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MATERIALIZING THE INVISIBLE:
A RETURN TO FORM-MAKING

by

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IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE
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ABSTRACT

Materializing the Invisible:
A Return to Form-making

by

Petia Dorian Morozov

In an era of information technology and dematerialization, our sense for materiality is significantly jeopardized. It is particularly disturbing when placed within the context of architecture - a mode of form-making typically fixed on the objective of building. In light of this, my thesis pursues questions of stability and contingency as agents of form-making; what can be done to render invisible, dematerialized forces as visible and tangible? My investigations suspend in a design proposal positioned on the edge between city grid and highway, where flows relative to this site were studied and re-invented as a source for form-making.
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"Somehow the wondrous promise of the earth is that there are things beautiful in it, things wondrous and alluring, and by virtue of your trade you want to understand them.

- Mitchell J. Feigenbaum
INTRODUCTION

Form-making occurs all around us. It is a relentless state of invention that procures the need for both stability and contingency. It is an open-ended condition of change layered over changes once made. As soon as contingency is in place, it becomes the new stability for some other contingency. It is a series of contingencies that inflict instability where stability requires disruption. This pattern is predicated on predictable unpredictabilities. Without such spiraling momentum, form-making suspends over the landscape like a stagnant air. Indeed, when vacuums of stagnancy invade the process of form-making, it stifles our perception of the landscape, causes us to respond to immediate conditions such as vacancy, destitution, sprawl, decay with short-term solutions. It is because contingency cannot be negotiated with; it will happen, no matter what. Whether events occur because of a natural order in place, or because man has imposed some built form on a stable condition, the inevitability of contingency is omnipresent. When a series of contingencies surface in random order, it is difficult to measure which states are stable are which are unstable. The pendulum of change swings infinitely between two states, one direction of forces always negotiating with the other. Perhaps, then, it is important to understand that whatever the hierarchy emerges - whether contingency or stability - that hierarchy is always being re-invented.
**Linear and Painterly**

In the most basic sense, there exist dichotomies of terms that suggest universal meaning. These terms essentially render two states of being:

static/dynamic
tangible/intangible
stable/unstable
visible/invisible
order/chaos
pattern/contingency
symmetry/asymmetry
fixed/indeterminate
solid/void
permanent/temporary
outline/mass
will/chance
real/virtual
individual/collective

And so on.

Perhaps it is worthwhile to consider another dichotomy, of linear versus painterly representation, as presented by Heinrich Wolfflin, author of "Principles in Art History: The Problem of the Development of Style in Later Art.". His discussion poses a reductivist notion that "between the art of Durer and the art of Rembrandt . . . we say that Durer is a draughtsman and Rembrandt is a
painter."\textsuperscript{1} With uncanny foresight, he offers the suggestion that applies in timeless capacity: "even if there is only one Rembrandt, a decisive realignment of the eye took place everywhere (relative to the 17th century), and whoever has any interest in clearing up his relation to the world of visible forms must first get to grips with these radically different modes of vision," the painterly mode. He explains that "linear vision means that the sense and beauty of things is first sought in the outline - interior forms have their outline too - that the eye is led along the boundaries and induced to feel along the edges."\textsuperscript{2}

In contrast, painterly vision is "seeing in masses . . . where the attention withdraws from the edges, where the outline has become more or less indifferent to the eye as the path of vision and the primary element of the impression is things seen in patches."\textsuperscript{3} Additionally, "painterly architecture is particularly interested in making its basic form appear in as many and as various pictures as

\textsuperscript{1} Wolfflin, p. 18.
\textsuperscript{2} Ibid., p. 18.
possible . . . The more manifold they are, the more they diverge from the objective form, the more painterly the building is considered to be." Wolfflin divides each mode of representation even further with this clarification:

"The development from the linear to the painterly, i.e. the development of line as the path of vision and guide of the eye, and the gradual depreciation of line: in more general terms, the perception of the object by its tangible character - in outline and surfaces - on the one hand, and on the other, a perception which is by way of surrendering itself to the mere visual appearance and can abandon "tangible" design. In the former case the stress is laid on the limits of things; in the other the work tends to look limitless. Seeing by volumes and outlines isolates objects: for the painterly eye, they merge. In the one case interest lies more in the perception of individual material objects as solid, tangible bodies; in the other, in the apprehension of the world as a shifting semblance."

The premise for establishing this scope of terms is necessary in order to prove an important point: these opposite terms cannot exist conceptually without the other. One cannot know what instability is without the measure of stability. For lack of a better word, these terms, while each describing an opposite condition of the other, are counterbalanced. But to find "balance" between terms is merely a reaction to understand that any two opposite conditions exist in a constant state of flux. Take, for example, Wolfflin's outline/mass dichotomy for linear and painterly. He vehemently argues that these two conceptions of the

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3 Wolfflin, p. 19.
4 Ibid., p. 64.
5 Ibid., p. 14.
world are co-dependent elements in the making of art and architecture: "The painterly mode is the later (mode of conception) and cannot be conceived without the earlier (mode of linear conception), but it is not absolutely superior. The linear style developed values which the painterly style no longer possessed and no longer wanted to possess." Indeed, these two modes, both with their respective bias for determinacy and chance, make for dynamic concepts in creativity that promote an evolutionary process in art.

Cross-reference in form-making

Establishing this broad set of parameters is key to understanding the premise of my thesis; terms mentioned earlier such as "visible and invisible," "real and virtual," are bound to cross paths, cross meanings and cross circumstances. It is an inevitability when discussing concepts of complexity, chance, movement, nonlinearity and contingency that such terms find themselves paired with other opposite terms. I hope to be so clear at the end of this paper that one might exchange terms almost intuitively, as though one concept of a word is fundamentally the same as its relative "synonym."

Which brings me to my next point, that of universality. This scientific approach to sameness in nonlinear systems established the groundwork for chaos theory. So, in theory, it's possible that a non-linear - painterly - process of making art can be ascertained similarly, through universalistic means. Alas, in the words of Mitchell J. Feigenbaum, father of universality, "art is a theory about the way the world looks to human beings. It's abundantly obvious that one doesn't
know the world around us in detail. What artists have accomplished is realizing
that there's only a small amount of stuff that's important, and seeing what it was.
. . . With Ruysdael and Turner, if you look at the way they construct complicated
water, it is clearly done in an iterative way. There's some level of stuff, and stuff
painted on top of that, and then corrections to that. Turbulent fluids for those
painters is always something with a scale idea in it."

Perhaps one only needs to see different things similarly, and see similar
things differently. It's both simple and provocative to think in such terms. With
form-making at the crux for my investigation, an intangible, "anything goes"
method is undesirable. So, too, is its countermethod of pure outline. The fol-
lowing, instead, is a period of negotiating, of extracting a balance of both ap-
proaches in order to recognize the essence of form in all things visible and in-
visible.

