THINKING TOWARDS ARCHITECTURE

by

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How, at the beginning of a new century, might architecture progress from the fashion- and economics-driven art form that it is to something else, to something better? What resources ought we to be using? Should architects learn from other disciplines—even join with other fields, like psychology, geography, to tackle the tasks of architecture? Or should architects stay within architecture, reaching out to other disciplines only now and again, and then only for exactly what we want?

What I've found over the years is that you cannot simply search out "results" from research in other disciplines and apply them to the problems and aims of architectural design. Economists can't design; nor can sociologists, ecologists, and most engineers (!). They do not have the same mind-sets, skills, questions, or agendas that architects do. And the data they produce is not easily incorporated. If, on the other hand, you completely enter one of the other disciplines yourself—which takes a good few years—or if you come from one of the other disciplines *to* architecture, the very learning of the second discipline tends to eclipe the first. There's so much to know. In the late modern age it's rare to find the functional amalgamation or two or more distinct disciplines in a single person.[2]

Here are a few diagrams that clarify what I mean by the above assertions. **Figure 1** represents one model of how to go about moving architecture from where it is to some place better. It represents a set of different disciplines, along with architecture itself, "feeding in" to architecture and in some way propelling it forward. One might imagine committees of experts pouring their knowledge, insights, and desires into architects who try, with every building, to put it all together.

Another approach, **Figure 2,** is much more internal to architecture. One stays within the field. One's influences are: architectural magazines, architectural travel, architectural theory, previous architecture, architecture books, architecture lectures (like this one? probably not), architectural conferences, and so on. One marries a fellow architect; one wears black clothes . This diagram represents the current *modus operandi*. Once inducted, welook mostly at what other architects do. People who make forays into different disciplines (excepting fine art) tend to have little or no influence on the profession (and only slightly more in academia); and this not only because

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[2] It can happen in closely adjacent disciplines, e.g. math and particle physics; molecular chemisty and biology; geography and ecology, architecture and landscape or structural engineering, and so on. But physiology and literature? architecture and nursing? theology and mining? One can invent scenarios and dissertation topics that bring them together, but their overlaps in style and content and subculture are tiny.

it's a difficult procedure that rarely results in new design, but because it's regarded as something of a defection, a disloyalty...proof, anyway, that they were not really—not *fully*—Architects.[3]

The model we should be using, I think, is represented by **Figure 3**. Here one starts in architecture and ends in architecture, and remains in heart an architect. But one makes one or more extended journeys into the other disciplines, journeys that might last a period of years. These journeys into art, or ecology, or engineering, say, are less like tours from which one brings back interesting souvenirs, and more like living with the natives for a while, speaking their language, getting excited about what *they* get excited about...and coming home before it's too late. This *modus operandi*, it seems to me, is the best way of keeping our questioning distinctly architectural while at the same time learning other ways of seeing and acting in the world. Not everyone need embark on this course, or can—just those who think there could be more to architecture than what meets the eye (and more to it, too, than constructional ingenuity) and who have the time and institutional support to do it.

Let me relay to you some of the enthusiasms I picked up from just such extended intellectual visits. Each, I think, could contribute to the task of thinking about architecture in new ways and thus taking it forward. Only time will tell if I am right. I will touch on four topics:

1. **evolutionary complexity theory,**
2. **economics**
3. **the psychology of human needs,** and
4. **phenomenology**

The kinds of slides I'm going to show you are a bit of a mix compared to the usual fare. There are very few pictures of great-looking buildings; there are lots of charts and graphs that I'm going to ask you to follow. But there's some pretty cool stuff near the end. So you have to stay awake!

1. Complexity theory and evolution

This is the man who inspired me: Louis Kahn. He loved science more than fairy tales; and although he did beautiful buildings he thought architecture's deepest impulses were ethical, not aesthetic. Here he is at the chalk board **(Figure 4 a, b, c.**). See how with both hands at the same time, he draws a beautiful sequence, starting with something simple and filling it in with life, lapping the borders. When Louis Kahn drew that pattern he was expressing something very deep about how life evolves and elaborates itself not only in nature but through man. Indeed, if you look at any of Kahn's many metaphysical diagrams, you see him trying to say where architecture "comes from." It comes, he said, from turning silence into life, darkness into light, from potential into joy. What a life-affirming way to think of architecture, and indeed of any creative

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[3] Here's an exception: using graphicand 3D modeling software made for movies and/or car design, and making 'architecture' with it The jury is still out on the long term pleasures of living in buildings shaped like eggs or plates of metal lasagna. Are they to be any better, intrinsically, than the piles of bars, zig-sags, and shards favored by Deconstructivism? I knock Decon for its formal proclivities; but in truth I respect the movement a great deal for the intellectual energy it demanded (and released) from the hundreds of young architects in the 1980s and early 90s whose style leaders delved seriously into Continental cultural 'theory,' and French philosophy. For better and worse, that adventure has left an indelible mark on how all architects in their 40s and 50s now think. There is a chance that *liquid architecture*, to use Marcos Novak's term, will amass the same level of intellectualism for another generation.

endeavor involving conscious design. *Life-affirmation* is an ethical principle, as is the idea implicit in the image on the board that life is intrinsically complex and becoming more so as it "fills itself in."

These are ideas that I have tried to work out in my own way by voyaging into complexity theory and becoming—for only a while, I trust—a total nerd. Come with me.

Let's look at these equations (**Figure 5**.) They come from information theory, a science that developed in the 1940s and 50s and that formed the basis of computer science today. I'm not going to tell you exactly how these equations work, which would involve showing yet other equations, on and on.... But I do want to describe to you what they *mean*. *C* denotes *complexity*, C_{pot} denotes *potential complexity*, *R* is *organization*, and Ω (*omega*) is *complexity-and-organization*, a measure, I claim, of *lifefulness*. You will find the other variables in any text on information theory; but you will not find Ω.

Now *C* and *R* are actually independent variables, and not the mutually dependent ones most people assume they are.[4] We usually think that you can only have one at the expense of another: that is, a system is *either* complex *or* organized; more of one meaning less of the other. But if one understands things correctly, you can have both in any amount.[5] **Figure 6** is the simplest chart that represents this fact. Complexity, C, goes from *simple* to *complex* on the X-axis; organization, R, goes from *disorganized* to *organized* on the Y-axis. Figure 6 also maps Ω. Ω is defined as the square root of the product of *C* and *R*. The hyperbolic contours are therefore lines of equal-Ω, with Ω increasing in magnitude to the right and up.

At a very elementary level, Figure 6 divides into four regions or states: the bottom left— *simple-and- disorganized*; the bottom right—*complex-and-disorganized*; the top left— *simple- and-organized;* and the top right—*complex-and-organized*. Ω is highest in the top right-hand corner. Here's the claim: *the combination of high complexity and a high organization is what life "wants."* In the story of evolution, all species try to "travel" up the ridge of that topography (on the 45^0 line; or, said more accurately, all (or nearly all) new species find viability only higher up on the ridge than their parent species did. Why? Living things create each other's environment. As they multiply in number and get in each other's way and compete (both with each other and with other species), the world becomes more complex for all, and more demanding of organization. This is to put things very broadly.

