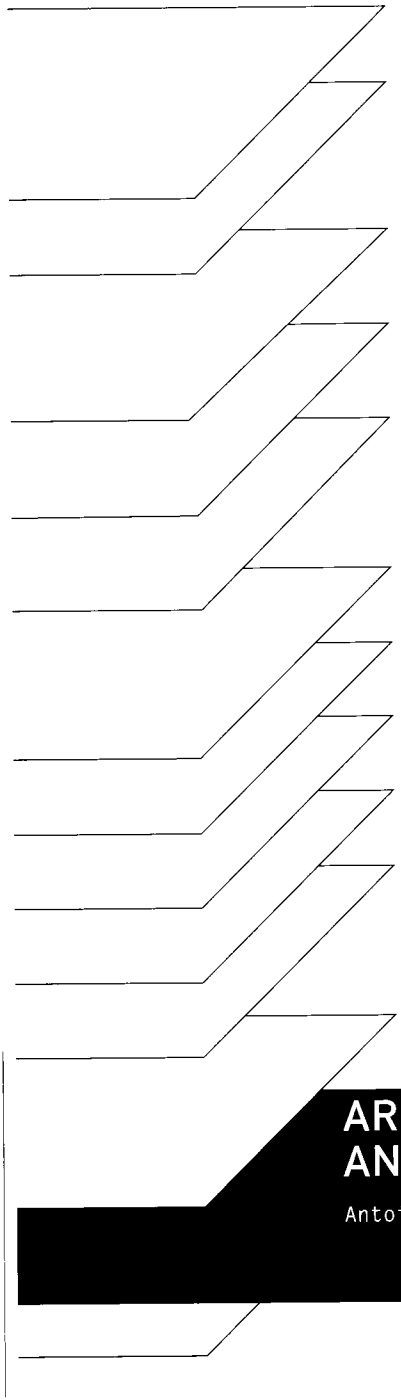


ARCHITECTURE, SCIENCE, TECHNOLO AND THE VIRTUAL REALM

Antoine Picon

In recent years, a growing number of images and metaphors taken from mathematics, physics, and molecular biology have spread among architects. A large number of these images and metaphors are linked to the development of digital architecture and to the growing importance given to the virtual dimension in the architectural discipline. It seems worthwhile to reflect on their possible significance. Is the abundant use of references such as topology, fractals, chaos theory, or DNA sequencing a mere rhetorical habit,

or is it dictated by more profound reasons? In other words, at what level do scientific references function in contemporary architecture? The question has become unavoidable, given the multiplication of these references.

The use of scientific images and metaphors within the architectural discipline is, of course, no recent phenomenon. Throughout the nineteenth century, architects made frequent reference to the rapidly developing biological sciences. Similarly, the main protagonists of the modern movement invoked scientific notions such as Einstein's theory of relativity. But these episodes are not equal in status or importance to those of today.

The greater or lesser degree of importance of the scientific references made by architects can be assessed through the extent of their contribution to the architectural culture. In the architectural field, borrowings from science have sometimes led to the production of new concepts and notions that have proved seminal for architectural practice. What would nineteenth-century architecture have been without the notion of structure? This notion resulted from a series of exchanges between architecture and the study of living beings. Actually, the French word *structure* was first used to designate the internal organization of the body and its various organs before it was applied to buildings.[1]

Some scientific references have proved more superficial than others. Such was the case with relativity and the modern movement. For an architect like Le Corbusier, relativity remained a prestigious but remote and somewhat obscure theory. What are the conditions that, at certain times, make the relations between science and architecture truly productive? This question, again, is difficult to escape, given the contemporary state of affairs in the architectural domain.

At this point, we may consider a possible answer. The productive character of certain episodes in the history of relations between science and architecture is perhaps attributable to the existence of similarities between the operations upon which science and architecture are based. We know, indeed, that concepts and notions do not develop in an ethereal intellectual sphere. They are inseparable from practice, from concrete instruments and operations. Geometric constructions and surveying techniques were, for example, common to the European scientific and architectural practices of the fifteenth, sixteenth, and seventeenth centuries. Nineteenth-century biological sciences and architecture shared the practice of dissection. As Martin

Bressani has shown in his dissertation on Viollet-le-Duc, dissection was as fundamental for the nineteenth-century rationalist archaeologist and architect as for the scientist studying living beings.[2]

These similarities would present no meaning if they were not imbued with a sensorial dimension. In other words, science and architecture meet when they both contribute to the cultural construction of perception. As Michael Baxandall puts it in *Patterns of Intention*, to live in culture is synonymous with a specific education of the senses.[3] Vision is especially important in dealing with architecture. Science and architecture often meet in their common attempt to shape or reshape the categories of visual perception.