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PART I

(IN)VISIBILITY
1.
Now You See It

As you sit on the beach, soaking up the sun, body-surfing to the shore, form-making is at work before us. Visible. In fact, the very wave that you're riding is one of the billions of waves to crash against the coast, altering its shape with each thrust. Perhaps there's a jetty - projecting out from the tip of the beach, where ocean and bay collide - protecting boaters from strong winds and currents. With diving equipment and measuring sticks, you'd discover shallow waters and pockets of sedimentation settled in the banks of the jetty. Eventually, its initial purpose to slow beach erosion will be exhausted as soon as currents changed by this built intervention shift deposits of sand and harmful waves elsewhere along its shore. Because this jetty was designed to absorb the forces of wind and water, it will itself fall victim to the elements, its remains becoming part of a changed topography.

Turning inland, dune fences are erected among tall grasses and sand drifts, looking worn from many unforgiving northeaster winters. Notice the shape of the sand dunes surrounding the fence. There's a distinctive pattern emerging because of its position, creating mounds of drifts at its base and to the southwest.
Soon, too, these fences will lose their effectiveness and whither under the weather, having left the mark on a landscape for new forces to shape. Whether by fortune or by defeat, human efforts to preserve the dunes will reappear in similar form. With unsurpassed measure, nature will return with a vengeance.

**Dune dynamics**

The scientists dedicated to understanding the dynamics altering the shape of sand dunes are split on determining the appropriate steps to reduce their erosion. On the one hand, scientists believe that human intervention only helps to delay the inevitabilities of erosion, but offers no immunity in the long-term effects of the environment.

Scientists such as Antony R. Orme, for example, have identified impacts at larger scales in order to point out the pervasive nature of human-induced change through recent history and the significance of continued human changes on future dune stability. Scientist Psuty has outlined how human efforts to achieve stability are counter to the natural trend of shoreline change, and he demonstrates the rapid failure of structures that introduce imbalance into the coastal environment. These authors stress one commonality. That is, human efforts complicate interpretation of the landscape and hinder the development of geomorphic models.
On the other hand, there is the belief that human intervention is well-intended in the preservation of sand dunes and their ecologies, so long as strict guidelines are in place and interim studies are thorough. Research conducted by Dr. Ken Pye, for example, follows eight management objectives as outlined by the Coast Management Scheme Steering Group: (1) dune conservation, (2) landscape maintenance and renewal, (3) woodland management, (4) nature conservation, (5) foreshore management, (6) visitor management, (7) interpretation, and (8) monitoring. The results of his intervention seem to have a positive impact on the study area, though many changing factors such as heavy storms and pedestrian activity make short-term effectiveness difficult to assess, and long-term results too far in the future.

Perhaps it is better to agree that dunes should be viewed in a far broader context, as integral parts of larger systems - coastal and otherwise - exchanging mass, energy, biota and information (through feedback) with other environments. Because coastal dunes are so sensitive to environmental changes, it is reasonable enough to approach their intricacies from either side of the debate.

There is room for a myriad of possibilities. Strict protection efforts can either succeed or fail. If they succeed, there's stability. If they don't, instability. If no ef-
forts are implemented at all, the same could still be said. It comes down to what lens is used to examine our impact on earth. A microscopic view might possibly reveal the notion that intervention of any kind is disruptive, while a macroscopic view might indicate that any living system, if it is to achieve any stability at all, must undergo constant change.
2. 
Now You Don't

The example of dune ecosystems - and our part in it - marks a general point in any discussion on nature and man. Who is to say that it is not natural for human intervention to occur in the shaping of the landscape? Some will argue that man suffers from "nature envy," wishing to construct some system of our own that competes with nature's. When we study the microsystems of insects, we see an order that is unexplainable. We cannot safely answer why an ant behaves in a particular pattern, though empirically, we speculate what possibilities there are based on other objectives. We are curious creatures in a persistent struggle to understand how other living systems operate. The city grids, computer networks and compartmentalized appropriations of space, work and leisure are the manifestations of our envy.

Let's say, according to Feigenbaum's theory of universality, we consider that man's systems of operation are one and the same with nature's. Having said that, let's measure the visibility of variables at work in dune ecosystems. As illustrated in Fig. X, several obvious features such as waves, vegetation and human activity are readily perceptible and measurable dynamics shaping form in the dune landscape. But what of the invisible variables? The forces of wind, sun and microbial loops add significantly to the evolving topography and, as one might guess, these forces are difficult to gauge unless, that is, some field of flexible form is set against the grain of impact. In this case, the dune is that field on which all forces act. This system is open, i.e. an evolving system of energies
and information flowing in and out of itself. Therefore, the field - which is integral
to the system - exchanges forces with the forces acting on it. So, even though
characteristic forces remain invisible, their shape is visibly imprinted on the
landscape of the dunes. Particularly noticeable is its impact after an intervening
fence is positioned to collect gusts of sand (as illustrated in Fig. X).

Technology Clocks In

As mentioned earlier, man devises his own program of open systems that
rate similarly with nature’s. Phenomena of order and chaos pervade these sys-
tems of which the most intriguing cases emerge out of invisible energies. Re-
cently, critical attention has been given to the nature of work, how it has evolved
in the last century, withstanding shifts from agricultural to industrial (mechanical)
and now, to informational. Of course, there
are many factors guiding the shape of work -
social, political, economic - though the most
central force enacts technology as its primary
generator.

Since the beginning of civilization, the
concept of work has been an integral part of
our daily existence. From the Paleolithic
hunter/gatherer and Neolithic farmer to the
medieval craftsman and assembly-line work
of this century, work has consistently meant a matter of earning our keeping and
keeping us busy. With the thrust of the industrial age, however, the invention of machines promised to absolve us of more work. To occupy that lapse of productivity, we invented leisure time. That time provided the necessary backdrop to make work less labor-intensive, and far more focused on high-tech automated production. Now, intelligent machines are replacing humans in countless tasks, forcing millions of workers - blue and white around the collar - into unemployment lines, or worse still, breadlines. And for the first time, the concept of work implies an indistinguishable state between leisure and unemployment.

Leisure and Free Time

It's a matter of fact that technology has reconstructed two fundamental orders in our lives: (1) Our workweek has diminished while (2) our life expectancy continues to climb. This convergence of factors has produced a phenomenon whitherto unknown to history. We are now a population with more time spent at leisure than at labor. Luckily, some of this time can still be spent fulfilling our most basic needs for survival with the most basic services. We still need to eat, sleep and be: waitstaff, mattress suppliers and nurses haven't lost a job. Yet. In the best-case scenario, you might say that one person's source for income is another's source for leisure. Some argue, however, that what technology has wrought is not more leisure but more free time.

But remember, technology has not replaced labor-intensive work altogether - though that possibility grows stronger daily - it's only redefined work for a select group of people supported by telecommunications. Indeed, Daniel Bell,
celebrated author on sociology and economics, was on the mark when he coined the term "technocrats" to make reference to such members of this group. Those left out - the new breed of "have-nots" - have been forced to realign the backbone of the economy while combating the threat of unemployment. What traditional sectors of the economy remains - namely, manufacturing, agriculture and services - are experiencing technological displacement. A new sector has emerged - that of information - and comprises a cosmopolitan elite of "haves," of entrepreneurs, scientists, technicians, computer programmers, professionals, educators and consultants. In this sector, software replaces industrial machinery and manufacturing plants, and information is stored in databases like wheat once stored in silos. While unemployment rises, however, there is little hope that this new sector can absorb the tidal wave of job-seekers. More likely, a subclass of technoslaves will amass around the need for low-tech services that include delivery and distribution, data entry and utilities and infrastructure installation.

