is that of scale. Perhaps the preeminent examples of scale in natural ornament are trees. (I'll be addressing trees and scale again more fully later in this chapter in a different context.) Trees are the archetypes of gradated hierarchy. Proceeding from trunk to limb, limb to branch, branch to twig and twig to leaf, the structure of trees negotiates a range of scales while generating ever-increasing levels of geometric complexity and a density that, while varied, becomes somewhat known, predictable, and *reliable*. No wonder architect Richard Neutra protested, in defense of what some consider a formulaic architecture, that "no one ever tires of the monotony of a tree."

Simply, we don't perceptually operate well when our environment deprives us of the kinds of transitions in scale that a tree provides, especially the kind of scalar order that characterizes our preferred natural environment, the savanna.[25] As it turns out, Woody Allen's love for the Manhattan skyline is related both to the implications of the savanna hypothesis and to the curious properties of scale in what are called fractals.

Fractal mathematics, which was introduced to other disciplines ranging from economics to linguistics as recently as the 1970s, has already inspired plenty of research in design. Eventually, I will argue (and I am miles from being the first to do so) that fractal mathematics can be a valuable

[25] Craven, B. J.; Watt, R. J. (1989). "The use of fractal image statistics in the estimation of lateral spatial extent. *Spatial Vision*, 4, 4, 223-239"; Cutting, James E.; Garvin, Jeffrey J. (1987). "Fractal curves and complexity." *Perception & Psychophysics*, 42, 4, 365-370; Knill, David C., Field, David; Kersten, Daniel, (1990). "Human discrimination of fractal images." *Journal of the Optical Society of America*, 7, 6, 1113-1123; Kumar, T., Zhou, Peng, Glaser, D. A. (1993). "Comparison of human performance with algorithms for estimating fractal dimension of fractional Brownian statistics." *Journal of the Optical Society of America*, 10, 6, 1136-1146; Passmore, P. J.; Johnston, A. (1995). "Human discrimination of surface slant in fractal and related textured images." Special Issue: The perception of symmetry: II. Empirical aspects. *Spatial Vision*, 9, 1, 151-161.

analytical tool for researchers seeking to evaluate the connections, or lack of them, among people, environments, and ornament. Just one example, a paper, "Fractals, Skylines, Nature and Beauty," by Arthur E. Stamp, author of *Psychology and the Aesthetics of the Built Environment,* proposes that a skyline will be *preferred* if its "fractal dimension" matches that of the surrounding landscape, meaning if the design mimicked some aspect of its context; in this particular case, the profile of the surrounding mountains.[26]

As is the case with silhouette complexity and façade articulation, it almost goes without saying that architects and builders have employed such natural features from time immemorial. The Sumerian ziggarats in Mesopotamia (now Iraq) +/- 2800 b.c.e. and Neutra's "gloriette," the open-air second story at his 1946 Kaufmann Desert House paying homage to Mt. San Jacinto in Palm Springs, are two examples. Even deconstructivists , those architects who use the recipes of philosopher David Husserl and literary theory to employ natural patterns, forms, aspects of the site, etc., to find new inspirations for design and then abstract them for a strategy are under this umbrella, although it might be hard to discern the link in their work. Indeed, mathematics itself is not a description of, but an *abstraction* of, nature: it distills relationships into symbols and numbers, but is no less "natural" than a tree. Geometry was natural to the Babylonian mathematicians who invented it, and the relationships it reveals using circles and lines are natural, just as the Greeks and Renaissance architects understood that branch of mathematics to be. As architect/theorist Amir Ameri reminds us, it was Alberti who said, "The source of beauty is nature … and the greatest artist at all manner of composition." Ameri writes:

> *"This nature is the greatest artist, whose work, nevertheless, is said to be regulated by a set of self-imposed rules and principles that collectively warrant the perfection of nature's compositions. These are a set of constant, though secret, laws that every theoretician in turn seeks to unravel and reveal."*[27]

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[26] Arthur E. Stamps III, Psychology and the Aesthetics of the Built Environment (Springer; 2000)
27 Amir H. Ameri quotes Leone Battista Alberti, *Ten Books on Architecture*, 1755 Leoni Edition, Transatlantic Arts Inc., 1966, p.203. From Ameri, in "On The Exorcise of Theory," *Art History*, The International Journal of the

Fractal mathematics has taken those ancient and later strategies in new directions since 1975, when Benoit Mandelbrot introduced the concept of fractals. His book, *Les Objects Fractals: Forme, Hasard et Dimension (Fractals: Form, Chance, and Dimension*) triggered an explosion of investigation throughout a broad array of disciplines that included urban design and architecture. Fractals are important in this discussion because they can describe in far more "natural" ways attributes of scale, proportion, texture, the means to divide space and even how things are constructed, whether it be the folds of the human brain or a two-dimensional pattern.

Mandelbrot coined the term fractal from the Latin *fractus* or "broken." A fractal is a geometric object which is rough or irregular on all scales of length, and so which appears to be 'broken up' in a radical way. Fractals show self-similarity, an important concept which simply means that small parts of the fractal look like large part of the fractal at different levels of magnification but are not exactly identical.. A fractal can also be described as a "cascade of never-ending, self-similar, meandering detail as one observes the detail ever more closely," according to Carl Bovill, an authority on fractals in architecture.

Before Mandelbrot, fractals were known as "monsters" because they were apparently strange interruptions in otherwise intelligible mathematical systems. Mandelbrot's new term enrolled fractals as lawful members of the community of mathematics. Notwithstanding their revised linguistic status, however, fractals have not lost their power to awe. They are powerful analytical tools finding applications in many branches of sciences ranging from biology and psychology to art, design, economics and investing. Stamp's paper, for example, is one attempt to apply the complex but very

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Association of Art Historians, London, Vol. 16, no. 2, 1993, 336-348. Retrieved 28 December 2004. http://web.pdx.edu/~ameri/folder/Publications/Writing/Writing.html.

"natural" fractal mathematics to urban design, enriching the concept of "nature" itself.

Human apparently have the means to easily recognize the self-similarity characteristic of fractals. The eye/brain system first encodes a pattern in terms of one or more basic, fairly coarse units along with how these units are distributed. If the units are repeated in some symmetric fashion, then only a little additional information is needed to specify the pattern. "In the absence of any symmetry or ordering, our eye/brain system has to compute the position of each unit separately, which increases effort and comprehension time," writes mathematician Nikos Salingaros, an expert on ornament and the brain. He notes that patterns tend to be preferred over a random distribution of repeated units.[28]

At this point, he joins many critics of architectural modernism for its deliberate avoidance of ornament and what he sees as its resulting visual barrenness, contrasting such paucity to mathematics, which he characterizes as a "science of patterns." Modernism is "implicitly anti-mathematical," with "unique, irreproducible cases;" it has delivered us into a patternless world with the potential, he suggests, to weaken or even disable the "crucial capability to form patterns." Insofar as the "presence or absence of patterns in our surroundings influences how easily one is able to grasp concepts that rely on patterns," according to Salingaros, nothing less than the "trained functionality of the human mind" is at stake. He writes, "Ornament is an indispensable part of this connection, but people today, after a century of suppression, have almost forgotten how to generate ornament."[29] It should be no surprise that Salingaros comes down firmly in favor of traditional ornament.

So, to teach people what they need to know to generate the kind of ornament that sells, cognitively speaking, Salingaros has come up with rules that emerge from cognitive neuroscience, some of

28 Salingaros, ibid.
[29] Ibid.

which also seem quite compatible with both the major visual components of the savanna hypothesis and with fractal analysis. This annotated list includes:

> *Rule 1. Every structure ought to have some sub-region with a high degree of contrast, detail, and curvature. Those correspond to high values of the first and second spatial derivatives.*[30]
>
> *Rule 2. Plain surfaces require either their interior, or their borders, to be defined through contrast and detail.*
>
> *Rule 3. Our visual attention is immediately attracted to elementary ornamental elements, such as symmetric stars, concentric circles, crosses with an outline, etc.*
>
> *Rule 4. Visual information can be ordered efficiently via linear continuity.*
>
> *Rule 5. Symmetries and patterns organize visual information, significantly decreasing the computational overhead.*
>
> *Rule 6. Coherence occurs when each scale is related to many different scales -- it is often necessary to introduce new structures on the smaller scales to create a hierarchy of connected scales.*
>
> *Rule 7. Human beings connect to their environment on a number of different scales, and the connection is strongest when the environment is visually coherent.*
>
> *Rule 8. Color is an indispensable connective element of our environment.*

In addition, according to Salingaros, ornament is "successful" only when it has what he calls a "recursive capacity." Recursion means putting back into something what was there before: repeating a detail like a small curve that has the same shape as a larger curve in a picture or a landscape plan is

[30] A "derivative" is term from calculus. The "first derivative" of any quantity is rate of change. The "second derivative" is the rate of rate of change, such as acceleration, i.e., how fast something is changing. So Salingaros, I believe, is referring to a 'sub region' of space where some measure like surface finish, or line, or shape of line, either shows change (i.e. first derivative) or change in rate of change (i.e. second derivative). However, ornament need not have curves to be successful ornament.

a recursion. So, what Salingaros is saying is that in order for ornament to be strong and successful, it needs to *reiterate*, or re-express something (some quality, distinction, form, etc.) of the larger whole that it is ornamenting. Fractals are examples *par excellence* of recursion.