Look at the Ω contour lines again. On the left, where *C* is near zero, there's is a kind of a trench along the Z-axis. We can call that "the trench of *rigidity*:" all organization, no complexity. Along near the X-axis there is another trench, which we can call "the trench of *chaos*:" all complexity, no organization. Everything that's alive is travelling or "trying" to travel up and along that ridge of Ω, which is a far as one can get from both trenches. (**Figure 7.**) Easy? No.

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4 For a full explanation of why and how this is so, see my forthcoming *A General Theory of Value*. Until it hits the bookshelves, see *http://mather.ar.utexas.edu/center/GenValu/*

5 That's not always true. Because $C_{pot}^2 = C^2 - R^2$, the value of potential complexity, C_{pot}, if it's fixed, creates a ceiling of sorts. The way that *C* and *R* can have *any* value is to allow C_{pot} to have whatever resulting value too. When people think that *C* and *R* are trade-offs, what they have assumed is that C_{pot} is a constant. Contours of constant C_{pot} would show in Figure XX as concentric quarter-circles centered on the origin.

The second law of thermodynamics (which says, basically, that every isolated system slowly "goes to hell" —to chaos), can be represented as a clockwise "wind" of sorts that's trying to blow creatures off the ridge of Ω and down into the trench of chaos. The opposite danger is ossification, which can happen when internal energy levels drop too low, or order is imposed from without.

Figure 8 more or less shows how things stand evolutionarily at the "moment" (i.e. as it has been for about two hundred thousand years). Along the one contour—the lowest contour of Ω—one goes from the most rigid things (diamond, rock, soil), to the other end (seawater, a cloud, a star). Somewhere in the middle, coming out of the marshes and beaten by the sun and zapped by lightning, is where life begins at the viral-cellular level. From there, evolution herds its charges up the ridge: from bacteria through mushroom, clam, frog, bear, to human beings, *homo sapiens*. (The list is a bit arbitrary, of course, except for us).

This describes a large and general pattern of biological evolution. But I think that this large pattern is reflected everywhere, at nearly all levels and scales of life, like a hologram, including the human scale and the individual psychological level. Another way to put it: our bodies and minds are the product of the universe, and the process has left its traces. These traces aren't hard to find. The psychologist Mihaly Csikszentmihalyi, for example, finds the pattern described above within every human life and what makes truly happy. What makes us happy, he says (aside from eating when we're hungry, winning the lottery, and the like) is being in a state of *flow*. What does that mean? Look at **Figure 9**. It ought to be familiar. The terms he uses are different to ours, of course: where we have complexity, *C*, he has "(degree of) challenge," a variable that goes from low to high. Where we have organization, *R*, he has "(level of) skill," another variable that goes from low to high. (He also has empirical ways to measure these things.) People feel best, Csikszentmihalyi shows, and people operate best, when they are in a state of *flow* (or "in the flow channel"), which is to say, when the challenge (task complexity) is equal to their skill (task organization). If degree of challenge exceeds one's skills, one feel anxious; if one's skill exceed the degree of challenge, one feels bored. But right in the middle (it's a kind of Goldilocks theory too, like mine) you feel *just right*. When in a flow state, time flies like a banana (thank you Groucho); work doesn't feel like work. You feel happy, competent, neither over- nor under-extended.[6] The feeling of flow is the feeling of long term *viability* ("I could do this forever!"): which is how the larger pattern of evolution we have been discussing makes itself felt. With experience and with learning, both the level of challenge we want and the level of skill we achieve increases—matching each other in degree—to come to rest (for a while) at a higher level: greater *Omega*, more life.

Let me take this thinking back to architecture. This can be done in many ways. Here are two:

First: I think that what we all call "design", the mental *process*, is actually evolution speeded up. It's a way of taking a mind—a brain—and making evolution run faster *in model form*. After all, in designing, we reiterate the three essential processes of evolution, i.e. reproduction with inheritance, variation, and selection; we generate options, test them, reject them, draw them again a little differently, do it again.... We have evolution at an accelerated rate of the virtual objects of our imagination. Then we build prototypes and test them... The process itself increases both the complexity and organization of the thing being designed, not to say the complexity and organization of the mind of the designer as well, especially if he or she feels

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6 See Mihalyi Csikszentmihalyi, *Flow* (.....)

flow. The practice of design is itself passed down through the generations, and it evolves. Through design, humans individually and cultures as a whole have found a way to speed up the evolution of the artifacts essential to enriching and extending life. Design adds value, we say, because "value" is what we attribute to anything that enriches and extends our lives.

Second: Evolutionary processes are uniquely capable of generating copious amounts of organized complexity. (Or "complex organization," which is the same thing. Both mean high Ω). And because more Ω means greater lifefulness, a moral duty exists to perpetuate the pattern, to aid and abet evolution. Deliberately moving an evolved artifact, process, or organism off or down the ridge is anti-life.[7] That's why greater simplicity can never be good thing if it is combined with less organization. Indeed, I would say *the love of simplicity-and-disorganization is the root of all evil*. If this is true—and I think it is—we should wary of all kinds of fundamentalism, religious or architectural, because they advocate movement towards greater simplicity on the one hand (e.g., fewer elements in play, fewer alternatives and with stronger preferences upon them) and more *dis*organization on the other (e.g., absent, laxer, less precise, or more arbitrary application of rules in practice—qualities often misrepresented as "freedom.").

Certainly, any evolutionary theory of design should give us a much higher tolerance for complexity in architecture, as long as it's concomitantly organized complexity. The thrust of life—and therefore of design, we should realize—is towards richness, towards the Baroque not the Diagram, the peacock not the cage. Venturi was on to something. "Back-to-basics!" is a cry we should not long to hear. It means something has gone awry. Nor, too often, should we hear that this or that feature of our design "doesn't matter," that it's "unnecessary" or a "frill." Nature gets her frills any way she can. So should we.

Let me extend these two observations into a more specific critique.

I'm would like to show you a computer simulation of evolution, a movie called "Evolved Virtual Creatures." It was done by a computer scientist named Karl Sims at the Thinking Machines Corporation "way back" in 1994. Here's what he did. He programmed a handful of basic virtual objects—five or six blocks and paddle-like blocks— and assigned to them rules for joining together and rules for motion between each other, such that they could hinge or swivel with some "force" as well as hit into each other. He also programmed a resistive medium for these blocks to be "in," water or air, and he programmed in the force of gravity. So far so good, but unremarkable. Programming the laws of physics into virtual objects, making them (appear to) fall and bounce and so forth, is not that hard. But then he did this: he gave random pairs of configurations of joined-together blocks the capacity to "intermarry" and "breed" with heredity and variation: i.e. two parent configurations could have offspring that were a bit like them but identical to neither. Finally, natural selection. The criterion for a given configuration surviving to the next round of reproduction was the ability to "swim," "run," "jump" (and a few other actions) defined in some rudimentary fashion. Those that did not succeed doing one of these things, did not get to have offspring; those that did, did. (**Figure 10**.)