At last, what does this mean for the shape of our environment? How momentous is technology's impact on our ecologies of nature/man? How do we negotiate the shift from mechanization to information as our new medium of industry? In all honesty, how do we get our hands on something that's not graspable nor permanent? As economies rely less and less centralized organization, the dissipative energies of this third Industrial Age (of Information) make use of transparency in order to disorient our sense of direction, tactility, ground-
ness and perception of space and time. The time is ripe for intervention, to put to task our will (and resistance) for change. To go with the flow.
3. Iterative Form-making

Clearly, our built environment is the outcome of any number of dynamic forces. We know that by erecting barriers among delicate dune ecosystems, we can protect our beaches and shorelines from erosive wind and ocean currents. The placement of that fence is completely contingent on the pattern of those currents. These currents are easily identifiable by movements of water and sand, and the traces of patterns it leaves in its path are the visual markings.

But how does one make, or even recognize, form out of dynamic forces less visible, but equally influential in shaping form, such as global economies, population growth and political climates? Of course, it is easier to see its residual impact in forms left as their trace. Deserted urban centers and abandoned factories are the remnants of the shift away from low-tech industrialization to high-tech specialization. But to really see it - information, that is, that engine of technology - one's eyes become strained, as though trying to see wind. Without clouds or sand drifts - nature's mode of intervention - or our own inventions of flight, what shape wind takes is unrecognizable. Who controls wind? is the question. And similarly, Who controls information? How are these invisible forces directed? In a related line of questioning, Kevin Kelly asks, "Can the distributed life in such loose associations as governments, economies and ecologies be controlled in any meaningful way? Can future states of change even be predicted?"
One reality stands out: information proliferation has its roots buried deeply in this century's spur of mechanization. And, as Kelly argues, the seed was planted by James Watt, the inventor of the steam engine. He credits him for less obvious reasons than having introduced the potential for greater mobility. Watt's innovation "spread widely and quickly. The mills of the industrial age were fueled by steam, and the engines earnestly regulated themselves with the universal badge of self-control." To this end, Kelly states, "information, not coal itself, turned the power of machines useful and therefore desirable."

Response to mechanization

Inevitably, one looks toward the future with some anticipation of resolution or impact. The concept of future draws an outline of some multi-dimensional form inside of which we fill with new substance. The outline is always familiar, the substance is always for us to create. But to forecast the future is at once sensible and absurd. Sensible because it implies responsibility to generations ahead of us, as well as the notion that complexity sustains evolution. Absurd, however, because there is no hierarchical value one can place on change without devising some law of averages. Even then, the results are grossly generalized.
Perhaps the more interesting study lies in observing what revolutionary efforts in the past were made in reaction to change. It seems appropriate, then, to highlight the most radical responses made in the worlds of art and architecture at the time mechanization stepped in to change our modes of space and time forever. Undoubtedly, the works of artists and architects spanning this century offer an exceptional range, gauging the magnitude of mechanization in our society. Paul Klee, for example, explored languages of automatism, color and subliminal consciousness in his work, while De Chirico, as part of Bauhaus' rationalist revival, laid the groundwork out for the new aesthetic of order, the Metaphysical movement.

De Chirico

As early as 1915, De Chirico had foreseen an alternative hypothesis to the then ruling models of development in his Metaphysical Interior with large Factory. The factory is represented as an essential to the laboratory of life, but outside the genuine city of squares suggest a post industrial city. (p 441, Vercelloni).
Fig.9: De Chirico, *Metaphysical Interior with large Factory*
Futurist Past

It's impossible to overlook the importance of the Italian Futurist movement in the wake of the industrial age, and consequently, its significance bears even more weight in the wake of the information age. Assembled around Tommaso Filippo Marinetti's Foundation Manifesto of Futurism, published in 1909, this group lead the pack of revolutionary artists eager to unscramble the mysteries of machine aesthetics. To this day, the work to emerge out of this movement garners criticism for its sensitivity to temporalities in movement and instability. The dynamics of space and acceleration established an acute break from classical, linear approaches, and pushed the envelop of painterly style to infinite dimension. Most notable is the work of Umberto Boccioni and his studies in dynamism, in Henri's Bergson's ideologies of flux, to be discussed in Part 2: Traffic.
Fig. 11: Boccioni, *Stati d'animo: Quelli che restano*

Fig. 12: Boccioni, *Stati d'animo: Quelli che vanno*
Robert Smithson

The meaning in Smithson's major work, Spiral Jetty (1970), is the culmination of natural forces and architecture at their junction. It is biomorphic minimalism in the sense that there is both architectural and human aspects at work in the making of the spiral-shaped jetty. Made of dumped earth, it is plasticity, architecture, nature and aesthetic in one simultaneous gesture.
Alvar Aalto

The body of work that Aalto pursued is rich and incredibly self-centered. His architectural experiments in light, form and space were infused with the plain and simple notion that nature is not to be mocked, but to be questioned. One cannot design with nature as the aesthetic, but as an energy, pushing against our rigid systems of operating, and braking it as necessary.

Fig. 14: Alvar Aalto, *Laminate wood study*
Indeed, his work prevailed with these ideas at the helm, but most poignant are his experiments with laminated wood. Taking what is inherently natural of a material, he invoked movement, plasticity and dimension in laminated woods, stretching their capacities for tension, compression and fluidity. It is in this spirit of exploration where questions of form-making relative to contingency can be addressed. Because wood is made to undergo stresses and forces of unusual proportions, the "space" and "Time" of wood are found in their form.

Fig. 15: Alvar Aalto, Lamine studies for Italian housing project
4.
Will/Duchamp/Chance

Let us divert at this time to discuss the notion of will in the process in art. One's will to create is a nonlinear method of operation, something much too complicated to be negotiable. Too many variables are dependent on the profile of each individual. How does one quantify the will of the creator without robbing him/her of their complex nature as human beings? It seems an indeterminate factor that is rarely accounted for in its entirety. The element of stimulus becomes one of the few least subjective components to enable validation of the creator's will. In an effort to suggest the diversity of stimuli with which the modern creative process begins, William C. Seitz, in a panel discussion entitled "The Creative Act," explained that "the hundreds of pages which comprise the works of Paul Klee, for example, constitute a whole library of cues given by nature, by the unconscious and the intellect." He added that "Mr. Sweeney's 1948 interview with Joan Miro enumerated more than 30 (cues), ranging from hunger hallucinations to organ music in a medieval church and a smear of blackberry jam."