Another way of putting this is that ornament needs to 'rhyme' with the pattern integrity that it is 'ornamenting'; much of nature already 'naturally' 'rhymes' in this way., e.g., trees. This capacity to appreciate the connectivity of recursions allows the human mind to analyze images at different levels and subsequently "synthesize" the information. "I emphasize connectivity and integration because I believe it to be a central factor in experiencing our environment," Salingaros writes.

It's important to note that he also believes that "introducing 'disintegration' and the occasional lack of connectivity can also be valuable and credible moves given a specific context." This is exciting because this green light validates how a sophisticated architect can introduce a new set of affordances tailored to a specific project that create new feedback loops, affordances that may be quite startling at first. That is exactly what Wise's Zen gardener did, without ever having heard of a feedback loop or affordance.

6 Falkestrasse, CoopHimmelb(l)au, Vienna, 1983.

One of my favorite examples of the occasional "lack of connectivity" and introducing new affordances is fairly old by contemporary standards but makes the point well: the 1983 law office addition to the roof of a traditional apartment block in Vienna designed by architecture firm CoopHimmelb(l)au. Both the apartment, with its ornate detailing and creamy Baroque yellow façades, and its 20th century parasitical-like glass and steel rootfop appendage read more vibrantly in this now legendary example of a dialectical dance between old and new. We spend time considering both the older building and disruption to it than if the addition never existed. And while using fractals may be a technique to ensure a range of scales across a building, they, too, can also be used to disrupt paradigms. In his 1985 project *Moving Arrows, Eros and other Errors* (or the *Romeo and Juliet* project), architect Peter Eisenmann used fractal architecture to distort scale, employing precise methods to intentionally destroy the stability of architecture and undermine the anthropomorphic orthodoxy that has sustained architectural theory since Vitruvius, according to Michael Ostwald, a distinguished theoretician, architect and educator. Eisenmann wrote of the project,

> *For five centuries the human body's proportions have been a datum for architecture. But due to developments and changes in modern technology, philosophy, and psychoanalysis, the grand abstraction of man as the measure of all things, as an original presence, can no longer be sustained, even as it persists in the architecture of today. In order to effect a response in architecture to these cultural changes, this project employs another discourse, founded in a process called scaling.*[31][13]

If we substitute the concepts of "pattern/scale/proportion/color" for "ornament," we may take a step closer to the precision of scientific thinking about ornament. If so, perhaps environmental psychologists, architects, and designers can find new ways to introduce ornament into design, providing elements that comply with our needs for "pattern/scale/proportion/color" without necessarily employing the conventions of traditional ornament. This may not be good news, of course, for champions of these conventions, although I emphasize that these traditions already possess those "cognitive" requisites, with the added advantage of providing historical continuity. By definition they are traditional.

[31] Ostwald, Michael, "Fractal Architecture": Late Twentieth Century Connections Between Architecture and Fractal Geometry," *Nexus Journal*, http://www.nexusjournal.com/Ostwald-Fractal.html

The idea of life in a "patternless world" does indeed, as Salingaros says, sound like a death sentence for the soul as well as the mind. No one disputes that. Even so, some architecture with a minimalist bent turns out to have "enough" ornament and affordances to satisfy our environmental needs. Just as often, however, ornament produced within the official design canon of Modernism can be ineffective because it does not register. Its detail may be too small or indistinct; it may be ignorant of scale, or differentiations are too faint, tentative, or excessively subtle, thus failing to create something to visually grab onto to make an emotional connection. Few would argue that many contemporary environments bear witness to a lack of understanding and recognition of scale's importance.

The other end of the spectrum, of course, in any style, would be too much or uncoordinated ornament that is just as visually alienating. In any case, no matter what style is applauded or attacked, ornamentation that does not succeed in producing coherence produces its opposite – incoherence.

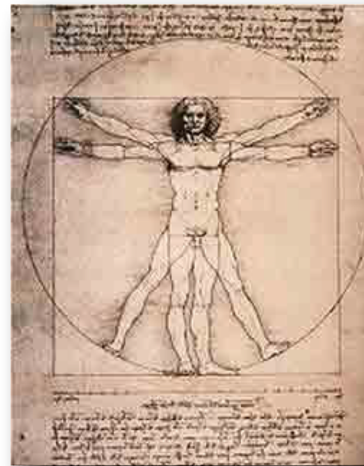
trees: the template of ornament

From a cognitive standpoint, I have come to believe that the tree is the primordial ornament. ***(This may be one of two original ideas I've had in my life.)*** The tree does two things perfectly: It embodies the iconic fractal and also our need for the elements of natural landscapes in our environments. Beyond this, or because of it, they hold a sacred place in human history as treasured symbols of life and growth.

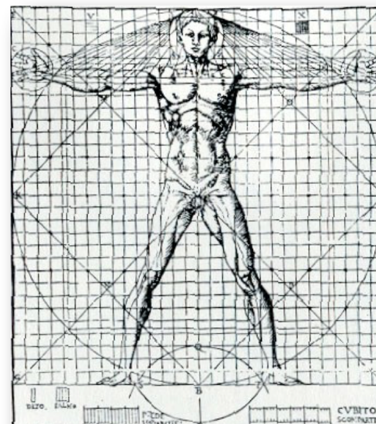
In study after study, people tend to prefer real trees above other kinds of imagery, natural and artificial. Trees, after all, have represented well-being to us from prehistoric times. From our safe vantage point beneath the tree canopy, we hairy hominids scanned our surroundings for water, mates and prey, fashioned branches and leaves into shelter and tools, made healing tea or clothes or shoes from its bark and ate its fruit. Adam and Eve's fateful Tree of Good and Evil, the Buddha's enlightenment at the foot of a tree, or the "Tree of Life" that appears in so many disparate cultures in so many periods bear witness to the tree as a hyperliteral ground of being. Even Woody Allen would probably happily take shelter from a Central Park tree for protection from a sudden rain though he might be shocked, *shocked*, were it actually to provide fruit for his pleasure (apart from the dilemna of where and to wash it) without paying for it at Zabar's.

When we look at a tree, and examine its trunk, primary limbs, branches, leaves and canopy, we have an intuitive sense of its organic growth. We have a similar intuition in the presence of architecture that draws on tree-like imagery, such as the High Gothic fan vaulting of King's College Chapel, Cambridge, 1515; the lily-pad-style vaulting of Wright's Johnson Wax Building, 1939, or any number of canopied structures by contemporary architects. In the forest, a protective "ceiling" shelters us, while letting sunlight enter through interstitial spaces between leaves, dappling the forest bed with light. This protective but diaphanous quality is exactly the kind that worshippers often seek in religious buildings or places for meditation. The edges of trees, where the leaves form a jagged and diffuse contour, provide the fractal-like outline that our brain is equipped to recognize and take hold of, another example of "stickiness." Trees that are dense with leaves in the center (a place we can hide) and diaphanous at its edges (which we can see through to points beyond) have high survival affordances.

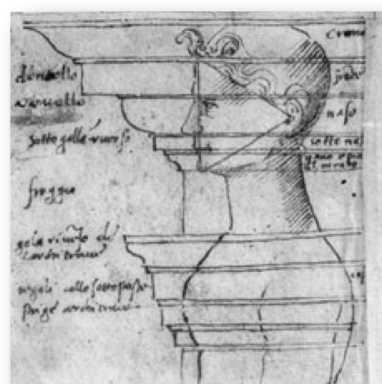
Moreover, the typical image of the tree, with its branches multiplying into smaller and smaller branches, reinforces the concept of "self-similar" structures occurring on multiple scales, moving from leaf to twig, twig to branch, branch to trunk, trunk to earth and roots. In short, living in the presence of trees contributed significantly to the development of our ability to respond to fractal-like images.



To me, the seminal go-to ornament is not just a tree but the acacia tree, regarded by many evolutionary biologists as the most "preferred" tree; that is, consistently evoking positive emotions above all other tree forms. Native to the savannas of East Africa, the acacia's wide, umbrella-like canopy and its elegant, biologically efficient form that allows the tree to absorb more sunlight with fewer leaves has always provided a large, shady area for nomadic human and animal alike. The acacia's dappled light and shade of the acacia's canopy perfectly afforded our ancestors, earning points for "high prospect," (the degree, high or low, of visual expanse available) and "high refuge," (hiding and protecting oneself. The trunk of the acacia makes very good charcoal and firewood. Its flowers can provide honey that is considered a delicacy, and the feathery shoots of the *Acacia pennata* flavor soups. Some say the stem of the tree can treat asthma and diarrhea. In addition, the bark of the acacia can be used as a disinfectant, while the pods are used to make porridge.