I don't' know for how many rounds, for how many generations, Sims ran his program [movie plays], but look at the result: this creature walks by throwing his arms in the air. This one swims

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[7] The piece of the argument missing here for lack of space is how not just living creatures but the elements of the environment that support them, are best (i.e. most supportive) when *their* complexity and organi-zation are equally matched too.

by squirming like an eel. There's a cross between a fish and submarine. This one seems sad... The components of these virtual creatures are simple (we don't see muscles or circulation or alimentary systems, which would be necessary in real creatures) but their form *through time* is marvelously complex and organized even without these physiognomic support systems to look at too.

Now look at **Figure 11**: it's a page the *Towards a New Architecture* where Le Corbusier tells us that the best architecture is made up of "basic forms brought magnificently together in light"—or something like that, promising that this simplicity would bring us new freedom. You have architects like Aldo Rossi taking that to heart, and all sorts of reductive and simple versions of architecture following Corb's dictum to this very day. I might also have used Mies as an example. Unlike Sim's creatures, architecture is motionless. **Figure 12** is *Maison Bordeaux* by Rem Koolhaas, another block house. It has a room-size elevator inside. Nice. But you know, I don't see in this work any of the evolution that I see in Karl Sim's creatures. It's still an overly strict box, as hard as steel, as dumb as a brick.

But when I see a picture like this—which is Le Corbusier's cabin at Cap Martin, where he went when he got tired (I suppose) of his own buildings—I remember that Corb was not just an iconic designer with a penchant for the big picture, but a real and life-loving *person*. (**Figure 13**.) Look at that marvellous ancient tree; look at the rustic log walls of the cabin he designed; the gingham cloth on that table where he lunches with his wife, the crooked trelliswork. Think of the ocean roaring nearby, the gulls. When it really came down to showing us what architecture ought to be like, this is as good an example as any of what evolved complexity in a place can give you. Le Corbusier should have put *these* photos into *Towards a New Architecture,* not pictures of silos.[8]

Architects need to find ways to embrace complexity, to embrace age, and to embrace other life-forms from living animals and plants to natural, renewable materials, in order to give their architecture at least *some* of the organized complexity of nature.[9] I think it's what our souls want. But I also happen to think that it's the most *ethical* direction for buildings to go in right now, and that , in turn, makes me unhappy about the predilection many young architects have for brutal if stylish minimalism of the Dutch or Swiss kind. The sometime sublimity of these inhabitable diagrams—so easy to draw in CAD and build—could entice the whole field into another round of de-evolution towards over- or under-organized simplicity—Modernism itself having been the first. Design is partner to evolution. Greater complexity, not less, is its natural goal: complexity organized but not too..., at all scales, and yielding more life.

2. Economics

I would like to report a few things I learned from another discipline I spent some time with, namely, economics, or rather, economic theory.

Economics is the science of markets. It is the study of exchange involving money and "goods," where the goods involved might be material things, energy, knowledge, information, work, time

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8 Actually, of course, the cabin was built much later in his life.

9 Frank Gehry may not be exemplary in his use of natural, renewable materials, but he certainly is exemplary in his determination to infuse architecture with "animal spirits." Even his non-fussy attitudes towards detailing—Gehry is no Norman Foster—speaks of his love of spontenity, of getting on with things

or money itself in some other package or form. In all this, economics casts one party as the seller and the other as the buyer. Often the first is also a producer; usually, the second is also a consumer. Then there are brokers, agents, regulators, and so on. We are all familiar with these terms.

Now, markets have a only short history of being thought of in evolutionary terms. Certainly marketplaces grow, and when they do and get large enough, they produce a degree of social organization and social complexity that no one can fully understand, not even economists. When millions upon millions of people at the same time work, want, pay , make, invest, swap, bet, risk, borrow, insure, hedge...and are connected to each other world-wide, and especially when money can flow anywhere in a twinkling, the Market becomes a global force, a quasi-living thing in its own right that no one can control. Whole new phenomena emerge, spilling over into politics and art and science, into every human endeavor.

As architects, we do not think of economics as a creative discipline or as something we could learn from. We don't teach economics at architecture school. This is a pity, and not just for practical reasons. Reading economic philosophers like Adam Smith, Karl Menger, William Jevons, Karl Marx, J. M. Keynes, Vilfredo Pareto, Friedrich von Hayek, John Kenneth Galbraith, even Paul Samuelson, is a pleasure. How ardently they try to grapple with man's dual desire to profit and yet do good, to do good and yet profit. And what a charming combination of rhetoric and mathematics, of speculation and observation, these thinkers developed to model what happens thousands of individuals act to realize these dual ambitions partially independently, partially in imitation of each other, and partially bound by rules under changing social and technological regimes.

No, "economics" enters *our* professional milieu mainly as a spoiler of dreams. Anything good or interesting we propose to build is sure to cost more than anyone wants to pay, including ourselves. That's economics. Thus does The Budget enter as the bully player, the nay-sayer, the invisible Force that stalks the office. To keep our sanity (not to mention our self-respect) we have persuaded ourselves that we can be just as creative with small budgets (per square foot) as we can with large ones—"in fact more, because we *have* to be." But that's a kind of denial of the truth, painful as it is, that quality costs.

I became interested, therefore, in whether and how certain well-known mechanisms of the marketplace could be ju-jitsued into allowing architects a little more freedom, putting more money into their buildings and into their pockets too. One quickly figures out that no belief circulating among architects today is more self-destructive than their belief in the power of *creativity* to conquer cheapness. I'll come back to that.

Here is are some very simple diagrams of the possible relationships between *price* (or cost) and *quality with* respect to any good whatsoever: shoes, meals, buildings. (**Figure 14**)

The first diagram, on the left , illustrates the belief that price and quality are essentially uncorrelated. It says that if you shop long enough, within wide limits you'll find every price quite randomly attached to every quality of a certain class of good. Here the "correlation coefficient," $\boldsymbol{r}$, between price and quality is nearly equal to zero.

The second diagram illustrates the belief that there is a rigid (here linear) connection between price and quality; $\boldsymbol{r} \approx 1$. "You get what you pay for" is the message. Indeed , you believe, when

$r \approx 1$ you don't *need* to judge the quality of a good directly or yourself, since price alone is a reliable indicator.[10]

Most people, however, don't think that either of these two are true. What most people believe is something in between, and that is illustrated on the right, in the third diagram. Here the correlation between price and quality is positive but not perfect, i.e., $r \approx 0.5$, with more variation in the middle range than at the extremes. You have a sort of leaf shape. In general, this diagram says, the more you pay (or the more is costs to make), the better the quality of good you'll get...*but only roughly*. There are many exceptions. Bargains are possible, and one has to be clever.