It seems, then, that in order to appropriate a clearer understanding in this discussion of creative process, it would be absolutely imperative that specification of factors be made. Given my own particular fascination with the resonating impact of the Dada movement, it's inevitable that at least one factor - that of chance - might provide insight into the method of making adopted by many Dadaists. And the quintessential factor of all creative process - that of invention -
would necessarily be studied alongside chance since invention is fundamentally intrinsic in the making of all things. By studying these two factors, might we regard these as foundations for an analysis of their influence on the artist-creator? To answer this, the work by Marcel Duchamp comes to mind, hopefully to illustrate how each factor, both as singular and as collective entities, shaped his own creative process. I am further challenged to understand whether the synthesis of chance and invention constitutes groundwork for successful implementation into the process of making.

**Chance**

But first, it is important to identify each factor before embarking on a study of their fusion. In general terms, chance is that which occurs out of accident and coincidence. For something to happen due to chance, it must be absolutely undetectable as far as outcome is concerned. In terms applied to art, however, a distinction must be made between chance, or accident, as subject matter, and chance as compositional principle. Deliberate use of chance as creative process - as subject matter and as the formal principle of the pictorial composition itself - presupposes a notable difference between portraying chance artistically and producing a chance assortment of shapes. The accidental throwing together of elements does not always produce disorder, deviation, lack of connection, or interference. It will not depict obliqueness of relation only but rather
any kind of relation. Some will suggest order or even symmetry, others will be quite irrational. Some will be harmonious, others discordant. But, since they are thrown together by chance, none of them can make its particular point. It is this very discrepancy of which Rudolf Arnheim, in his essay, "Accident and Necessity in Art," is critical, and to which he conveys his sterner sentiment: "... the increasing number of dismal examples that have accumulated in the Western art of the past centuries when the compositional patterns of realism became so complex that the average painter's and sculptor's eyes could no longer organize them."

Not surprisingly, chance as theme in Western Art emerged long before it ever gained momentum in the Dada movement. As case in point, Arnheim chronicles shifts of chance as subject matter in the development that emphasizes accidental relationships:

Accident always refers to relation, and when we call a relationship accidental, we express our belief that it did not come about through a direct cause and effect connection between the parties concerned. The stylized Byzantine features are more closely controlled by the primary concept of man than is the Rembrandt figure, which shows the intrusion of extraneous, individual encounters. The difference may be expressed also on the language of the statistician by saying that with increased realism, the solution offered by the artist becomes a less probable one.

To demonstrate accidental relationships depicted in painting and their evolutionary development, Arnheim begins by citing Tintoretto's *Last Supper* in
which a seemingly chaotic crowd atmosphere conveys a new interpretation of a familiar artistic theme. Also mentioned are the tavern scenes as depicted by Jan Steen and Ostade. In these, the chaotic effects of such crowd scenes impart an enriched impression of peasant life. In Romanticism, the accident as subject matter was used more consciously "to defy the rigid order of rationalism: and the same device points up the imperfection of everyday life in the harsh statements of social critics and naturalists, from Hogath to George Grosz."

Another distinction in the meaning of chance is what Arnheim terms the "statistical use of accidental patterns." In his description, he rejects piles of accidents that, "when examined piecemeal, the random collection seems to possess the wealth of universality since it contains an enormous variety of being, behaving, and relating. But the riches turn out to be useless when we attempt to draw the essence from the whole."

Invention

In defining the second factor, I argue that invention imparts hierarchy of meaning in two orders. The first order of invention is one that hardly exists anymore, the sort akin to man's first hunting tool or cliched wheel. Such choice firsts establish what I consider to be a second order of invention. Within this order emerge two distinct models of invention as we know it to mean today: the first is an approach to process that essentially hybridizes an already available, detailed model of some realized form, and customizes according to use and expression. This seems characteristically microscopic in view and furthermore,
limits process only to creation of the parts, and never of the whole. The second approach suggests that process is really an outgrowth of (perception of) memory of an already available model. This model - of some rough, even unrealized, form - is transformed, copied, at many levels, and all from (perception of) memory, whether consciously recorded or not. So conversely, this might be considered macroscopic in view and optimistically, open to process as creation of not only the parts, but of the whole itself. Furthermore, this approach comes closest to the occasional possibility of invention of the first order.

**Willful Chance**

Given these two factors as indicators for a particular creative process, can it be inferred that chance as a systematic method of making falls under the second order of invention? And having said this, can it also be inferred that, if the act to exercise chance and to deny will is to defy willful invention, and if that in itself is a form of invention, the act of imposing willful chance in the creative process is just as ironic as imposing unwilling invention? If so, then the question is, Did chance as creative process act to safeguard Duchamp from “transferable memory imprints,” the very substance that consciously determines so much of an artist’s will? Remember that will, the mark of determinacy, is what both artists strove to deny in the creative process. His goal was to knock the security of predictability out from under its bourgeois spectators providing, in turn, a flexible, unrestrictive frame in which experiments with chance could flourish.
Married, against her Will

Take, for example, Duchamp's *La Mariee mis a nu par ses celibataires, meme*. In this, his most comprehensive work, he agonized for nearly a decade to resolve what might have inadvertently evolved into an object of will. Granted, the work requires simultaneous referencing to his notes in "The Green Box" in order to gain any further insight beyond the graphic reading. This gesture alone salutes his intentions for indeterminacy, since the notes aren't arranged in any sequential order, either chronologically or otherwise. Still, it is worthwhile questioning whether or not Duchamp ultimately backfired in his deserving attempts to do away with will altogether. For otherwise,
how else can one justify his difficulty in deeming the work complete, spending years of painstaking deliberation - as validated in his collection of notes - going over each and every detail. Perhaps the most fitting outcome for this work of art was that chance, not as willful creative process but as pure accident outside of Duchamp's control, was the final determining factor. Without the last intervention in the work wherein the piece was broken while in its storage case, it seems unlikely that he would have ever resolved its completion with any satisfaction.

**Pure Invention**

His most "inventive" work, I believe, emerged out of his series of readymades. Beginning with his first ready-made, the bicycle wheel mounted on a stool, Duchamp struggled to eliminate the notion of aesthetic taste, which in turn, meant to negate perceptual habit. He exploited chance relationships as a means to obtain new configurations of a high degree of improbability and which, in theory, would be all but impossible to reproduce. This method for creating work - his creative process - is inventive in the sense that, since readymades are distinguished by their use of familiar objects, but arranged in unfamiliar ways, it tends to match the criteria set earlier in terms of the macroscopic view of invention. So again, it could be argued that even with this mode of creativity - that which denies determinacy - Duchamp could do very little to withstand the inevitable force of will. He understood the complexities inherent in choosing chance as his mode for invention. However systematic Duchamp was in executing his works of art, he bore the burden of constantly having to justify the use
of chance as long as he insisted on removing himself from decisiveness and will. Much in the same way Nature seems to inexplicably determine that its only determinant factor in its creative process is to allow for degrees of variation, so much like the second order of invention.
PART II

TRAFFIC
4. Flow

I have already touched upon what implications technology has had on our society and, more specifically, on its power to shape our environment. We see vestige patterns in the shape of our cities, our workplaces, our habits of interaction. It forms our transportation means, our economies, and our access to information. The cycle of invention is infinite: We invent technology. Technology re-invents us.