Leonardo's man, above; below, an idealized male derived from Platonic Geometry from Vitruvius Pollio published in 1500.



the diaphanous quality of trees

Gert van Tonder, a scientist of visual cognition, has conducted research in what he calls the "language of trees." He sees significance in the diaphanous quality that master Japanese gardeners deliberately elicit in their tree-pruning. Such pruning, he says, articulates the hierarchy of a tree's structure, "extending the fractal-like outer and inner structure of the tree at the same time," according to van Tonder.[32] This "extension" pleases and reassures us on both primal and more sophisticated aesthetic levels. In addition to establishing a hierarchy, the diaphanous quality allows us to see through the tree and assess other vistas or activities beyond it. This ability to "see through" vegetation is one of the most highly selected aspects of our visual system, and accounts for our forward facing eyes, all the better to "penetrate" vegetative surroundings.

Given that not only the leaves but the bark on trees could be said to be "ornamental" in their/its patterning, whether it be the dappled, pale, smooth integument of the eucalyptus tree or the hairy fur of the redwood, is there such as thing as too much natural ornament? Yes. One researcher has noted that floral patterns in domestic interiors, such as in wallpaper, become less attractive, less preferred as they become "busier."[33] One hypothesis is that this distaste for overly busy patterns is an evolutionary adaptation because heavy foliage prevented humans from seeing and responding appropriately to danger.

more on the second issue: scale

One of ornament's most important tasks is to provide scale to an environment. Scale is defined by the *Concise Oxford Dictionary* as "a series of degrees, ladder-like arrangement or classification, a graded system." This usually means an absolutely graded system, as opposed to a proportional grading system, as in fractals. Charles and Ray Eames' 1977 film, "Powers of Ten,"[34] is a superb example of this kind of scaling, from universe to atoms. Scaling is a relationship that remains

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[32] Gert van Tonder, "Nimble Hands and the Eye of the Beholder," paper presented Oct. 21, 2004, Kyoto Institute of Technology First Conference of the KIT Aesthetic Innovation Project.
[33] See **Patterns in Interior Environments: Perception, Psychology, and Practice.** by Patricia A.Rodeman. (Hoboken, NJ: John Wiley & Sons, 1999.) .
[34] Need footnote for film.

The effect of trees extends to other contemporary relationships, such as working conditions or our experience of the ground plane. One research project concerning interior lighting demonstrated that people prefer an overhead lighting in which the source of light enters the room from a 45° elevation angle (such as that from clerestory windows or brises soleil), presenting an array of lighter and darker areas on the floor similar to the graduated lighting provided by Gothic elements such as vaulting and tracery. Such canopy lighting mediates between the pure shade of a deep forest penetrated by shafts of light, and the intense brilliance of an open plain in the visual "surround." When introduced in present-day architectural interiors, a dappled quality of light evokes the beautiful and comforting lighting pattern that prehistoric humans experienced under the trees of the savanna. Such affordances provide us with the mental "set" for safe exploration, just as similar affordances did for our forbears, in turn giving us the ability to approach our work with an ever-so-slightly enhanced, if apparently inexplicable, confidence.

constant and *identical* across orders of magnitude. As I've noted, fractals are is a special subset of scaling in that they remain similar but *not identical* across orders of magnitude.

We can identify a certain scale of ornament as being human scale, that is, its size approximates that of the human body. Architect types will immediately think of Le Corbusier's "Le Modulor." Corbu's proportioning system is expressed in a famous graphic, the diagram of a standing man with right arm raised, which the architect sometimes inscribed on his buildings. He based his modular on the Golden Section (the 1:1.6 ratio of a rectangle's length to its side), a fractal ratio also related to the humanist proportional systems of the Renaissance Man (recall the famous drawing by Leonardo of the naked, spread-eagled-man, whose extended figure touches the edges of a circle, and whose proportions are indicators of cosmic harmonies.)

The Golden Section is notorious in architecture, and often invokes a kind of worship, though it is a tool which can be employed badly as often as well. One may recall the warning of Dr. Anne Tyng, a former professor at the University of Pennsylvania who worked alongside Louis Kahn, and who specializes in geometry: she advised that one neither worship nor limit this "very profound and universal principle."[35] Le Corbusier, she dryly noted, eventually discarded Mr. Modular. "He based it on a six-foot British policeman instead of asking, 'Well, what size opening can people walk through,

[35] Interview between Dr. Robert Kirkbride and Dr. Anne Tyng conducted November 11 and 13, 2003. http://www.nexusjournal.com/Kirk-Tyng.html#anchor228296.

including very pregnant women and very tall basketball players?' That's a problem, because there are people taller than six feet, and there are people fatter than other people…." [36] Wise says Corbusier's larger problem was that "He proportionalized the wrong things - i.e., actual [and static] limb lengths instead of the rates of growth of those limbs. He basically tried for too obvious an application of the Golden Section geometry. He looked at unique, rather than species-specific, relationships."[37]

Still, the larger point is that natural or well-scaled architectural ornament is often used as a device to bridge the levels of scale from *within* an object to *beyond* an object, throwing itself, in a way, out to the environment. That is, it enlarges the radius of our perception of our environment at the very same time successful ornament requires less mental energy to process that environment, liberating it for more interesting or more urgent challenges. In building, the unification of components through scale reinforces order and thus harmony, which is not to mean sated complacency. The scale inherent in the concept of ornament weaves disparate aspects of a scene together, just as a natural environment is tied together by a cascade of fractal structures.

It may be helpful to introduce two more "rules of ornament according to Salingaros," these referring to scale:

> *Rule 6. Coherence occurs when each scale is related to many different scales - it is often necessary to introduce new structures on the smaller scales to create a hierarchy of connected scales.*
>
> *Rule 7. Human beings connect to their environment on a number of different scales, and the connection is strongest when the environment is visually coherent.*

[36] Ibid.
[37] James Wise, interview, June 28, 2007.

The idea of scale, of course, ranges from infinitely small to infinitely large and all points in between, as Yu-Fu Tuan pointed out in his example of the Eiffel Tower ornamenting Paris, or the Washington Monument's relationship first to Washington D.C. and to the nation itself.

In architecture, the human observer will typically identify one figure or element that approximates the size of her/his own body, because the body is our first and most instinctive yardstick, and the standard by which all other objects are determined to be either larger or smaller than ourselves. That information is, or can and should be, critical to designers, because should they elect to use fractals in design, they have to approach them differently than do mathematicians. In design, what sets the levels of scale are the "interaction distances" that people have when coming into contact with the fractal forms. So if vision is the sensory mode, then we need to set levels of scale at those "interaction distances" where the users of a setting will encounter the ornament. For a building, this might be at certain visual perspective points when the building first becomes visible and then becomes successively approached and experienced, recalling Stamp's paper and the points made about silhouette complexity and façade articulation.

Historically, scaling is something most makers of ornament have exploited, e.g., Turkish carpets (extensively analyzed for their fractal qualities by both Alexander and Salingaros) or Gothic architecture, a style that can be likened to fractals, because of its seemingly endless ability to divide and subdivide itself yet incorporate slight variations.[38]

[38] Andrew Crompton, "Fractals and Picturesque Composition," *Environment and Planning B*, 2002, Vol. 29, p 451-459.

Classical Greek architecture similarly exhibits an elaborate system of scaling, seen in the way a temple façade is composed of a hierarchal system of individual parts. Seeking out the underlying relationships (and revealing possible strategy) for this obvious observation, in his paper "*Fractals and Picturesque Composition*" Andrew Crompton argues that that traditional rules of composition go beyond scale and favor fractal forms such as the well-known Koch Curve (which can look very much like the plan of a Gothic column with bulging areas further divided into smaller bulges in groups of threes). Describing the entablature of the Doric Order, Crompton points out that it divides naturally into three parts, namely the cornice, frieze, and architrave, all of which divide internally into three parts; in fact, the whole composition seems to be a concert of groups of three. "This 'threeness' of classical ornament takes on an added significance when placed next to the well-known [fractal] 'the Devil's Staircase' … the resemblance of which to a cornice is most striking …This *lack of exact periodicity* [which indicates its allegiance to fractals] combined with repetition at smaller scales suggests that classical mouldings are fractals."[39]

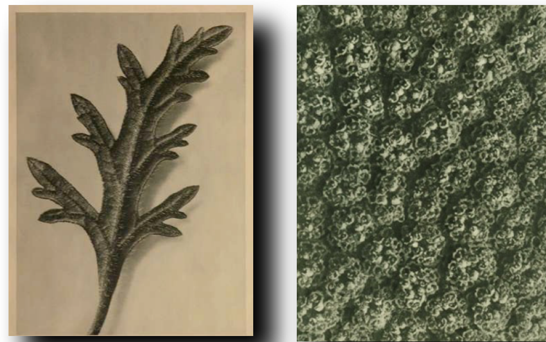
What this research tells me is that scientists are trying to understand the deeper resonance between science and culture. There is probably no more widely known tectonic element in Western architecture than the Doric column, and to spend time unlocking its romance and authority makes sense to me.

scale and "good" modernism

I argue that the additional ingredient of successful ornament through scale distribution can strengthen the feeling of communal "ownership" of certain buildings, or even entire neighborhoods and urban districts because it adds "stickiness." That sense of ownership, in turn, leads us to the notion of the

[39] Ibid.

"public man," a person free, anonymous yet grounded in a confident understanding of the city she/he inhabits, as described by social critic and historian Richard Sennett in his brilliant book, *The Fall of Public Man*.