What does it mean to be *clever* in this matter? The seller of something and the buyer of something have two different desires. The buyer wants to maximize quality and minimize price; the seller wants to minimize quality (because it costs) and maximize price. One way to picture these desires is shown in **Figure 15**. Take a dot in the middle of the leaf, representing a certain middling-quality good at a certain mid-level price, and imagine that those white arrows are pulling on that dot. They're in tension, if you will, pulling with a force that's equal to their length. (We might call them "price-quality vectors.") If they could force any change, the consumer/buyer would want to pull the good down and to the right. More quality for less money is what they want and what they think they deserve. The producer/seller wants to go the other way: less quality (because producing quality generally costs them money) and a higher price.

Any long-stable market price (for a certain good), then, can be thought of as a stalemate, a tug of war with no motion, between what the producer/sellers would prefer and what the consumer/buyers would prefer. And the chances are that stable point is on or near the diagonal.

Actually, this sort of stability is rare in non-commodity goods. ("Commodities" are goods that are standard in quality no matter who makes them, like sugar, salt, gasoline, lumber.) As soon as we introduce novelty, technological progress, artistic judgment, fashion, perceived or real shortages , and so on, the price-quality stalemate is undone. Goods start sliding around the diagram, pulled hither and thither. Opinions fly; justifications are offered. There's introductory and predatory pricing, there's reputation exploitation. Competition abounds.

Now, one might think that there can't be any real *progress* in this model. You pull this way, I pull that; we come to an agreement as to price, and that's it. This is not quite right. Progress can be made in an absolute sense. Recalling our earlier discussion, I've gone ahead and called that progress "price-quality evolution" and its opposite, regress, "price-quality de-evolution." Evolution is represented by motion up and to the right, de-evolution by motion down and to the left. Although price is not simply organization, R, or quality simply (!) complexity, C, which would map Figure 15 oh-so-neatly onto Figure 6, I would claim that both—but especially quality—represent *complexity-and-organization,* Ω. Goods evolve, and when they do, *they get better*. Markets evolve, and when they do, the costs of things traded in them drifts upward too as

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10 It's a belief that's open to exploitation, of course, and very "psychological." For example, if you buy a $200 shirt, it's a "$200 shirt" forever, whether or not you could actually tell it apart from a $20 version of it. As long as *you* know it's an expensive shirt, you iron it, you don't abuse it, you hold your head high when you wear it, and so on. These altered attitudes and behaviors *make* it the $200 shirt it may or may not be, qualitatively speaking. I doubt there is *any* relation between the cost and quality—as reliable, accurate *time keepers*—of wristwatches over $500.

more bits, more internal markets, and longer supply chains form. When a whole class of products improves—becomes more complex-and-organized—the drift of the entire leaf is up and to the right. More people are able to pay more money more for better stuff. How are they able to do that? Because they are richer. Why are they richer? Because the goods and services *they* produce fetch higher prices too, because they're better. And so on, round after round, as more energy and intelligence are applied to satisfying more people's needs more completely. This is not inflation, which is what happens when governments put more money into circulation than is warranted by production-, employment-, and quality-levels. It is economic *evolution*, and it's been happening for thousands of years.

I paint a rosy picture, good over the long term. In the short term, however, other dances are danced in the correlation space of price and quality. Say a new business comes on to the market: a new restaurant opens or a new car is introduced. What do producer/sellers offer? Relatively high quality for an obviously low price—the consumer's dream. But as time goes by, the producer/seller slowly causes his product to drift along the arc shown in **Figure 16** to the position he is happier with, which is to say, high price and low quality. This is doable in part because, with success, per-unit average production costs can come down. "Economies of scale" is the name economists give this phenomenon, and it allows producers to keep or lower their prices while maintaining or increasing their profits. In this scenario, quality *needn't* suffer, although it often does, especially with relatively low-tech goods. But our arc describes another phenomenon. To wit: people are much better at noticing price differences than they are at detecting quality differences. The latter requires connoisseurship, vigilance, and immunity from the *reputation* of the producer. Exploiting their good reputation, producers can lower production costs by cutting corners, hollowing things out , skimping on services and warranties, using cheaper materials that look the same, and so forth. Such goods, in the minds of their consumers, come to occupy what I have called the *phantom position* shown in Figure 16. Eventually that position evaporates, of course, as the truth becomes known and as a competing products start *their* cycle...with the same or better product at a lower price. But in the meantime, much money can be made.

Now, why should architects worry about this whole process? Well, as producers in competition with each other, and as people unusually anxious to please, we often find ourselves following above pattern, including, occasionally, the exploitation of reputation.

More frequent is the following scenario: a client comes in and says "I want you to do this, this, and that for $100 per square foot"—way too little. What do we say? "No problem. I'm creative. I'll get right to work." The client knows and *you* know that the price is going to go up as you get into the project. The question is: by how much. It's basically a bad faith agreement at the start, with both parties trying to "psyche the other out." But with architects there's a twist. As an artist and professional, you are trying to move what you offer up and to the *right*—a nice progressive move.[11] And you are (probably) more interested in total quality than the client is.

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[11] It's interesting in this context to consider what a "profession" is. Be it engineering, law, medicine, accountancy, or architecture, a profession is a service characterized by the fact that the people for whom the service is performed are not equipped to judge the *quality* of the service except in the barest and most selfish of terms. Professionals thus make a public oath as a condition of induction to, and continuing membership of, the profession. This oath is a promise to preserve, protect, and promote the public's interest as well as their client's to the best of their ability, deploying the up-to-date specialized knowledge they *profess* to have, and within the law. Most workers, tradesman, and businessman like to think of themselves as a professionals too, and form associations to create the requisite token economies.

He or she, on the other hand, is trying to pull you down to the bottom and left: to reduce costs and eliminate unnecessary quality, especially if its benefits are to be felt by passers by or others who won't pay. The result is: diametrically opposed vectors. Stalemate? Not usually, because operating in their favour is Gresham's Law: "bad money drives out good money."

The Earl of Gresham was finance minister to Queen Elizabeth I, around 1650 in England. What he noticed was that when you introduce coinage into circulation that has a lower metallic value than the coinage currently in circulation but has the same face value—if you mint silver dollar coins while gold dollar coins are also circulation, and gold per ounce is more valuable than silver per ounce—then people stop using the gold coins as money, and melt them down instead to get more silver ones. Or they might simply hoard the gold coins as their price (in silver dollars) goes higher. Sooner or later brass dollars replace a silver ones, paper money replaces brass money, digital money replace paper money, and so forth. That's because money, to be money, need have no quality beyond inducing other people to trust that yet other people will give them goods in proportion to its face value. Money's true form, as it were, is to be no more than a digital wink.