Take, for example, the automobile. The great Henry Ford invented the one commodity that would bridge gaps between man and machine in one giant leap, and in doing so, allowed technology to be utilized by greater numbers of people. Ford revolutionized the concept of mass-production by measuring profitability against the buying power of his workers. At once, he managed to increase the rate of production while making his automobiles affordable to the working class.

Within only a few decades, the invention of the automobile has shaped every aspect of our existence, accelerating the transformation from an agriculturally based society to and industrial one. When young Ford left his father's farm in 1879 for Detroit, only two out of eight Americans lived in cities; when he
died at age 83, the proportion was five out of eight.¹ Once Ford realized the tremendous part he and his Model T automobile had played in bringing about this change, he wanted nothing more than to reverse it, or at least to recapture the rural values of his boyhood. For better of for worse, the social, economic and political ramifications turned out to be acutely irreversible.

The New Science

The path between country and city was paved, literally, and an extravagant enterprise of transportation networks grew out of that junction. Not only did we learn to re-invent our rituals of interaction by means of the automobile, we discovered how much faster it could happen. Highway transportation systems were designed around this notion of optimum speed. As automobile technology advanced, so did the efforts to accommodate more and more drivers. Meanwhile, a new generation of mobiles learned very quickly how to disperse in every direction, inhabiting the spaces between these two polar points of density, the suburbs. Sprawl influenced an entirely different mode of socialization, commerce and architectural ideals. Older, densely populated subdivisions were forced to make way for new highways, slashing communities, redefining neighborhood boundaries and separating social classes based on its proximity to the arteries. And as highway development increased, a new science emerged, devoted exclusively to the dynamics of traffic.

**Pick your Speed**

Vehicular traffic. A science of dynamics right under our noses. On the way to work, to the store or to the beach, traffic infests the highways in varying degrees we can easily recognize. In scientific terms, these qualitative ranges of traffic flow intensity can be broken down into three categories:

*Light Traffic*, where vehicles travel at the speeds desired by their drivers. That is, there is little, if any, interference between vehicles such that a driver must reduce his/her speed because of the presence of other vehicles on the roadway.

*Moderate Traffic*, where vehicles form clusters or platoons in which faster vehicles are forced to slow down temporarily behind slower vehicles. Such impediments endure sporadically, and vehicles usually achieve average speeds that fall within their desired speeds.

*Heavy Traffic*, where platoons elongate and tend to run together, forming still larger ones. Under these conditions, nearly every driver is constrained to follow the preceding vehicle with little flexibility in speed. The impediments endure continuously, dropping the desired speed substantially.
If we were to intuit what scientific analogies best describe these different states of traffic intensity, we might say that light traffic resembles a gaseous state, where each molecule moves independent of others. Consequently, moderate traffic resembles a vapor state, and heavy traffic a liquid state. Perhaps a fourth variation of traffic intensity - where no movement occurs whatsoever - would suggest a solid state. The hope for traffic scientists, then, is to understand how to diffuse more solidified states of traffic, to de-congest and to evaporate them. Or at least, to make them more fluid.

Traffic Theory, Big and Small

Understanding related variables and parameters of each of these ranges is the basis for the development of different traffic flow theories. And from that, essentially two approaches emerge from study of these ranges. The first approach is deterministically based and deals only with average values of variables and parameters. Under these criteria, a microscopic approach may be applied, where the typical behavior of one car following another is analyzed, or the approach may be macroscopic, where collective behavior of vehicles is studied, and for which no single vehicle's behavior is accounted. Consequently, the microscopic approach has resulted in car-following theories which give formulate the stimulus-response relationship found when one vehicle seeks to flow behind another with a lesser desired speed. Conversely, the macroscopic approach has yielded patterns that parallel fluid dynamics or continuum theories. The most important feature of this approach is the conservation of vehicles, i.e.
physical matter that is neither created nor destroyed but thrives as a continuum. Think of it as a stream of traffic, in propagation, as though in a wave and the behavior of vehicles passing through those waves.

The second approach is statistically based and deals only with the distributions of values as well as their averages. This approach has generally tended toward studies of light traffic intensities since little or no interaction between vehicles is easier to measure. Under these conditions, however, the conflict between the individual driver and his/her "desires" and the collective body of traffic and its irreconcilable interdependency between drivers is left unresolved. Through the application of statistical physics - notably, the kinetic theory of gases - this theory attempts to address macroscopic scales of traffic dynamics.

**Flow Theories**

In light of this overview, the three theories to dominate in the study of traffic science are presented accordingly. The first - deterministically-based car-following theory - considers only the microscopic point of view. The second - deterministically based kinematic wave or hydrodynamic theory - stresses a macroscopic viewpoint. And the third - the so-called Boltzmann-like approach, statistically based - evolves from both viewpoints. However, at this time, each model suffers from discrepancies that are difficult to account for, since human behavior is intrinsic to the formula. Obviously, only averages in driver conduct are considered, inherently contaminating the results of any study. How can the behavior of an irate driver be measured? Quoting formidable traffic theorist Ilya
Prigogine, "Here we are already faced with the basic problem associated with every theory of traffic. Can we describe quantitatively the so-called friction that results from the competition between drivers?" Indeed, our will, our individual and collective states of order and disorder are the very operatives that we struggle to correct.

**Car-Following Theory**

Based on single-lane traffic flow, i.e. no passing allowed, the theory is approached with the basic assumption that each vehicle in the line of traffic follows the one ahead of it according to a stimulus-response relation. In the regime of about 40 to 175 feet, the driver processes information received from the vehicle ahead and modifies his control action on that basis, if necessary. All in all, a deterministic approach tends to better serve light traffic flow models where little or no interaction occurs between vehicles.

The chief interest of the theory is to examine questions of stability as well as the type of steady-state flow characteristics that derive therefrom. There are two types of stability - local\(^3\) and asymptotic,\(^4\) - that are of particular interest since each respectively characterize what's microscopic and what's macroscopic in the line of traffic flow. Unfortunately, this theory of car-following is limited to

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\(^2\) Prigogine, p. 6.

\(^3\) local stability: short-range response of one car to the change in motion of the car in front of it.

\(^4\) asymptotic stability: response in a line of traffic to a disturbance or fluctuation in the motion of the lead vehicle.
sampling only ensemble averages of quantities such as speed and flow, which in turn represents averages taken over the population of drivers.

*Hydrodynamic Theory of Traffic*

Based on the view of vehicular traffic as a continuum\(^5\) fluid flowing along streets and highways, the theory assumes in its approach that traffic is conserved, i.e. there is no creation nor destruction of cars on the road, and that there exists an equation of state.

Furthermore, the theory predicts the existence of traffic shock waves where small perturbations\(^6\) propagate. In the case of traffic flow, as with fluids, it has been shown that traffic waves, like kinematic waves, can run together to form traffic shock waves with associated large reductions in speed. These can form

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\(^5\) continuum: describing a space or field whose elemental parts cannot be separately discerned at the scale of observation.