Photogravures from Urformen der Kunst, 1928
Blossfeldt, Karl (German, 1865-1932)
ink on paper; photogravure
1928 (2000.14.1)

Though scaling is typically associated with traditional or vernacular ornament in architecture, it need not be. Los Angeles-based Richard Neutra, 1892-1970, mentioned briefly before but here introduced more specifically, to my knowledge was the only Modernist to have discovered and harnessed the savanna hypothesis in its infancy, which in turn propelled his strategies vis-à-vis fenestration and landscaping. Recalling Ruskin's rules on ornament, Neutra invariably incorporated visual and physical access to nature at close, medium, and distant ranges, thus including a variety of scales from leaf to mountaintop or horizon, and ordered them according to function. For example, he often reserved "nature-near," for bedrooms or private areas (places of refuge), where he wanted the dweller to feel embraced by plants and greenery at close range, while floor-to-ceiling glass in public spaces, e.g., living/dining areas, permitted expansive panoramas (places of prospect.) And Neutra considered a sense of nature so requisite to well-being that he believed architecture could *be* natural without *looking* natural. His work also reflects his thinking on that: since nature is the mother lode of pattern-making, why not let nature herself provide the visual ornament for buildings, experienced from the inside out?

One of the icons of Modernism, the Piet Mondrian-informed Rietveld Schroeder House (Utrecht, 1924), designed by Gerrit Rietveld and his talented client Truus Schroeder, is another excellent example of how scale can be addressed in architecture at a residential level. It clearly reveals a hierarchy of scale from the exterior planes and lines to the furniture and fittings within, from larger planes of white to the thin pipe railings in black. The designers assigned strong contrasts of primary colors and black and white, providing scale and reinforcing form, to varying hierarchies of architectural elements so that edges and boundaries read cleanly and coherently. While notoriously contrasting with its conventional surroundings of row housing, its diminutive size and scale align it to the neighborhood. Thus, the composition reads as a unified setting on many levels, although I would not say it is an ornamented building, as it does not fulfill enough of the criteria established in Parts I and II. In contrast, the de Young Museum in San Francisco, 2005, at least points to those criteria.[40] Architects Herzog and de Meuron are no strangers to harnessing nature in their work. The photo-printed acrylic panels with a repeating botanical image seen at the Ricola-Europa Factory and Storage Facility, 1993, Mulhouse, France, are based on the work of Karl Blossfeldt, 1865-1932, a botanist and photographer in turn-of-the-century Berlin. Blossfeldt photographed twig ends, seed pods, tendrils, leaf buds, etc., at close range against stark backgrounds. He was deeply interested in forms and textures that nature uses over and over again and was constantly exploring issues of scale; his microscope and imagination revealed the latent revelations inherent in humble plant parts.

The patterns on the building (the long, low, horizontal museum and the brooding, oddly shaped office tower beyond it) do provide some scale (though not enough) do provide texture, do evoke an emotional connection to site, do abstract nature, and do provide narrative content. I will explain.

[40] Basil, Switzerland-based Swiss-based Herzog and de Meuron and Fong & Chan Architects, San Francisco.

"Le Corbusier relates that one of his teachers used to preach that 'only Nature is inspiring and true' and that one must 'penetrate it,' 'make a synthesis of it, by creating ornamentation.' " – Oleg Grabar, The Mediation of Ornament.

The perforations themselves are an abstraction of the lush landscape surrounding the buildings. Using photographs of specific trees, the digitized images were transformed into a figure-ground drawing of hollow circles, some larger than others, later stamped out of the panels, so that each panel carries a unique image. In turn, each panel was torqued or gently bent, creating a second degree of individuality. Whether one perceives these rounded cutouts as circles (when standing directly in front of a panel), or as ellipses (when standing to the side), the result is a composition that demands movement on the part of the viewer in order to be apprehended: the viewer must be actively and dynamically engaged in the act of perception.

Some strict interpreters of ornament may decry the panel treatment at the de Young as "ornament*al*" (that is, the treatment is a decorative screen that does not bring the "Other" to the work of architecture) and not as *ornament*. Fair enough.

To the latter, I respond that yes, the copper treatment does not bring an explicit narrative quality to the architecture. On the other hand, some might consider this as ornament indeed because the cladding *communicates,* albeit at a subtle level, an abstract portrait of the surrounding gardens and trees. One may ask what is "Other" enough to be defined as ornament? Might one not think of the abstractions here in the same vein as a Doric abstraction of the human body?

It could also be argued that the patterns are only used for this particular setting and are thus unique and self-referential, and therefore are not communal in spirit in the sense of being a motif that others will or can use. But in a way, it is the *technique* that generated it and not the inividual *pattern per se* that is the true ornament. One could respond that since virtually every panel is unique, it could qualify as a technologically updated Ruskinian ornament in that the panels, according to the architects, were painstakingly worked out by hand after many experiments with various metals, which included hand-embossing them with tools in their studio. Only then was it possible to instruct the metal fabrication company in how to treat each of the 7,200 panels so that each was idiosyncratic and different from the next, specific to a specific place, yet predictable in a range of differentness. One could argue, too, that there is no figurative patterning or recursion

And while the scale of the building's elements is not as evenly distributed as I would like, the range of what does exist assists in emotionally connecting human, architecture and landscape. Wise remarks that "the genius of this particular technique is that it 'bookends' the visible range of observable ornamentation with the same elements. Seen from afar, the perforations recall the texture of the surrounding treescapes. Seen from close up, they capture the dynamic changes in light and dark and shifting visual penetration one has when walking through those treescapes."[41]

Up to this point, our discussion has drawn upon different kinds of research about the nature of perception and cognition, and the role that natural ornament plays in the way that people perceive and navigate through various environments. One connecting thread is how seemingly simple processes – the act of seeing trees, for example – involves a near-infinite amount of information that the human mind must simplify along certain patterns.

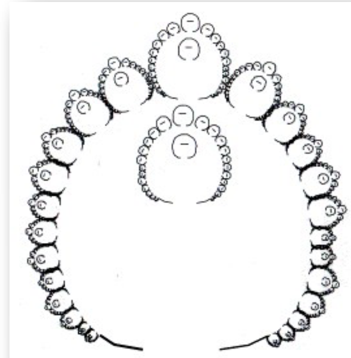
[41] Wise, ibid.

back to fractals

This book is obviously not the venue for a full explanation of scaling and fractal geometries, let alone chaos theory, which can be summed up as seemingly "lawless behavior governed entirely by law"[42] to make sense of dynamic irregularities and previously hidden systems: both bodies of knowledge are too complex for this facile little book, and exploring them in my hands would be a fool's errand. Here I am concerned with the potential applications of fractal mathematics to ornament, primarily the way that fractals may shed some light on the relationship between ornament and scale. Ambitious readers should turn to Mandelbrot himself or texts such as Ian Stewart's *Does God Play Dice?: The Mathematics of Chaos*, Carl Bovill's *Fractal Geometry in Architecture and Design*, Yannick Joye's 2007 paper, discovered as this book was being edited, "Fractal Architecture Could be Good for You,"[43] or the writings of Ron Eglash or Michael Ostwald, who have written extensively about the fuzzy relationship between this new mathematics and recent architecture.

As noted earlier, the essential attribute of fractals is their self-similarity. Long strings of fractal iterations, cascades (sometimes called "clusters") invariably take on their own distinctive geometric characters, exhibiting complex contours that are often suggestive of natural phenomena, such as an ocean shoreline, the profile of a leaf or a broccoli floret, or the Manhattan skyline. To the right is a superb diagram of a fractal in architecture.

[42] Ian Stewart, *Does God Play Dice?: The Mathematics of Chaos* (Oxford: Basil Blackwell, 1989),
[43] Yannick Joye, "Fractal Architecture Could be Good for You," *Nexus Network Journal*, Vol. 9, No. 2, 2007. 311 – 320.



While it may look like a blowfish or a claspless necklace, it's actually the plan of an African village in south Zambia. It is impossible to tell the size of the object from the drawing alone, but it is easy to see that one shape is repeated across many scales. The image is from ethno-mathematician (who knew there was such a profession) Ron Eglash's 1999 book, *African Fractals*, lauded as one of the most significant books on African studies in the 20th century, which illuminates the role of fractals in a long history of African life, ranging from providing the framework of huge swathes of cultural, social and religious activities, to optimizing engineering and braided hair. According to Eglash, the smallest circle with the opening at the right describes an extended family's home, with the chief[44] father's house at the farthest point from the opening, containing the family's altar at the rear and a tiny dwelling for the spirits in the center. This size and location of the dwelling describes the family's wealth and status.

True to stereotype, the peculiar (though utterly logical and efficient) layout of this group of dwelling/work spaces was undervalued by early Western visitors. Eglash "surmises that European settlers considered most African settlements to be large villages rather than cities, because instead of the Euclidean street arrangements of Europe, they found complicated fractal arrangements. 'Thus fractal architecture was used as colonial proof of primitivism.' "[45] A pity.