Gresham's Law is not just about "bad money" driving out "good money," which is why I bring it up. It's also about understanding that not every property or quality of a thing we make is equally valued by the person receiving it (if it has value at all). And it's the clever producer who is able to capitalize on this fact by redesigning the good so that *only* the things people notice and want in the good are, in fact , manufactured. A quick rehearsal of this procedure, and the alternatives:

In **Figure 17**, the shaded circle represents the set of all the *valued* properties of an object. The larger circle around it represents all the properties that this object actually has. Now, when you realize that this object (and it could be anything, by the way, a shoe, a movie, a building...) when you realize that this object has more properties than people want or even notice, there are two things you as a producer/seller can do.

One is to "close down" on the object until it's exactly what people want, and *only* what they want, jettisoning all the superfluous stuff. The good is simplified and organized ("rationalized" and "value engineered" are other terms).

The second road—and potentially more evolutionary road—is exactly the opposite. It is to increase people's appreciation of the object as it is in full. It is to discover *more* of its qualities; it is to try to *increase* the complexity of the object and of people's valuation of that complexity. Gresham's Law will always take you down the first and lower road.

Again, why should we care? Well, if you look at the percentage of U.S. Gross Domestic Product (GDP) that architecture (i.e. non-residential, non-military construction) represents as a fraction of the whole GDP, it has been dropping steadily since 1965. (There's actually data that shows that its been dropping steadily since the 1930s.) Maybe we are building less? Wrong: we are building more each year. **Figure 18** shows percent of GDP expended *per billion square feet* of floor space built. It too declines steadily for the better part of a century. I imagine the same is true in Canada.

What does this mean?

Think of your own "GDP"—your own household earnings and expenditures per month say, or per year, and ask: What fraction of my earnings do I spend on drinking the same amount of

coffee (i.e., per cup)? Has that changed? Or on clothing, assuming you bought the same amount of clothing? If that fraction has been going up, it's because you are valuing coffee (or clothing) more highly than other goods in your budget. You might say, "well the price went up so I *had* to spend more." But that's exactly the point: if you had enjoyed drinking coffee less, you would have drunk less or found a substitute, like tea, and the fraction of your income you spent on coffee would have stayed the same or declined.

What our national "%GDP/sq. ft." statistic shows is that as America has grown wealthier and wealthier (the GDP has been going up in absolute terms, like your getting a raise every year), a smaller and smaller fraction of its wealth is being devoted to the creation of architecture, or the creation of buildings in general, in the same amount. By analogy, when you start spending less and less of your new income on something, this is the surest sign of that something losing value to you. You spend most of your raise on what you presently want most. You assign less of it to what you presently want less. Do that year after year...

This is Gresham's Law at work. If people can't see the difference between a good building and a bad building, they're slowly but surely going to get worse buildings. If they can't tell the difference between expensive and cheap, they're going to get cheap. And architects who whip themselves to be more Creative, who stay up nights to find cheaper ways to make cool-looking buildings, are only going to make the line representing %GDP for architecture drop further faster.[12] For when one of us occasionally succeeds at building cheaply in an interesting way, it lowers the ceiling for everyone else. Before long we will *all* have to build that cheaply; the "interesting" component having quickly become routine.

This is not a future we should have to live with, or get used to. It's a dead end, a prison. Architects have to fight back, and the only way to do so as far as I can tell is to stop talking about simplicity with such reverence (e.g. as "the soul of Modern Design") and start talking about complexity, about life and its richness, and how much needs to be done. There's more to this than preferring the Baroque. To revive architecture's value, we need to identify publicly and quite specifically which human needs architecture serves and how it does so. The task is to explain the goodness of (good) architecture to ordinary people in such a way that they will be willing to pay for its finer points, even if indirectly. This requires us to be knowledgeable in the first place, clear in communicating architecture's many, many subtle qualities, and never being reductive, essentializing, or diagrammatic about it. People want reasons to value what they value. If we don't supply them, who will? So, on to:

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[12] Also paying ever lower wages to ever younger architects, and students, to get it done. A true blue economist would be quick to offer another interpretation of the %GDP statistics I have been citing. It might be, they would say, that the building construction industry has become more *efficient* over the years, producing buildings as good as they used to be for less money, or better ones for the same money (per square foot, and corrected for inflation, of course). This being the case, the trend ought to be welcomed and the industry, including architects, congratulated. So the question comes down to whether you think that the average building of the 1930s, say, was better considered and better built than its functional counterpart today. I think it was. Certainly, this is true: that the fraction of the average building's construction cost that went into mechanical and electrical equipment increased substantially over the last sixty years. Ditto with products like insulation and insulated glass. Call these improvements. The question remains as to whether these improvements have anything to do with *architecture* as such: the pleasures of functioning windows, of material, light, sound, and space; harmony of proportions, care in craftsmanship, quality of cabinetry, the fitting of building to site, landscape, and view...and so forth. I would estimate that these factors are receiving ever shorter shrift precisely because so much more of the total construction budget is going towards "equipment." And I am grateful for every exception to the rule.

3. The psychology of human needs

Most of you who have had any contact with academic architectural theory over that last twenty five years or so know that there is a genre of it, issuing mainly from schools in Boston and New York, which really has very little to do with human life or human needs, with what people want or what people value. It is theory totally internal to the discipline, and very much based in history, specifically the history of Modernism. I alluded to this at the beginning of my talk.

To my mind, this is a prime example of architecture shooting itself in the foot. Architecture has the potential for being one of the greatest wealth generators of the 21st century. Given the dotcom bust and the telecom bust, I think that architecture (and environmental design generally, from interiors to landscape) stands poised to become a major driver of national economies: a new center of investment, innovation, appreciation, and quality-of-life increase for all. And I don't just mean "housing."

But for that to happen, we're going to have to recast what architecture *is* and what architecture *does* in terms that are both understandable to ordinary educated people and provocative to us from an intellectual point of view. I'm *not* asking us all to drop our intelligence and start talking to the masses, tabloid style. I am saying that just as psychology has some extremely complex and difficult theory that both keeps academics busy *and* interests ordinary people, so too can architecture sustain interesting, difficult, and challenging academic theory whose aim is to explore the architectural phenomenon in terms whose outcomes will help produce buildings and experiences that non-architects will appreciate, could profitably study, and, most importantly, want more of.

The right way to go about developing such theory, therefore, is to start to question what the human needs *are*. I mean, if you can't say what human needs are, then you can't say which of them architecture serves; and if you can't say which needs architecture serves, you shouldn't be building in the first place.

One has to be careful about the word "need." It's often abused. Someone might say, "I need a Coke...no, I need a *Diet* Coke..." What they might *need* is to drink; what they *want* is a Diet Coke. Not everything you feel like having or experiencing is, itself, a need, although it may be motivated by a genuine need. (I bet you've met people who use the word "need" rather unfairly to motivate others, and overuse it too. "I need you to pick up Julie. I need you to do the dishes." "Oh, O.K," we say, convinced, somehow, that this is no ordinary request.)