\(^6\) perturbation: a disturbance in a space or field to which its field responds, by oscillation, vibration, or otherwise.
on roadways, at the rear of a slowly moving platoon or at other regions of increased density, such as at a bottleneck.

This concept can be thought of in very simple terms. Consider the concentration of traffic relative to the collective speed on the roadway as the propagation in the rope as it's whipped against the fixed point of a tree. As the propagation approaches the tree, its wave pattern diminishes or slows. Once it collides with the tree, an inverse propagation wave disperses back through the rope. In traffic terms, a platoon of vehicles traveling forward will slow considerably when approaching a high concentration of traffic. Once this platoon hits this point of critical concentration, the impact will propagate in back of itself, and with all likelihood, will hit the platoon behind it.

When these two waves of concentration run together, one moving forward, the other moving backward, a shock wave forms at the point of collision. This point is also referred to as a perturbation, as it is also termed in hydrodynamics. Shock waves will collide with other shock waves, forming more and more perturbations, and perpetuating traffic indefinitely along its stream of platoons. Ultimately, it will be too difficult to determine the location of each shock wave as the contingent factor for another shock wave.
Kinetic Theory of Traffic

Based on an important aspect that driver-car units, like gaseous molecules, make up a collective group of individuals - albeit with statistical fluctuations - this model makes use of statistical mechanics to study the interaction of vehicles. In the spirit of the fundamental Boltzmann equation of kinetic theory of gases, an integral equation for the velocity distribution of cars is loosely applied, yielding the following results: For sufficiently small concentrations, a free-speed distribution is achieved. For finite concentrations, the distribution is altered towards lower velocities. At some critical concentration, the velocity distribution changes abruptly, i.e. traffic jumps states of flow, from individual - where vehicles move independent of each other - to collective - where vehicles move at critical condensation.

Again, this concept can be demonstrated with the use of a simple child's game. Consider the following model, where the object of the game is to shift the numbered pieces around until they are placed in sequential order on the board (left to right). Notice where the numbers begin. On this particular board, the number "13" is the only piece located correctly. The other 14 pieces must maneuver in order to reach their desired place on the board. Consequently, the number "13" will have to be displaced many times before collective order between the numbers is achieved.
After several moves, the numbers begin to find their respective places on the board, though with traffic volume is so high, and desires for each piece to find its own placement, movement on the board can seem futile, as in lane changes made on a crowded highway.

\[
\begin{array}{cccc}
2 & 3 & 4 \\
1 & 10 & 7 & 8 \\
5 & 9 & 6 & 12 \\
13 & 11 & 14 & 15 \\
\end{array}
\]

Finally, the numbers find their proper place on the board, at which point, “traffic flow” of the numbers seems evenly dispersed. It may require a lot of give and take on the part of each piece to allow for certain numbers to move before others. Collective flow of the numbers forces such compromises at times, and it is fascinating to observe just how often numbers must jump from individual flow to collective flow in the duration of movement.

Obviously, this example represents are a very linear system of traffic flow, but it is more important to understand that the states of flow fluctuate in order to keep a system “alive,” i.e. where traffic flow maintains some speed above zero. These changes of state correspond to singularities - a perturbations - wherein conditions go from individual to collective flow. The most remarkable notion outlined in this theory developed by Prigogine is the premise that instabilities must arise in order to reach some new order of traffic stability.
Critical Variables

Whether traffic is modeled after hydrodynamic states or not, each of these approaches employs three characteristic variables in their respective mathematical models: flow \( q \), concentration or density \( k \) and traffic speed or velocity \( u \). (It is important to note here that there are two types of velocity, that of individual cars, and that at which density waves travel). The most fundamental equation relative to all three variables is their function to one another, \( u = q/k \).

Essentially the existence of these variables stresses one critical point: traffic science is a dynamic, dissipative, "living," system. Living because it must exchange matter and energy in order to propagate in its environment. Because it exchanges matters both physical and sociological, its complexity is that much more intriguing to study.

Invisible Forces at the wheel

Surely, we can identify many forces that actively shape the form of platoons, which in turn shape the form of highways, which in turn shape the form of its perimeters, etc. Strictly speaking, however, there are three forces shaping traffic: flow, density (concentration) and velocity (speed). The innumerable forces governing the behavior of traffic’s drivers - distracted, lost, angry, fearful, hurried, tranquil, sad - are inherently present in the first order of traffic flow variables, but remain a category of second order variables because of their inhomogeneity.
Concerning ourselves only with the first order, then, how do we record both temporal and spatial fluctuations when traffic densities within the space of a highway are constantly changing? Speed and density as forces in traffic flow are like the game pieces of relativity, where multiplicities of these variables flatten only to create duration periods for new multiplicities of forces. This relentless process is proactive in generating form within the system of traffic itself. Henri Bergson refers to this phenomenon of movement as a dislocation of simultaneity: "What is simultaneous in a fixed system ceases to be simultaneous in a mobile system. Moreover, by virtue of the relativity of rest and movement, by virtue of the relativity even of accelerated movement, these contradictions of extensity, these dilations of time, these ruptures of simultaneity become absolutely recip
rocal. In this sense there would be a multiplicity of times, a plurality of times, with different speeds of flow, all real, each one peculiar to a system of reference."

So Bergson might say that for traffic, yes, it is a system of its own multiplicities. However, its rates of flow are relative to other rates of flow in other dynamic systems, with their own sets of multiplicities. In order words, duration - or multiplicity - has the power to encompass itself, uniting itself with itself. What does this mean for invisible traffic forces and our ability to make out its shape? Well, unfortunately, we tend to focus very narrowly on the repercussions of traffic - the delays, the hostility between drivers - and the united set of multiple flows is perceived in compartmentalized doses of duration. The object is to perceive each of these simultaneous moments of flow, movement, speed, as part of a greater duration - one multiplicity - where invisible forces in traffic flow are inherently part of some whole. To understand what that whole is, we must also acknowledge potential visible forces that shape traffic flow.

Road (form-making) Visibilities

Without a doubt, the highway and roadway systems are the very containers for traffic flow. So, in theory, we could say that the highway is the shape of traffic flow itself. But let's consider for a moment the possibility that traffic flow is shaped by other spatial conditions of a highway. Depending on whether a highway is above, below or even with groundlevel, traffic flow could be forced to slow or accelerate. Surely, highway engineers take these objectives into account, and design accordingly. For instance, if a highway is ten lanes wide and
laid on a flat, vast horizon, the driver’s perception of the highway and his/her relationship to traffic flow may be one of high velocity and high visibility. These characteristics will likely dampen the sensation of traveling at high speed since there is no framework within which to gauge that speed. Sixty-five miles an hour will feel like a mere forty. Conversely, if that same driver travels on a sunken section of a four lane highway, the speed will feel intensely exaggerated. Forty miles an hour will feel like a shaky sixty-five.