At the other end of the spectrum, fractals can also be used to indicate what kind of environment might be best to enhance mental performance, as various research demonstrates.[46] In one paper,

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[44] The word "chief" is not translated as an authoritarian figure, as it might be in the West, but defined as "cherisher" or "nurturer.")
[45] http://classes.yale.edu/Fractals/Panorama/Architecture/AfricanArch/AfricanArch.html. Ron Eglash, *African Fractals,* New Jersey: Rutgers University Press, 1999, p. 196.
[46] Wise, J.A. and E. Rosenberg, "The Effects of Interior Treatments on Performance Stress in Three

participants were exposed to four different murals: a high-quality color photograph of a forest with a mountain stream, a more abstract scene of a savanna with acacia trees, a box with scattered squares, and a plain white panel. During continuous exposure to an image, each participant performed a sequence of three types of tasks designed to induce mental stress (arithmetic, logical problem solving and creative thinking).

Although the forest scene was favored to be the winner, and even though the savanna image was more abstract, participants exposed to the savanna experienced the smallest physiological response to the stress of their mental work. (The experiment was conducted by NASA in a simulated space shuttle, as in such cramped quarters in space, every effort has to be exerted to make a potentially hostile environment hospitable to the astronauts working together under pressure.)

The results of the NASA experiment were then evaluated using fractal mathematics. When the research team evaluated the fractal dimension, aka "D," the savanna image fell within an "aesthetically desirable range" of D = 1.3 - 1.5 (1.4 for the savanna image; 1.6 for the forest image, none for the pattern of squares or the white field). The scientists went one step further, hypothesizing there may be a natural "setting" or preference, with a fractal dimension in the ranges of approximately D = 1.3 - 1.5, a hypothesis in line with scores of studies beginning in the 1970s.

What is particularly interesting is that test participants not only preferred the savanna, but when under its influence, so to speak, they "were also found to *excel* in cognitive tasks involving 'simultaneous synthesis' (the ability to combine current perceptual information with information

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Types of Mental Tasks," Technical Report, Space Human Factors Office, NASA-ARC, Sunnyvale, CA, 1986. See "Perceptual and Physiological Responses to the Visual Complexity of Pollock's Dripped Fractal Patterns," R.P. Taylor, B Spehar, J.A. Wise, C.W.G. Clifford, B.R. Newell, C.M. Hagerhall, T. Purcell, and T.P. Martin. *Journal of Non-linear Dynamics, Psychology, and Life Sciences*, Vol. 9, No. 89, 2005, p. 115.

from long-term memory), with the authors speculating that natural fractal imagery resides in the long-term memory."[47] Still other research suggests that the lack of preference for higher D values than 1.5, in which scenes are complicated, can be traced to the same difficulty viewers had with busy floral wallpaper. Given the reluctance of scientists to make broad statements, virtually all of the research cautions against reading too much into the magic D of 1.3, which links the savanna to the scale qualities of the fractal. Still, it's hard to resist a growing consensus that suggests that for best cognitive performance, tune your mind (and your environment) to 1.3 on the primitive brain dial.

I am quite aware that all this may seem more than a little distastefully mechanistic, particularly to people who may react almost reflexively against any seemingly determinist model of the human mind. One can easily imagine an even more insidious paradigm in which, armed with this research, we learn to manipulate the visual environment all the more cunningly, turning our venerable but vulnerable brains into even better receptacles for advertising/propaganda. While environmental psychology's practitioners are well-intentioned, little we humans have ever invented has remained purely benevolent.

However, such a kneejerk response is just uninformed. The study of fractals in human cognition and resulting applications do not contradict a commitment to humane and humanist values, does not automatically ensure effective ornament, and does not negate hoice. Fractal mathematics is a tool, just like the ancient geometries of the Middle East. The larger, and completely humanistic, message here is that ornament plays a positive esthetic and cognitive role in the human mind, full stop., and that role can be confirmed to some small degree experimentally. It is equally clear, however, that one does not need to understand fractals to want and to be able to generate a richer distribution of scale in

[47] Ibid.

our environment, as our predecessors in many cultures have shown us. The universe itself, some suggest, is starting to look like one gigantic system of fractals, with the tiniest phenomena linked to the largest through some cosmic cascade.[48]

For some followers of architecture theory, the mention of fractals *again* may seem like a bad case of *deja vu*. Chaos theory, complexity theory and fractals were lauded as the new darlings of architecture (if not architectural theory) in the '80s, only to lose their cachet in the following decade. In the 21st century, however, fractal research has matured in ways that are more multivalent than anticipated 25 years ago and is more regularly folded into a larger repertoire of approaches for generating form. Architects such as Asymptote, Charles Correa, Coop Himmelblau, Peter Eisenman, Carlos Ferrater, Arata Isozaki, Charles Jencks (also the author of *The Architecture of the Jumping Universe: How Complexity Science Is Changing Architecture and Culture, 1997,* one of the best-known introductions to complexity theory), Christoph Langhof, Daniel B. H. Liebermann, Fumihiko Maki, Morphosis, Eric Owen Moss, Jean Nouvel, Philippe Samyn, Kazuo Shinohara, Aldo and Hannie van Eyck, Ben van Berkel and Caroline Bos, Peter Kulka and Ulrich Königs, and Eisaku Ushida and Kathryn Findlay—for whom fractal architecture "enables hidden aspirations of people in the modern city to become fulfilled"—have all worked with fractals.[49] Fractal geomety is seen as a way to provoke "dynamic stability, which is obtained in open systems far away from equilibrium … involving total participation and that maximizes both local freedom and global cohesion … It is the experience of processes cascading through the continuous scales of fractal space-times that are all coupled together or entangled," researcher Mae-Wan Ho writes.[50]

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48 V.J. Martinez, "Is the Universe Fractal?" *Science*, Vol. 284 (1999) p. 445 ss.
49 Daragh Moller, "SOHO and Davidson: Architects of the Future," 09/16/2004 *Business Beijing*, http://www.commune.com.cn/english/_asp/articles_temp.asp?id=10000319, Retrieved___________.
50 Mae Ho, Bioelectrodynamics Laboratory, Open University in Milton Keynes

With no disrespect to a building's exterior, which after all is critical to public experience, fractals are not simply a graphic technique for generating more interesting façades, which had earlier been the focus of investigation among architects. They offer potentially a much richer strategy to organize and unify the architectural elements of space, site, context, building program, infrastructure *and* ornament in ways that promise to be as liberating and remarkable as anything Rietveld or Wright or Louis Sullivan designed. We might do well to appropriate many of the cultural, economic, and scientific applications of African fractals as well.

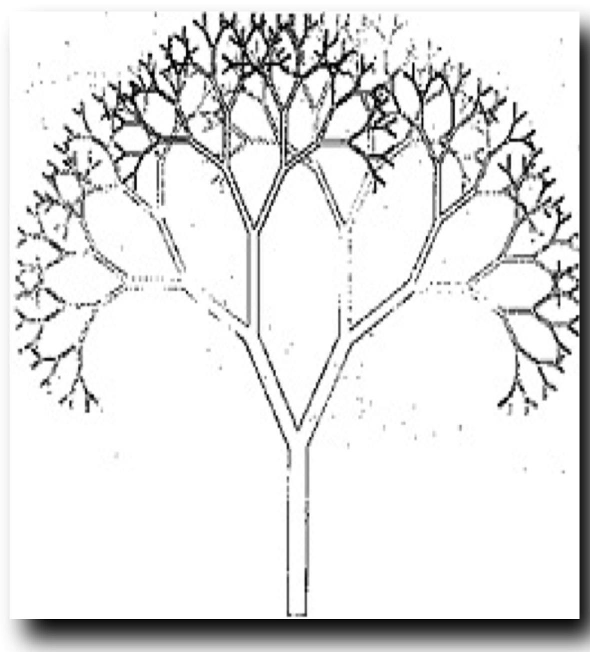
Just as some architects have a design signature, fractals have personalities. Certain fractals suggest greater potential for design than others, as long as whoever is generating the fractals is creative enough in designing a generator (an operation performed to produce a particular type of fractal) and has the ability to apply and adapt it to the rest of the process of building: materials, budgets, construction schedules, energy goals and design review committees. "The most desirable fractals for architecture are those displaying a characteristic richness after a certain number of iterations, before dissolving into infinite dust or yielding filament lengths that approach zero," Maletz says, referring to the so-called Koch curve, which could lead to a building infinite in length –not a very successful strategy in building design. That, in conjunction with harnessing a D of 1.3, might lead to some interesting new ways of conceptualizing design.

the greeks, ruskin, and fractals

Ruskin writes very specifically about the technique of ornament in a way that suggests the Victorian "discovered" fractals long before Mandelbrot. Ruskin's *Modern Painters*, 1843, in fact, contains portions that read like an elementary manual of fractals.

In *Seven Lamps of Architecture* Ruskin shows how closely he observes his environment in defining the rules of architectural composition he proposes. In fact, observation and exploration are not an option but required: "A man must lie down on the bank of grass, on his breast, and set himself to watch and penetrate the intertwining of it, before he finds that which is good to be gathered by the architect," he writes.[51]

Ruskin speaks specifically, and frequently, about scale. One of his rules is that "an ornament should be designed so that it is meaningful when seen at long, intermediate and close range," says Crompton (to recall, he wrote the essay "*Fractals and Picturesque Composition*").[52] He quotes Ruskin: "All good ornament and good architecture are capable of being put into shorthand; that is, each has a perfect system of parts, principal and subordinate, of which, even when the complemental details vanish in the distance, the system and anatomy remain visible."[53] This thinking brings us back to the two papers discussed at the beginning, describing the visual impact of the skyline depending on one's proximity to it.