Needs run deeper than wants and preferences, and they are fewer in number. Let us grant this. On the other hand, to cut all needs to down to *one* essential need—the need to *survive*, say—is overly reductive. Somewhere between one basic, urgent need and the five hundred momentary desires we feel every day, lies a useful number of discreet, genuinely basic needs—five or six of them, say, that we *all* have, and the satisfaction of which underlies the myriad smaller things we just we want, things which are more or less substitutable for each other. (A Sprite will do as well as a Coke...or as well as *water*, if you are really thirsty. A Nissan will do as well as a Toyota...or as well as *any* car, if you need to get to the hospital. You get the idea.)

Rummaging around in the literature of motivational psychology, the most useful list of basic needs I came across was one I had learned of long ago, in some college course. It is Abraham

Maslow's well known "hierarchy of needs," first proposed in 1954. As I carried on my own work, ultimately I had to expand his list of five needs to six, but there's a great deal of similarity between them. As I spend the next few minutes explaining what the six needs are, and how they interact, my debt to Maslow will become obvious.

The six basic needs are as follows (and the order matters, as we shall see): *survival*, *security*, *legitimacy*, *approval*, *confidence*, and *freedom*. I often display them as a vertical list, with survival at the bottom and freedom at the top. The implication is that they form are hierarchy among each other, although I prefer to call mine a *stratigraphy*. What that means is that needs at the bottom, i.e., the "lower needs," are more basic and intrinsically more urgent than the ones at the top. An unsatisfied lower need will usually motivate you to do something about it before an equally unsatisfied higher need will. Why? Because no higher need can be satisfied (more than a little) unless the need immediately below it is considerably satisfied first—and so on down. You cannot move up the stratigraphy without first consolidating something at the lower levels. Each need is foundational to the one above. Each emerges from the one below, once that is substantially satisfied.

In a bit more detail: Having satisfied the need to survive for now, the next need to emerge will call itself "security." This need will launch us on the quest to make (or find) such arrangements as will *guarantee* our survival for the longer term. After feeling sufficiently secure, we will start to seek *legitimacy*, which means turning to society, with its laws, rights, "positions" and roles, to find our place. It is with its laws, rights, positions, and roles that society constructs a web of interchanges and resources and dependencies that is much larger than our immediate circles. This weblike network has its own rules and language, overlaying the simpler security and survival structures that hold it up, so to speak, and screening us from dealing with them directly.

With every step up the stratigraphy, things become more complicated: the physical, social, and psychological arrangements that must be made become more numerous and subtle. After a measure of legitimacy is won, for example, and the issue dies down in urgency, the need for *approval* rears its (ugly?) head. We want people to *like* us; we want them to approve of what we did, do, and plan to do, of how we look, who we are, what we wear... This is an endless task, as you all know, and quite a trick to pull off completely, since you want the *right* people to like you, not the wrong ones. But from the simple fact of enough people approving of you, you start to gain *confidence*, which means getting past the need for *everyone* to approve of you all the time for everything. It means you can take risks; you can act spontaneously. You can trust your judgment knowing that if you failed there would structures beneath you firm enough to break your fall, as it were: friends and colleagues, your firm or institution, the law, a physical home, money in the bank, food in the fridge...and so on down. Only feeling confident enough can you begin to feel *free*, truly free.

One might call freedom that's based on the substantial (if not *perfect*) satisfaction of all the lower needs: *well-founded freedom*. By contrast, one can have *poorly*-founded freedom; i.e. some degree of freedom *without* one's lower needs adequately satisfied.[13] This is not good. Anyone who claims they are "perfectly free" while they still, in fact, feel unliked, illegitimate, or insecure, is kidding themselves. How do we know? Because such individuals are easy to bring down. They're vulnerable to blackmail, to being "exposed." So fragile is their freedom that threats to it are likely to be met with violence of some sort. For deep down they know that their

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[13] The same could be said of any of the needs in relation to those lower than it.

freedom was stolen. They know it was not paid for by the lengthy negotiations required of everyone else (the people they call "suckers") in order to found *their* freedom on the consent and respect of others, within the bounds of law, and on the basis of material security and life-provision for themselves and whoever else might be affected by their actions.

There's more to learned about our behavior from exploring the inherent dynamics of the stratigraphy of needs. For the sake of time, however, I must be brief, and ask you to read my book , *A General Theory of Value* (if it ever comes out!) for the details.

If I might go into just one more of the stratigraphy's features before turning to architecture specifically:

One of the ways to parse the stratigraphy is to divide it formally into two groups of needs: the lower needs—survival, security, and legitimacy—and the higher ones—approval, confidence and freedom. It's a useful division in several contexts. For example, it can give you a handy criterion for distinguishing between *coercion* and *persuasion*. If you are exchanging goods or tokens with someone such that the consequences of the trade involve increments or decrements to their lower needs, you're probably using coercion, i.e. using violence, power, or authority to try to get your way. If, on the other hand, the consequences of your interchange involve changes in the satisfaction level of one or more of one's higher needs, then the interchange is likely fueled by persuasion: one or both of you is using flattery , encouragement, or, the gentlest of all persuasive strategies, your own example.

The logic underlying all this is a simple moral rule. This rule says that, when dealing with others to obtain some objective,"use minimum force" or—same thing—"start at the top of the stratigraphy." The way to get people to do things is, first, by your own example or pointing to others'; if that doesn't work, by encouragement; if that doesn't work, by flattery and insult; if that doesn't work by the use of authority; if that doesn't work, by the use of power; if that doesn't work, you can punch them (violence). Upon introduction, and for as long as possible, interact with people at the level of their highest needs before interacting with them through their lower ones (if you need to at all). Like the presumption of innocence in law, this honors them as a person of accomplishment enjoying well founded freedom. Says the rule, in sum: prefer persuasion to coercion, and higher forms of each to lower ones. Happiness is what we feel with every increase in our total satisfaction, which is progress to well-founded freedom. Sadness or sorrow is what we feel with our satisfaction's decrease, for we know it is on the way to consuming worry about survival.

O.K. All my examples so far have been in the realm social interchange. But if the needs we are talking about are real, and the stratigraphy is real, then we ought to be able to ask this simple question: *how does architecture satisfy—or help to satisfy—our basic needs*? Can all six be addressed completely by architecture? Can any *not* be?

To do a thorough job of this investigation would take a long time—a seminar, a career. Let me suggest to you, then, its barest outlines.