But we are forgetting one other important aspect of a highway’s space. The landscape that surrounds the highway is subjected to change from other dynamic systems of economics, human behavior and politics, and they cannot be accounted for their effect on a highway’s design. Engineers begin with the intervention of a highway to which all forces visible and otherwise are activated. Before long, the environment and all of its forces adapt, re-shape, re-invent the landscape around the highway. And, of course, the highway itself changes in this cycle of invention.

Perhaps we can assume, then, that traffic flow is a force that falls somewhere between invisible - where the shape of flow is in constant flux - and visible - where the shape of the highway, its physical container, is fixed. While these two notions of forces contrast in legibility, it is no different conceptually from the model of the dune ecosystem. In this case, wind becomes speed, water becomes flow, sand becomes vehicles, fences become highway walls and paved surfaces. Not to mention human interventions that strive to sustain these systems. And yet, we still struggle to understand how interdependent the forces in
traffic flow are to each other in shaping form. It may be because notions like hydrodynamics and statistical physics cannot fully answer questions of instability in a traffic system without first analyzing human behaviors that accompany the equation. For the sake of argument, the following chapter will observe the dynamics of traffic flow in an alternative manner in order to bring some sense of full materialization to a somewhat invisible system.
5.

Eddy

As we have already seen, traffic flow can be measured, in principle, in the
same way as can be measured any flow of fluid. Hydraulic models of rivers,
pipes, bayous and flood streams employ the same variables of flow, concentra-
tion, and speed in order to evaluate dynamic fluctuations. In the best case sce-
nario, then, we could say that when traffic moves in a pattern of light (or individual) flow, we are witnessing what's known in hydraulic terms as laminar flow.
Quoting Encyclopedia Brittanica, "laminar flow is a type of fluid (gas or liquid)
flow in which the fluid travels smoothly or in regular paths . . . The velocity, pres-
sure, and other flow properties at each point in the fluid remain constant. Lami-
nar flow over a horizontal surface may be thought of as consisting of thin layers,
or laminae, all parallel to each other. The fluid in contact with the horizontal
surface is stationary, but all the other layers slide over each other. A deck of
new cards, as a rough analogy, may be made to 'flow' laminarly." In traffic terms,
laminar flow corresponds to "unperturbed flow" in the hydrodynamic model.
In contrast to this sort is turbulent flow, "a type of fluid (gas or liquid) flow in which the fluid undergoes irregular fluctuations, or mixing . . . The speed of the fluid at a point is continuously undergoing changes in both magnitude and direction." This type of hydraulic flow best simulates conditions of heavy (or collective) flow in traffic. What turbulent flow means in traffic terms is "perturbed flow," where waves and waves of traffic are in constant collision with each other in the stream.

The likenesses between river systems and traffic systems are uncanny in that they both possess variables of speed, density and flow. And if a highway is designed as an artificial cavity below normal street grade, it looks remarkably like a river channel, featuring embankments and directional streams of matter. And, in the same way that states of flow in traffic jump between individual and collective, states of flow in rivers jump between laminar and turbulent. But here lies the main difference between these two dynamic systems: in the making of rivers, matter is under constant shifts of sedimentation, water turbulence and direction, changing the shape of river channels continuously. Because of the plastic matters of which rivers are made, the river's shape gives in to this re-invention. Over time, the
shape of a river's channel will change drastically, snaking through pliable landscapes and succumbing to the forces of fluid dynamics. Conversely, a highway built in the same channel profile remains that shape forever, always hardened to whatever flows it contains. In the following sections, I will come back to this notion of erosion over time, confronting, instead, the shape of highway and the forces that cause erosion to its perimeters.
PART III

HIGHWAY
Thus far, I have briefly discussed the visible dynamics of a river’s laminar flow and the consequences on its embankment. Now it is time to link this notion of laminar flow to the invisible dynamics of a highway’s traffic flow and the consequences on its edges. The dynamics behind traffic flow relative to the highway offer little evidence of its impact unless seen against the grain of something rigid, i.e. something tangible, such as a city grid or a planned subdivision. In selecting the most fitting area of study for this purpose, the city of Houston seems not only appropriate but unavoidable. In fact, because Houston is world-renowned for its strategies in ground transportation, it opens up many more possibilities to explore and to analyze, not just for its complexities in network
systems, but for its landmark position along proposed Interstate 69 (still known as Highway 59). This interstate highway is important for several reasons. Firstly, it joins all three NAFTA countries as the major trade corridor. This will undoubtedly impact Houston’s economic situation, but more importantly, it will increase vehicular traffic tenfold as I-69 passes through.

Another reason to consider Houston for study is its ambitious radial master plan for future transportation networks. Texas Department of Transportation plans to complete yet another ring of highway in the coming years, bolstering the persistence of suburban sprawl while threatening to dilute the draw of its centerpoint, downtown Houston. Curiously, today’s plan of Houston resembles the 1840’s railroad development plan for France, called the “etoile” plan. This ironic condition beckons
the question why Houston's plan performs inversely to France's radial plan. Paris was developed as France's focal city onto which all railroad destinations would converge, while Houston is like the point of impact on a piece of glass, splintering development of new towns and new commerce away from itself, never promising to return back to its point of origin.

Houston in the Constellation of Transportation

Another reason for Houston’s significance is the magnitude with which Texas Department of Transportation has developed its network of roads. A major focus in this development falls in the hands of Houston Transtar, a five-agency conglomerate exclusively run to monitor, survey and analyze real-time traffic scenarios. Made up of TxDOT, Harris County, City of Houston, METRO Transit Authority and Emergency Management Center, Transtar is responsible for the planning, design, operations and maintenance of transportation operations and emergency management operations within the Greater Houston Area. The service area encompasses 5,436 square miles with a population of 4.0 million. Aside from their coordination responsibilities over Intelligent Transportation Systems (ITS) programs, Emergency Management Systems and Enforcement efforts, components managed by Transtar include:
300 Mile Freeway Management System
Freeway and Arterial Street Incident Management
Ramp Metering
Closed Circuit Television Surveillance (CCTV)
Changeable Message Signs
105 Mile HOV Lane System
Regional Traffic Signal System of 2,800 Signals
Emergency Management Operations for Evacuations and Disasters

This technological superstructure of digital and telecommunications is growing at an extraordinary rate. Every day, thousands of feet of digital lines, surveillance cameras and remote computer substations are being installed along each and every one of the highways within Transtar's domain. With the integration of this megasystem, Houston’s drivers are promised faster commute times, shorter delays and intelligent navigation choices. Conceivably, this operation may very well be the physical embodiment of the super information highway, mystically connecting drivers to an invisible array of information and digital networks. For a city already preoccupied with the automobile, this development seems in keeping with its transportation traditions. Especially in the wake of NAFTA's preparations to open Interstate 69, Houston's networks - both transportation and digital - are surging with technology and internal infrastructures.
8. Displacements

What this development in Houston's transportation means for its city is an entirely different tale of displacement, rapid sprawl and a weakened centralized economy. Layers of bureaucracy, tax reforms, sliding land values, and infrastructure are the elements that have pushed homeownership and suburbia further and further away from the city center. Each ring on Houston's transportation halo is indicative of the degree of expansion. Ironically, but not surprisingly, this outward move increases the length of commuting time for those traveling to Houston's densest and centralized area of commerce and industry.