As Crompton observes, Ruskin also wrote of "uncountable bodies" which together communicate a "sense of power … by a continuous series of any marked features, such as the eye may be unable to number," which are yet distinct enough to prevent confusion. Crompton compares these "bodies" to fractals, which are also uncountable much as the pinnacles on Gothic

[51] John Ruskin, *The Seven Lamps of Architecture*, New York: John Wiley & Sons, 1885, p. 107-08.
[52] Andrew Crompton, op. cit., pages 451-459.
[53] Ibid., p. 456.

cathedrals seem uncountable, yet which are all clearly articulated.

Another Ruskin rule, his "law of principality," dictates that one primary form in a composition should be slightly larger than all others, making it the focus of the design. This law is analogous to the largest repeating unit in a fractal. Similarly, his description of the "law of repetition," in which "one group imitates or repeats another, not in the way of balance or symmetry, but subordinately, like a far-away and broken echo of it," could also be used to describe the downward cascading of ever-diminishing fractals and the fact that fractals are self-similar, not self-identical.[54] Ruskin's "law of continuity" suggests a single shape that undergoes a gradual change of character: "If there is no change at all in the shape or size of the objects, there is not continuity, there is only repetition – monotony," a statement that is pretty much basic fractal theory.[55]
In contrast to monotony, Ruskin prefers shapes "which suggests the idea of their being individually free, and being able to escape, if they liked, from the law that rules them, and yet submitting to it."[56] This, of course, is reminiscent of the way fractals "morph" through the course of countless iterations and point to chaos theory.

Of all Crompton's parallels between fractal geometry and Ruskin's laws, his most riveting example is the diagram known as "Ruskin's tree," which is almost eerie enough to be a caricature of "fractalness."[57] Ruskin was interested in "bounding lines," or the contour line delineating a tree canopy as if a net had been dropped on it, displaying "curves of delicately curved lines." And just as contemporary designers are beginning to explore the implication of fractals in three dimensions, e.g.,

[54] Ibid., p 457.
[55] Ibid.
[56] ibid.
[57] Crompton notes that Ruskin's drawing can be found in *Modern Painters*, 1904, Vol. 3, Fig. 56, pp. 83-84, in *The Works of John Ruskin*, Eds. E.T. Cook, A. Wedderburn, London: George Allen, 1904.

in section, plan and volume, Ruskin adds another dimension to his drawing of his tree by rotating it to plan view "so as to produce a mushroom or cauliflower shaped mass."

It certainly appears Ruskin anticipated fractals; in any case his careful consideration of what he called "the nature of nature" led him to conclusions about architectural ornament that parallels more recent discussions of fractal geometry.

the cosmatesque: an ancient fractal style of ornament

There are far more ancient examples of fractal-style ornament, seen in the exquisitely scaled mosaics in Greece at Delos and Pella, dating back to the Hellenistic period, 338-146 b.c.e., where ornamenters realized the same system of fractals that approximates the "Sierpinski triangle," a well-known fractal.

About a millenium later, however, an astonishing school of mosaic craftsmanship known as the Cosmatesque School flourished in the late Middle Ages, from about 1085 A.D. to 1216 A.D.. The Cosmati were artists who worked in Rome and its environs, designing flat, polychrome geometric ornament, usually applied to floors in buildings erected centuries earlier.[58] This little known style of ornament, sometimes seen on walls as well, is intriguing not only because of its resemblance to fractal geometries but because the Cosmati may have also deliberately employed fractal techniques as a tool to exploit a scarcity of materials and to overcome a relatively modest budget, qualities that make their work all the more alluring given

58 See the comprehensive and beautiful book by Paloma Pajares-Ayuela, *Cosmatesque Ornament*, New York: W.W. Norton, 2001.

today's crises in climate and resources. Visually, the work is disconcerting in its startling resemblance to precise Mandelbrot diagram, except a millennium before.

The Cosmati emerged when Rome was the fulcrum of three sprawling forces: the Byzantine Empire, Islam, and, to a lesser extent, the Western Empire under the descendants of Charlemagne, after 800 a.d.e. The extravagant largesse and authority of the Roman Empire of the first and second centuries was now only a memory, its crumbling spoils for the taking. The Cosmatesque mosaics show the influence of all three cultures, which in turn had wrested elements from even older ornamental traditions from Greece, Egypt (Africa) and Mesopotamia.[59]

These influences vary throughout the work. The Arab influence presented in some Cosmati ornament is seen in "acute, sharp and abrupt angles" as well as "a greater complexity of geometry, mobility, and dynamism than the Byzantine and classical [Cosmati] designs," which tended more toward sinusoidal (curves based on the sine function) and chessboard patterns with roundels, respectively.[60]

To fractionalize their patterns, the Cosmati used a compositional technique that broke a geometric figure into smaller figures by inscribing its inverse within it, according to Cosmati scholar Paloma Pajares-Ayuela.[61]

It is important to note Cosmatesque ornament was clearly added decades or centuries after the buildings they inhabit were erected. That is, it was decidedly "Other" in that it was *not* part of a building's original architectural conception. Nonetheless, their ornament was custom designed for specific spaces, adding color, scale, richness and pattern to animate the space with a distinctive and

59 Ibid., 24,25.
60 Ibid., 24, 25.
61 Ibid., 189.

dynamic new quality. Thus, here ornament is acting in the way that Ananda Coomaraswamy's moon "completes" the night. It helped to imbue the building, typically a worship setting, with a beauty and a sense of place.

Cosmati ornament is rewarding on a number of levels, whether one loves mosaics, practices mathematics, or advocates sustainability, and provides lessons in all three arenas. In her comprehensive study of the Cosmati, Pajares-Ayuela writes that the mosaicists traditionally "… used large dimensional modules, a legacy from the mosaics of the ancient age. This compositional tradition clashed with the reality of the available materials. The Cosmati resolved this conflict by using techniques of fragmentation, regulated by fractal laws … This system enabled the Roman marble cutters to make the most of the material available without abandoning the dimensional modules that formed part of their ornamental tradition. Thanks to the extreme fractionating of the pattern, they were able to use not only the marble spolia that they collected from the ruins of Rome but also the marble remnants that they themselves generated during the elaboration of a pavement, recycling all the material at hand and taking advantage of even the smallest leftovers."[62]

structural coupling and resonance

By now I hope that it is obvious that ornament in environmental psychology is multivalent and not at all linear. It is more push-pull than cause and effect. As we have seen from our discussion of early humans in the savanna, people have cognitive needs and capabilities that they seek to fulfill in their experience of the environment, a demand that is manifest in the idea of reciprocity, or *structural coupling*, between mind and environment. Recent research shows that introducing a human into an apparently neutral, "objective" environment changes it from that of a passive backdrop into a

62 Ibid., p. 143.

dynamic system, aka an "enactive" system which in turn can precipitate that structural coupling. Given that a human being must be there to engage an environment, it also matters what kind of human is doing the interacting, child or adult, tall or small. Crompton suggests that our physical size and, possibly our age hold some important clues to how we can exploit space and place.[63] Children, for example, often find many more ways to use a room than adults do: even a chair that an older person might use strictly for sitting turns into a cave, a battering ram, an airplane, or a castle in a child's hands. In other words, both because of their size and their lack of nuance when it comes to social propriety, children can bring out the "fractal dimension" potential of a room. In the presence of a child, that room provides more affordances and more opportunities for structural coupling ... in the end, it probably will be the children, not the adults, who truly own the room (not a specialized room like an operating room, hopefully well equipped to deliver a full range of affordances to a surgeon, or a space capsule for a trained astronaut.)

Extrapolating to adults Crompton suggests that designers of buildings and cities may be able to exploit this knowledge. For example, citing the advice of architect/theorist Christopher Alexander and colleagues, the edges of public spaces could be scalloped [somewhat like the folds in our brain] to make "pockets" where people will linger.[64] As conceived by Alexander, these scalloped edges are based on fractal geometry and are a perfect opportunity for introducing ornament. All of its roles in defining or melding an edge, in introducing the "Other," in knitting different scales, could be deployed here to reduce the impact of junkspace and to further *place* over *space*. Airport non-space, to name just one of potential building or urban types that typically boast acres of blank walls whose

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63 See Andrew Crompton, "The Fractal Nature of the Everyday Environment," *Environment and Planning B: Planning and Design,* Vol. 28, 2001, pp. 243-254. Crompton cites and credits Christopher Alexander, Sara Ishikawa, Murray Silverstein, *A Pattern Language,* New York: Oxford University Press, 1977, pp. 311-314 and 597-608. See also Christopher Alexander's other works, *The Nature of Order, Books 1-4* and *A Timeless Way of Building*.

64 Ibid.

only relief or texture is signage, could be transformed into at least slightly more satisfactory, albeit temporary, places of psychic refuge.