Take the lowest two needs together: survival and security. The first architecture consists of the arms of a parent. Furniture follows—the cradle, the bed—then architecture proper, walls, roof, room. The most fundamental *raison d'etre* for buildings since time immemorial has been to provide *shelter*...shelter from hot and cold, from wind and rain; from projectiles, dirt, poisons,

weeds, insects, animals. Although architecture's function is rooted in this realm, the satisfaction of survival and security needs continues to be provided by better architecture in more subtle ways. Cleanliness, for example, is vital for health, and so is light and fresh air. When you visit a place that looks and feels *clean*, the pleasure you feel is actually derived from our need to survive: "no disease here," says our unconscious. Similarly, the comfortableness of chairs, beds, sofas and so on, is no empty luxury. It too goes back to our basic needs for survival and security. After all, discomfort is prelude to pain, and pain is the body's early warning system that death would be imminent if whatever is causing the pain gets its way. The sound of laughter and the sight of happy animals are comforting in their own way. No danger here.

When we suddenly realize that our buildings are fragile—that there are circumstances under which we simply could not trust this roof, this ceiling, and these columns to stay put—the whole complex of attitudes we have towards architecture stands revealed and reduced. Look at how the events of 9/11/01 re-prioritized our need for security. In peaceful times, architects love to tease our need for security, i.e. to provide for it (as they must) while seeming not to. I mean tilted walls, high catwalks, long cantilevers, thin slabs, sheer glass, immense heights, open approaches, indoor-outdoor continuity, and so on. Indeed, elegant fragility in construction, together with absurdly open plans, becomes an indicator—a sign, "proof"—of peace's rule in the neighborhood, as does the obvious neglect of measures that protect us from violence such as high walls, gates, and locks. These factors underlie why the wealthy are often attracted to the minimalist modern style: it's what they can apparently do *without*, architecturally, that signals what they *have* by other means, e.g., by law, friends, noble character, or invisible high technology.

We have just seen how the higher reaches of lower-need satisfaction overlap with the lower reaches of mid-stratigraphy needs for legitimacy and approval. Onward up the stratigraphy:

We are *who* we are in part because of *where* we are. Identity is partly spatial because the company we keep follows the rules of propinquity. Buildings give us addresses, place to be and to be found according to our social roles and positions. Consider the social status of the homeless.

Consider too that, after land, buildings constitute the very basis for property rights, without which economic life would not be able to evolve past subsistence levels and democracy could not flourish .[14] Moreover, property lines define trespass, and trespass defines privacy, upon which a great deal rests.

All this spills over into the *approval* we show each other and the friendships that result. That we can be "at" a university or school or meeting place by virtue of citizenship and membership is marvelous. But we are also permitted seeking approval by spaces so configured as to promote our meeting and talking. The social bonds that form around our seminar tables, board rooms, classrooms, dining rooms, playing fields, and so forth are as ancient as they are important to satisfying our need for friends and associates in life. Architecture stands at the very nexus of all "coming" and "going," just as control over our own visibility (and audibility) via architecture

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[14] Henando de Soto, *The Mystery of Capital* (New York: Basic Books, 2000)

stands at the very nexus of social cohesion at all scales, family to polis.[15] And then there are the approvals we must get from neighbors and community boards before we build, and the admiration we get afterwards, for being responsible for fine architecture.

How does architecture give us *freedom*? Well, lets get *this* out of the way: if you make *money* from architecture—designing, teaching, building, renting or selling it—then much of the freedom you get from architecture is contained in cold hard cash—cash that you can do anything you want with. "Money is coined liberty," wrote Dostoevsky. But so is space, and so is time: space enough to move, time enough to think. Architecture clears space and time for us by how it excludes and holds back the forces that would otherwise take us over. I love this image of Pablo Picasso (**Figure 19**). For me he stands as the model of a confident, well-foundedly free and creative person. Picasso was no saint, to be sure, but he worked as hard as he played. He loved and was loved by many; he accomplished a great deal during in his own lifetime. No wonder he is dancing in the spacious studio of his villa on the Mediterranean—not far, one imagines, from Le Corbusier's spartan little cabin. Also, it's clear he's is about to have lunch.

Finally, let me show you a little-known building by a fairly well-known contemporary architect that is emblematic of what I am trying to convey: a "video pavilion" in Gröningen by Bernard Tschumi. (**Figure 20**) Here, everything that you would expect from a building in terms of its ability to shelter, protect, and so forth has been provocatively deconstructed. The floor is metal at a slippery tilt; the walls are glass, no mullions; and the roof is glass too. Moldings: none. Vulnerability to bad weather: 100%. Air circulation: minimal. Exposure to view: 100%. Remember the old saw about people who live in glass houses? No one will throw stones here! And that, of course, is exactly the point. Here is a folly: a fragile, unnecessary building beautifully crafted, prim and yet playful in its tilt and hide-and-seek games of transparency and reflections, placed into the public realm where lovers share blankets and dogs chase balls, but placed rather seriously nonetheless, as both fruit and demonstration of a civilization at peace, rich in technology, endorsing a (then) new art form. What luxury. What ease. *Lux, calme, et volupte*. I will leave you the exercise of applying the same criteria to the Guggenheim in Bilbao by Frank Gehry.

4. Phenomenology

What is phenomenology? A big word. But it means, most simply, "taking appearances seriously." This, in turn, means trusting one's senses. It means spending more time looking at and listening to the world in all its detail and subtlety, and less time speculating about the big picture and how it "basically" works. Phenomenology is a tonic for scientists as well as poets. Certainly it is good for architects who are too often in a hurry to turn their rudimentary diagrams into large buildings. Do too much phenomenology, however, and you end up producing tedious micro-descriptions of things no one cares about, observations which are in fact unique to oneself,

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15 There are now very sophisticated techniques for studying this dynamic. See for example, Bill Hillier and Julienne Hanson, *The Social Logic of Space* (London, Cambridge University Press, 1990), or any article in the journal *Environment and Planning B* (*http://www.pion.co.uk/ep/epb/epb_current.html*) having to do with isovists or visibility.

but which are claimed, portentously, to be true of Human Being.[16] So let's hear it for balance, and move on.

I'm going to show you the work of some students, done under my direction in a Monday night seminar called *The Art and Science of Architectural Phenomena*. Those of you reading this talk in print, I'm afraid, will miss a great deal.

The premise of the seminar is to treat buildings as extremely information-rich things, full of subtle facts and effects. Blurring the line between *art* projects and *science* demonstrations, we become "pathologically" interested , say, in how doors feel when they open and close. (This has to do with their weight, with the shape of the strike plate and the contour of the tongue of the lock, on the fit of door to the frame when closed, on the damping quality of the wall, and a dozen other things too.) Or we watch how a single window illuminates a room through the day and in different weathers and seasons, treating that mathematically and photographically. And so on.

One student became interested in the phenomena of changing eye levels. To make his point in a simple but powerful way, he carried a ladder around our school of architecture and took interior photographs from roughly two feet below the ceiling. Scale effects aside, these pictures were uncanny. We hardly recognized rooms we had used a hundred times. Their tonality was altered completely. If you've ever painted the ceiling of a familiar room you'll know what I mean. What do these images prove? That there are different-feeling kinds of spaces from about 6'-0" and up, and yet different ones from 8'-0" and up, *in the same room*. Architects avail themselves of none of them. (Can you think how you might?). A simple exercise, for us very revealing.