With the rise in development of transportation comes the inevitability of displacement. The most obvious types come in the forms of social and physical displacement for those in the path of construction. These types reflect the impact of a highway's presence in an existing area for which good and bad circumstances arise. The third type of displacement emerges out of the impact that technology has had overall.

That is to say, technology, as mentioned earlier, has accounted for the deepened division between social and economic classes: for those who can afford the means to connect digitally, a world of new opportunities is at their disposal. For the many who are not yet equipped for this rapid change in communications, consumerism and information, the disadvantages are severe. This spiraling effect seems to compound the class division even more: when this class is further divided due to their "have-not" status, they are inevitably forced
to choose low-income neighborhoods over more desirable ones. And because the properties marginalized by highway interventions are devalued, developers target these areas for low-income housing. This evolution of circumstances is relentless, like a stream of traffic or heavy waters, coursing through the landscape.

Physical Displacement

While it is difficult to distinguish the exact causes of physical displacement, there exist two fundamental factors influencing the dispersal. On a macroscopic scale, the goal on the part of highway engineers is to streamline design in order to minimize wasteful road coverage and construction costs. This entails surveying possible routes for expansion with regard to land value, vacancy, projections of future development, etc. This process usually takes many years to complete since government agencies must organize their efforts around budgetary and political issues. But the most precarious aspect of this survey often overlooks what possible damage is caused by intervention in a particular neighborhood. Whether because of low property taxes, low median household incomes or abandonment, certain tracts of land are destined to be razed. In some cases, whole blocks of neighborhoods simply disappear under the trail of the bulldozer. What is left is the trace of neighborhoods once thriving, once united, once densely populated. The flight to escape these areas in fear of degeneration is in itself part of the displacement.
The second agent of displacement is the degree to which a neighborhood lacks sufficient infrastructures. Basic utilities like street lighting, sidewalks, emergency provisions, signage and garbage disposal are the missing ingredients to a neighborhood fulfilling its potential. When such elements are left to decay, so do the communities that they're intended to serve.

Social Displacement

Needless to say, physical displacement leads a one-to-one proportion with social displacement. For those unable to flee a newly marginalized area - either because they cannot sell or afford to move - the only alternative is to face the repercussions of possible neighborhood decline. Concerns of safety, public education and amenities are jeopardized in the wake of abandonment. Communities suffer because unity and awareness are diluted with the dilution of the population. But it is important to note here that displacement incurred by the influx of highway development dissipates across all socio-economic classes. It just so happens that those nearest the impact are also hardest hit.
Virtual Displacement

Historically, our rituals of interaction have seceded to technology's momentum. Beginning with language, inventions of the alphabet, the printing press, the telegraph, the telephone, the television and now, the computer, have had an incredible impact on our intuitive ability for interaction. All these man-made tools for interaction have inadvertently shifted us further and further away from our most primal ritual of interaction, face-to-face. What was once one-on-one conversation is now cyberchat. What was once delivered mail is now electronic mail. What the telephone did, teleconferencing now does. We inhabit two contrasting, though simultaneous spaces of interaction - the physical and the digital.

And yet, in the communities marginalized by highway intervention, these technological transformations of interaction are resisted. Not only because of willful resistance, but because practically speaking, many areas lack the infrastructure to access digital information. Some neighborhoods lack even the resources for private telephone lines, let alone digital lines. Not surprisingly, such resistance is conditional on 1) lack of in-
frastructure to support on-line access, 2) fear of the technology, and 3) a misunderstanding that this technology will replace face-to-face interaction altogether. Equally disturbing, however, is the potential displacement that exclusion from the inevitable thrust of information technology poses on vulnerable communities. That such neighborhoods are already physically displaced is further intensified by their virtual displacement. And while such exclusion may have little impact on rural communities - given their obvious geographical isolation - it could have devastating consequences for urban neighborhoods already combating the threat of cities' decentralization caused by globalization.
PART IV

FORM-MAKING
9.
Wrap Up

The preceding sections went into great detail in order to lay the foundation for the following design exploration. Through an interpretative process, I have attempted to link the concept of invisible dynamics to a highway's traffic flow (and the consequences on its edges) to the visible dynamics of a river's laminar flow (and the consequences on its embankment) to the question at hand, which is: how can we render invisible, dematerialized forces as visible and tangible while acknowledging new modes of information, new modes of space, time and place?

Another important iteration of this process proposes the notion that strategic obstructions in laminar flow devise a system of localizing pockets of density (activity) along the highway in the same way that eddies form in banks of a river. These obstructions cause a shift from laminar flow to turbulent flow, effectively slowing the erosion of the highway's edges and recognizing this area as neither conforming to, say, city grid nor rendering it as vast and desolate as a highway.

The complexities that underpin the emergence of this unique urban typology have given way to an investigation incorporating the following hypotheses: 1) if laminar flow is re-interpreted to mean a stream of steady-moving vehicles along a highway, then without intervention of some sort, flow will further erode the city grid along its edge and 2) if new development were to occur in the vacuum between these opposing systems of organization and stability - city grid being static and rigid, highway being dynamic and fluid - then a new set of parameters
- organized around itself, like Bergson's multiplicity - must be established. Essentially this hypothetical response implies that, for this zone of marginalization, the city grid no longer functions in the capacity it once did prior to the intervention of the highway. Without this scenario becoming a battle between highway and city grid, aspects of both systems must be examined and reconciled. Perhaps an urban strategy could be designed to respond to the fluctuations cause by the new intervention. The following image comes to mind:

The most distinct feature in this landscape of sand dune and city blocks is the concept that two powerful shapes are colliding with each other. If one overtakes the other at different intervals, the landscape benefits from the constant exchange of contingencies and inevitabilities. This landscape breathes. It resounds with the knowledge that it will never become stagnant so long as both systems are at work.
To the Test

I hoped to devise the same "collision" of systems in my exploration. To do this, I inscribed the program of a Houston's Transtar Operations Center, its re-located site to be on the very edge between these two systems. The original program for this building was modified to include a traffic research institute and invited guest and scientist housing. In total, the program embodied roughly 130,000 sq. ft in all.

If I have any concluding remarks to make, it is this: my search to find and make form out of invisible forces was a search of optimism. Something in me ached to re-discover a path toward building. While it is exciting to consider the possibilities of virtual existence, I cannot yet find a comfort zone within it. My feet were planted in two places throughout this exploration, one in wind, one in water. The hardest struggles surfaced when I detected some imbalance in this strange new direction of architecture.

To be sure, I felt that in order to determine the validity of my argument, I could not waver in either direction. Information from both systems was ever-present and thick with possibilities as to what form the center would take. The following is a silent presentation of my arbitration between systems. It encompasses site analysis, program, and finally, form-making.
10.
Program
11. Site
12.
Design
BIBLIOGRAPHY