The point is to harness these ideas and integrate them into our buildings in ways that enable such structural coupling more richly, resonate biologically, and, these scientists argue, that acknowledge bigger truths, no less than what has to sound impossible and impossibly pretentious – the laws of the universe. Yannick Joye, a researcher at the Laboratory of Applied Epistemology, Ghent University, writes that human beings have "a sensory system biologically evolved to operate or to sense and respond in a natural world that is organized and hangs together on fractal scaling laws."[65] That "hanging together" refers to our broader cognitive grasp of the world, which involves our navigation through different kinds of information, some at a scale too small or too dense to comprehend (i.e., the microscopic realm), some just dense enough to understand (the realm of human experience) and others too large or diffuse to understand, at least unless through an interrogation of sensory information (i.e., cosmology, particle physics.) "The biological should reflect the structural principles of the environment; the way the organism engages the environment should be through the same kind of structurally organized processes," Wise says.[66]

In other words, a human and her/his environment together have an opportunity for some sort of profound reciprocity in their very structures. This radical idea, which only emerged in the early 1990s, is called the "Enactive Approach" to perception and cognition originating in systems theory and neuroscience. Its primary authors are the late Francisco Varela and Humberto Maturana, and

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[65] Yannick Joye, "Organic Architecture as an Expresison of Innate Environmental Preferences," *Communication & Cognition*, Vol. 36, Nr. 3 and 4 (2003), 391 – 429.
[66] See also "From molecules to mindfulness: How vertically convergent fractal time fluctuations unify cognition and emotion" by C.M. Anderson, in journal *Consciousness & Emotion* Vol 1., No. 2, 193 – 226, 2000. Published by John Benjamins Publishing Co.

their approach is especially exciting because it completely changes the old "stimulus-response" thinking about how we dwell in the environment. Instead, the approach proposes that an organism tends to "couple" with the environment in a way that corresponds to the capability of that organism. The organism is attuned to "structurally coupling," given what it can perceive and what is important to it. So *even if* there is an objective world out there, it is constrained by the parameters that embody the organism, suggesting that "the world" is created both by the organism *and* the environment. This hypothesis, of course, could not exist without Einstein's relativity theory, and, not surprisingly, one of the goals of the proponents of the enactive approach is how to measure such structural coupling.

To make sense of this, let's examine the way our primary genetic drives inform our interactions with our environment.

the relationship of emotions and the environment

According to clinical psychology, human emotions exist at a lower level of sensory information processing than other cognitive processes. Emotions, as it turns out, are both more genetically determined than other processes, and also more heavily conditioned by experiences of early childhood. Because they are more conditioned than other thought processes, they are more susceptible to environmental influences, especially when the environment is rich in those elements that trigger our emotions. So emotions are bundled with our very base, coarse perceptions of our environment, such as conditions of high brightness contrasts, or fast-moving large forms.

Remarkably, recent research on rats shows that their ability to distinguish among different spaces occurs at a cellular level—a phenomenon that impresses Wise. "We can reasonably argue that for humans, if we don't exercise these unique cellular domains of potentially differentiated cells, these cells are absorbed into other populations of cells, a common practice in the nervous system," he says.

In other words, use it or lose it.

Allowing that variety of cell populations to flourish and respond to the environment—a designer's privilege and obligation—acknowledges our evolutionary history and neurological makeup (whether we as designers do this intuitively or not), which prepared us to be, as noted earlier, the most gifted generalists of the animal world. To reiterate, we are predisposed to the types of contextual variation and change that can be thought of as "ornament." The act of making ornament with the elements of similarity, repetition and scale is a way of performing transitions among various sensory experiences, bridging the gap between one thing and the next thing. Thus, we can avoid abrupt perceptual transitions while at the same time expanding our context and simultaneously conserving and exercising neural resources.

When forced to confront and operate in an environment structure far from our biologically preferred one, our emotions of frustration, confusion, even fear may be activated. A landscape or cityscape bereft of the visual elements that mimic the vegetation of the savanna, or that lack intermediate scaling, or that deny us the visual and cognitive experiences we have identified as mystery, complexity, coherence, legibility, prospect and refuge, all contribute to a subtle but measurable sense of disorientation, both physical and psychological.

To be deprived of these cognitive elements also leads to an impoverishment of our humanity, because we are deeply predisposed, given our cognitive "style,"to fully participate both visually and emotionally in what I have called "natural ornament." Just as our bodies atrophy if we deny ourselves physical exercise, our ability to interact with our environment might similarly wither without the stimulation of ornament, whether human-made or not.

Seen in this way, ornament is no longer mere gratuitous decoration but "necessary equipment" in the best biological sense.

The word "emotion" comes from the Latin, from *ex-* "out" + *movere* "to move." Emotion is connected to action. Most of us laypeople, as I have mentioned, have always believed (crudely, it turns out) that emotions are the result of a stimulus: first there is the stimulus and then there is the response or the reaction. It's actually more complicated. We are actually primed to act before actually acting. A stimulus alone does not precipitate an emotion, and this point is important in defending the integration of ornament into design. This leads us to a second point and an even more remarkable assertion in neuroscience, that our brain/mind requires not satiation but a search for meaning. In his paper "The Dance Form of the Eyes," renowned neurophysiologist Ralph D. Ellis substantively argues these two points. Ellis's first point is that we pay attention to things through a kind of preliminary "gearing up" for them because they may have importance to us:

> *Perception is active rather than passive, and begins with efferent [conducted outwardly] activity in emotional brain areas (e.g., the hypothalamus, amygdala, hippocampus and anterior cingulate) which then motivates afferent [conducted inwards] processing (parietal imaging activity), a 1/3 second motivational/selective process, that resonates with occipital patterns.*[67]

... and he argues for the search for meaning in his second point, using art as his vehicle:

> *… Emotions arise from the total life process, which is a dynamical system – not as an isolated chemical event or a causal result of a simple stimulus. For this reason, emotions call not just for satiation or pleasure, but for explication; this is why art is different from entertainment or pretty decoration … The organism must act on its environment in order to be conscious of it … Emotions are not even triggered by simple 'stimuli', but rather by the meaning for us of a stimulus in a total context determined by on-going and dynamical organismic purposes. Visual art affords not only a meaningful, self-directed dance of the eyes, but also a meaningful dance of this emotional explicating process.*[68]

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67 Ralph D. Ellis, "The Dance Form of the Eyes," *Journal of Consciousness Studies*, 6, No. 6-7, 1999, 161.
68 Ibid.

Granted, ornament falls somewhere between art—which can many times be challenging, disorienting, disturbing—and "pretty decoration," but I am not too worried about the latter, as we have already defined the difference between ornament and decoration's roots in propriety.

Ellis's two points embody the essence of the "enactive" approach to perception and cognition. Our minds don't want, necessarily, a quick or crude resolution, as a layperson convinced this is all disturbingly Pavlovian might expect. As Ellis explains:

> *In experiencing art, we want a form of symbolization that can intensify our emotional experience, rather than merely reduce it (as in hedonistic drive reduction). This requires that … there must be an exploratory, excitatory or entropy-resistant tendency that is independent of, rather than derivative from, any hedonistic drive-reductive tendency … We want not only to reduce our drives, which brings pleasure in the straightforward sense meant by hedonists, but also to intensify the degree of consciousness we experience—to fully feel the value of that which we value … Such an analysis makes sense only against a background of motivational theory in which happiness and pleasure are not the only ultimate driving forces.*[69]

What a pleasing and riveting thought, a relief, that "drive-reduction" is not our *only* activity and that our "drives" are far more complicated than we may be aware. Ellis's existential point can also be made in neurophysiological terms "by thinking of self-organizing dynamical systems that tend to maintain their pattern at a fairly high degree of energy and complexity—systems that tend to be drawn into higher-energy attractors as well as lower-energy ones."[70] To rephrase, despite the world of immediate gratification and lowest-common-denominator in which we swim, we do seem to be attracted to things that involve struggle and the search for meaning, however we define it. We like to expend energy on behalf of that which nourishes us.

69 Ibid., 172.
70 Ibid., 173.

The end is to *exist* as the form of being that one is motivated to *be*, and to engage in the kinds of symbolizing functions and actions necessary for this purpose," Ellis notes with eloquence.[71] That is the basis for his metaphor of the "dance": the environment becomes the dialectic with which one engages. Sensory loops of information-activity create exchanges between organism and environment that can lead to *higher* energy (negentropy, the opposite of entropy) as well as lower energy attractor states. Natural ornament, by helping to knit the world perceptually, can help to lead the organism in its interaction with the world to higher-energy attractor states, which should be of some relief to that considerable population of architectural theorists who loathe environmental psychology. Ornament does this, according to Wise,

> *in part by providing a linking structure across sensory fields and scales within the environment, which decreases the demand on neural resources. It also produces the sense of a more large-scale integrated scene or of segments within scenes, that then become amenable [or available] for higher symbolic processing, like 'naming' things.'*[72]

Bravo! Yes!