Now here is piece trying to show how colour could work: not by painting walls but by coloring light. There are three primary colours. Mixing them in various proportions makes all the other colours. How to mix them, then? And why? What if you made spaces where the movement of people actually changed the colours of the room? A simple demonstration project was in order. Here a cylindrical room was made of fabric with three gelled lamps set at the vertices of the inscribed equilateral triangle. As people moved around, blocking first this lamp and then that , and then two of them and then none..., so the room's walls changed though the gamut of the spectrum. Not terribly deep, this exercise, but "fun was had by all."

This is another study of the possibility of a roof of water. This student built a very elaborate apparatus that suspended a cubic foot of water about four feet off the ground. He then shot 16mm movies looking up through it at the day (and night) sky. Dropped leaves and detritus, and random wind and structural vibrations produced, from below, some extraordinarily beautiful patterns of refraction, feelings of immersion, and perceptions of altered gravity. No aquarium this, but a Liquid Sky.

Research with *isovists* is something I started some time ago, and which one student revived for the *Phenomena* class. The idea of the isovists to map very carefully the limits of your vision in

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16 As it developed in philosophy, phenomenology has a much less distinct definition, covering the very different work of Husserl (it's titular founder) Heidegger, Merleau-Ponty, and others. Common to all, however, is an interest in *experience*, in how things look and "feel" and have ineradicable meanings that we also know, intellectually, to be "only human." Take the bigness of the sky. Try telling yourself it's not "really" big. Or that we don't live in "a world." No matter how recondite they become—and boy, do they—phenomenologists are interested in validating our conscious experiencing, not proving how "relative" or mistaken it is.

any space. After all, around any point in architectural space there is a finite volume of space that you can see, and from which you can be seen. That volume—that subset (of all the space potentially visible in and around a building) and associated with a particular point of view—is called the isovist ("equal see") *at* that point. The isovist has several properties. It has a size, a volume, an area; it has surfaces, and it has something called an occlusivity, which is a measure of how much of its surface consists of edges that can actually be broken through. (For example, if you look at me, there are lines from your eye past my body back to that wall which I'm concealing. Someone could theoretically jump out from behind me, and break the surface of the isovist behind me. A forest has high occlusivity everywhere. A rectangular windowless room has none anywhere.) There are other measurable properties of the shape of an isovist, but I can't go into them here.[17]

This 1979 work was the first architectural research to get funding from the National Science Foundation ever. Then we looked into the perception of spaciousness. Could isovist shape alone influence the judgment of how big a room was? The answer is yes.[18] Today you can get a Ph.D. doing isovist research at University of Cambridge, Georgia Tech, and University of Michigan, and people study many other variables.

Here is a project of Nathan Howe, a recent student in the seminar I've been speaking about. His idea was to find better and more vivid ways of representing isovists, using sight and sound and a fast computer. Here you see some of the results. (Sorry, dear reader). ... What we were trying to do here—and what you are seeing—is an attempt to capture not just in a quantified way and also in a phenomenological way—something about the experience of space. I hope you agree that it works well.

Finally, I would like to ask you to pay attention to a certain visual phenomenon I first noticed first in Mexico, in a small colonial town called San Miguel de Allende. It's one of those towns where, if you take your camera and pretty much shoot at random, all the pictures will all be great! I wondered why. The buildings aren't that great in themselves. I began to understand that San Miguel was a town in which the interplay between sun and shade was very intricate, very organized and complex. Every picture had moments of brilliant contrast as things in sun were seen in front things in shade, and vice versa only a few feet away. I began to obsess not so much about the shade and not so much about the sun, but on the "scientific" fact that whenever the sun is shining, there are invisible planes and boundaries that separate sunlit volumes from shaded volumes of space. (For example, if a bird were to fly through them, the bird would go from grey to white to grey to white as it penetrated these boundaries between sun and shade.) If only I could *see* those boundaries, those volumes, I could compose and design with them directly. In San Miguel, I realized, the streets were of such a width that, for most of the year, the boundary between sun and shade occurred exactly where people were walking about, active. And that's why you would often see people whose upper bodies were in sun and whose lower bodies were in shade, or people whose upper bodies were in shade and whose lower bodies were in sun, seen against backgrounds of exactly the opposite register. Also trucks trundling down the street, their loads sparkling and dark. Arcades were spaced and proportioned as though to multiply these

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[17] For more, see my original paper, "To Take Hold of Space: Isovists and Isovist Fields," *Environment and Planning B*, Vol. 6, 1979, pp. 47-65, and those found in *Environment and Planning B* since (see note 13 above)

[18] Michael Benedikt and Clarke A. Burham, "Perceiving Architectural Space: From Optic Arrays to Isovists." *Persistence and Change*, eds. W. H. Warren and R. E. Shaw (Hillsdale, N.J.: Lawrence Erlbaum, 1984), Chapter 6.

visual events too, and so were trees in the *zocalo* spaced and pruned to do the same. And courtyards. The whole town... **Figure 21** shows a small courtyard school.

In order to make a science of any of this you would have to have ask about the altitude of the sun. So I asked a very simple question: if one had to place a bet, at a random time of day and year, on what the altitude of the sun was outside, what should one do? Knowing one's latitude, should one place one's bets evenly between zero degrees (sunrise and sunset), and whatever the altitude of the sun is at noon of summer solstice (which is the highest it could possible be)?

The answer is no, you should not. In fact , every latitude has a highly characteristic most-likely-solar-altitude. Year round, the sun is at that angular "height" in the sky more often than it is at any other angular height. And if you were designing a city or building to generally maximize the number of boundary events between sun and shade throughout the year, this is the "design angle" you should use. **Figure 22** shows those altitudes for various latitudes. (FYI: the design angle always about one degree higher than midday winter solstice altitude for that latitude.)

One student in the seminar, Li Tao, took this as the theme of his master's thesis, the ostensible subject of which was the design of an open-air market in Beijing. We had a great deal of discussion about what markets were like in China, about the beauties and the merits of open-air markets in general for vegetables, trinkets, and what have you, the dual needs for shelter and non-shelter, and how critical for the "feel" of such markets was the complexity, rather than total quantity, of sunlight penetration, especially when there was a little smoke in the air.

He started by using volumes of sunshine as the actual objects of design, separating them out from each other to maximize their surface area. He worked these across the site in space and across the sky in time, sketching out the main concourse and taking special care of the where this shell intersected with cross streets and the extra traffic likely there. **Figure 23** shows the sun's-eye view of the site throughout one day, one of the hundred or so CAD studies he did. Li never really got to rendering the fruit and vegetables, the racks of fish, the stacks garments and trinkets. But he did manage these rather ravishing representations of the basic shell of the market, designed using his sun/shade boundary optimizations (**Figure 24**).

What do you think?