What is the role of emotions in our role in our interaction with the environment? What does it mean to "love" a building or to be drawn to linger in a particular place? According to A.T. Purcell, whose research at the University of Sydney, Australia, explores cognitive models of design, the experience of emotion is a kind of a break. "First, there has to be a blocking or interruption of either an established action sequence or established pattern of thinking or perceiving. Second there must be ANS (autonomic activity or arousal)."[73] That's exciting: the new disrupts the old and an emotion is born. When I see the face of someone I love—or loathe—all those physical changes I experience and the rush of emotion occur because I have been interrupted from my previous status quo. Purcell

[71] Ibid., 172.
[72] Wise, op.cit.
73 A.T. Purcell, "The Relationship between Buildings and Behavior," *Buildings and Environment*, Vol. 22, No. 3, 1987. p. 215.

illustrates the "interruptive" definition of emotion with an example of the Romanesque cathedral of Ste. Madeleine, Vézelay, France, completed in 1132 and renowned for its dramatic contrasts in light, height and spatial qualities. Emotions can also be learned, and based on older experiences generated earlier in similar circumstances. This is also interesting: The well-known can also precipitate emotion. Ellis uses the example of playing a beloved symphony to recall his feelings of an earlier time.

While we daily use our innate visual reflexes to deal with such issues as brightness, plumbness, levelness and the dimensions of large-scale contours, we do not always get to use those visual reflexes with something as sumptuous as Ste. Madeleine. In that special setting, our everyday responses are interrupted and enriched. And if we think of a forest, natural ornament accentuates the character of the forest and thus imparts drama. At Vézelay, the brightness and contrasts vary in light, height, texture and forms, the similarity of proportions and forms at different levels of scale, and the coloration of light in the stained glass windows all evoke primal responses to light and darkness. The interior columns mimic a forest but are inflected by human imagination and design.

Understanding Ste. Madeleine's place in architectural history is not inborn; it is an acquired taste requiring education, reading, thinking, direct experience, reflection. Yet few visitors will fail to have a strong emotional response to this majestic church, an impact which traces its way back to the qualities of natural ornament. Enriching that direct emotional response through understanding leads us to the "higher attractor states" because we are privileged to enjoy more affordances, broadening and deepening our emotional response. And of course it doesn't have to be such a caricature, if you will, of a cathedral. It can be a building by Herzog and de Meuron, as it is for my friend the architectural photographer Martin Schall, or for me, a museum by Alvaro Siza in Santiago de Compestella that I know in a very deep way acknowledges and demands the range of my humanity and my intellect. As we become more educated, the range of our affordances makes it possible to be emotionally engaged with many more kinds of architecture.

The cumulative gestalt of the composition makes the church "hang together," in Joye's terms, as an emotionally engaging composition, a perceptual whole, much like the natural environment.

Christopher Alexander is an architect well known for incorporating environmental psychology into architecture and urban design. In his many books, Alexander has argued both for incorporating practices into design that emerge organically from the site and program as well as principles concerning human habits and needs. In approaching any design problem, author David Seamon writes, for Alexander

> *it is important to write a pattern language that begins with larger patterns and then incorporates smaller patterns. In this way, the larger qualities of environmental wholeness are held in sight as smaller qualities [i.e., ornament] are fitted around them. Alexander also emphasizes that the 253 architectural patterns comprising his book "A Pattern Language" are illustrative and far from complete, adding that new design problems may require revised patterns or even entirely new patterns that the architect will need to create from scratch. In the end, Alexander's pattern language is not a finished product but an on-going process of dialogue among architect, client, user, builder, and site. Pattern language is not a master list of unchangeable design principles that must be incorporated in all buildings and places. Instead, it is a way of looking at and thinking about buildings and environments so that one can better understand how their parts might work together to create a whole.*[74]

fractals, ornament and contemporary architecture

Fractal "thinking" has been embraced by two opposing camps. One is that of traditional architects bent on establishing a scientific basis for endorsing traditional systems of ornament, who now may also call on chaos theory and the findings of environmental science to bolster their position. With this augmented foundation, champions of traditional ornament might confidently claim that such

[74] David Seamon, "Concretizing Heidegger´s Notion of Dwelling: The Contributions of Thomas Thiis-Evensen and Christopher Alexander," http://www.tu-cottbus.de/BTU/Fak2/TheoArch/Wolke/eng/Subjects/982/Seamon/seamon_t.html. Retrieved 2006. Dr. Seamon is Professor of Architecture at Kansas State University.

tried-and-true styles are superior to today's work. Meanwhile, contemporary architects with zero interest in traditional forms are integrating cognitive science and fractal mathematics along with new materials and technologies into their work.

Today we are far more astute in gauging the impact of the environment on our minds and bodies than ever before. We are aided both by new building technologies and new science to model our ideas. Each of these three arenas—aesthetic theory, architecture and environmental psychology—have given us new prospects of engagement.

In both science and architecture, something like a critical mass appears to be forming and emerging. Like a fractal structure, this critical mass is branching out in apparently chaotic lurches, and these apparently haphazard movements are being woven into an existing but changing way of thinking, if not yet attaining theoretical hegemony. The growing interest in ornament (even though many architects would not use that still-forbidden word), is a natural and desirable development away from the self-conscious strictures against ornament, and towards a more psychological and environmentally sensitive notion of design.

A small aside here: I keep returning to verbs like knitting and weaving in thinking about ornament. I have discovered that these are also the verbs of choice many critics and designers employ to describe the "extreme textiles" of some avant-garde buildings. Such usage detaches the language of building (at least in English) from its default gender associations—or in feminist terms, such new habits feminize (or de-masculinize) the vocabulary of buildings and urban space. As Pierre von Miess points out in a chapter prophetically titled "Fabric and Object" in *Elements of Architecture,* "Paradoxically, the Modern Movement has conferred upon *buildings* the object-status and upon *interiors* that of a fabric providing spatial continuity [italics added]."[75] Men build, women or gay men decorate. New paradigms in architecture, it seems, would extend the idea of fabric into buildings and urbanity. Maybe it is time to reread Semper on textiles and fabric as original building materials, flexible, hanging, not based on resisting compressive loads, not an intervention (another favorite architectural term), nor an imposition on the land. As architecture evolves, new nouns and verbs will have to step forward.

Digital technology, computers, and technology, obviously, also inform this enriched arena, well beyond the purview of either Post-Modernist design or Modernist criticisms of ornament. For example, computers and CAD-CAM technology denies Adolf Loos a vital cornerstone of his argument against ornament: that it wasted human labor. A century ago, making objects was pretty much the preserve of either large manufacturing facilities or the individual craftsperson. Now, the individual can harness markets and production techniques once inconceivable; the dissolution of the boundary between design and product is now within reach of Everyman. As designer Toor Boonje remarks,

> *Technology for me is a means of creating new methods to make new expressions. Also, I am interested in 17th, 18th and 19th century objects because I like the richness of the sensual use of materials and surfaces. Many of the techniques used to create these objects are very labour-intensive. New industrial processes enable us to explore these sensual qualities again. I am very disappointed by the global blandness that surrounds us and try to find ways out. Today I can draw something on my computer, send a file directly to a production machine and have an object made. The modernist rationale of unadorned production starts to break down, when new possibilities arrive every day. I think this is a very exciting time to be involved in manufacturing.*[76]

Thus, today a range of scale exists beyond the domain of the physical built environment: from the individual "act of making" to mass-customized to a different paradigm, embodied by women in India who set up their own branded web site for selling hand-made goods abroad, independent producers

75 Pierre von Miess, *Elements of Architecture*, Lausanne: Van Nostrand Reinhold International, 1986, p. *77.
[76] Boonje, Toor, Need Footnote.

rather than unskilled labor earning pennies as unidentified "third world" workers. While he might not recognize its form, Ruskin's cry for social justice and for joy in individual craft can be supported, not thwarted, by technology only distantly related to the crude production processes and economic and social disparities of the Industrial Revolution.

It goes without saying that this book only barely scratches the surface on the relationship between art and science and ornament, let alone the subject of ornament alone. This is just a starting point. A simple message about ornament's role in sensory perception is finally to respect and trust our ancient senses, in opposition to those figures from whatever century who would seek to suppress them as the unfortunate emblems of the id or primitive man. Ornament delights in challenging the architecture culture's prejudice against pleasure. And I am sure our own age does not suffer for lack of its own versions of gods, demons, cherubs and gargoyles to bring into our midst, although we might express them differently. Our roles as creators leads to the "transformative" potential of ornament, as Trilling notes. Except for most of the 20th century, ornamentation's history has been about intentionally inviting our monsters into our world, introducing deliberately fantastical themes into our physical space. It is that extra dimension of impudence, joy and delight, of daring to play with the sacred and the absurd, that architecture has often omitted. Traditional ornament humanizes our environment in languages we know and own, but new technologies and materials call out for new forms of ornament.

But as usual, Alberti wishes to have the last word:

> *We do not have to hold ourselves strictly to [the ancients'] schemes and take up each and every one in our works, as if they were unquestionable law; rather, having their lessons as points of departure, we will seek to find new solutions, and to arrive at a glory equal to theirs, if not greater.*[77]

[77] Leon Battista Albert, *Book Six*, *de re Aedificatoria*. See Eugene J. Johnson, "Leon Battista Alberti" p. 51