These categories are in their turn inseparable from the construction of the subject who looks at the world. From the Renaissance on, major shifts in vision have also been shifts in the definition of the human subject. What science and architecture share is not only the ambition to interpret and transform the world but above all to populate the world with subjects different from one period to another.

ARCHITECTURE AND THE VIRTUAL DIMENSION

Let me deal now with the question of the virtual. How is "virtual reality" to be defined? Etymologically, virtual means full of virtue, virtue being taken here as a capacity to act. According to the old philosophical distinction between capacity and act, virtual reality is nothing but a potential awaiting its full actualization. Virtual reality is by no means unreal, but its full effect is not yet in evidence. Reality is not the problem; it is its full development or presence that is partly lacking. Virtual reality can be interpreted as a germ, as the starting point of a dynamic evolution.

The distinction between what was only potential and what was fully realized played a fundamental role in medieval theology and philosophy. In the seventeenth century, it remained fundamental for philosophers such as Leibniz, hence the recurring interest taken by Deleuze in Leibniz's philosophy. Among contemporary philosophers, Deleuze is the one who has dealt most extensively with the theme of the virtual.

From its philosophical origin, let us remember this fundamental feature of virtual reality: it is a reality, but a potential one. Virtual reality might very well represent the potency, the tension, the fold or indefinite

series of folds, if we want to use Deleuze's vocabulary,[4] that makes the ordinary reality possible.

In such a perspective, architecture presents a strong virtual content, for architecture is to be reduced neither to a collection of remarkable buildings nor to the aesthetic, utilitarian, and constructive rules that make these buildings remarkable. Architecture is neither a collection of things nor a set of rules. It has more to do with a creative principle enabling the constant exchange between the built reality and the domain of knowledge, precepts, and rules. Architecture might very well be grounded in virtual reality.

This virtual character can be viewed from various angles. The notions of project and design correspond clearly to one of the most fundamental viewpoints. The distinction between the building and the intention that gives birth to it is essential indeed to the modern definition of the architectural discipline. This definition began to appear at the Renaissance with the emergence of the Italian notion of *disegno*, meaning both the intention and its spatial expression. The French word *dessein* and the English *design* had comparable meanings at the time.

From the start, design was a compound of numerous things. In addition to covering both the general intention and its spatial translation, design also comprised a technological dimension. Brunelleschi's famous cupola for the cathedral of Florence was among the very first examples of this technological dimension. It is well known that Brunelleschi designed not only a structure but also the machines and the process that enabled its realization.[5] His inheritors did not always follow his path, but this comprehensive conception of design has remained an ideal ever since that time. In many respects, Jean Prouvé's *idée constructive*, or constructive idea, is a new formulation of this old ideal.[6]

What is the reality of an architectural design? It is precisely a virtual reality. Through the maze of its determinations, design makes the actualization of an intention possible. Design is among the virtual dimensions of architecture.

The importance of this virtual dimension has grown almost continuously from the Renaissance on. After the founding episode of Brunelleschi's cupola, Alberti put the stress on the intellectual nature of architectural design in his *De re aedificatoria*. But until the late eighteenth century, this humanist conception was constantly challenged by a more down-to-earth vision giving

precedence to practical rules founded on the observation of existing models as well as to technical rules. This attitude was especially pronounced in France, where the professional figures of the architect and the master mason remained close to one another for a very long time, many architects being actual master masons. By the end of the eighteenth century, however, a radical turn toward a more liberal definition of the architect took place. This turn was accompanied by a new emphasis on the intellectual content of architecture. "What is architecture?" asked Etienne-Louis Boullée in his *Essai sur l'art*, written circa 1780:

> Am I to define it, with Vitruvius, as the art of building? No. Vitruvius's definition contains a flagrant error; he mistakes the effect for the cause. To execute, you must first conceive. Our earliest forefathers did not build their huts until they had first conceived the image of them. That production of the mind, that creation, constitutes architecture.[7]

By the end of the eighteenth century, Boullée was not the only architect to consider design as synonymous with the production of a mental image. At a time when architecture was trying to distinguish itself from engineering, imagination was given precedence over other intellectual qualities such as pure reason. The importance given to imagination, interpreted as man's ultimate creative faculty, reinforced the virtual dimension of architectural design. Simultaneously, architects became concerned about its social role in a changing world. As Manfredo Tafuri stated many times in his books, this preoccupation gave birth to a new relationship between the architectural project and social utopia.[8] Such a connection was to reach its climax with the modern movement. For the moderns, architecture and urban design were filled with a potential that would not only reshape the building industry but also transform the entire world. Nothing was to escape the power of the actualization of modern architecture and urban design.

Leaving now the question of design, let me turn to order and proportion. For centuries, these two notions were synonymous with another virtual dimension at work in architecture. In the frame of thought provided by the Vitruvian tradition, order and proportion were not something static such as a set of rules tacked onto the building. Extending beyond the architectural realm, they were at the core of the universe. The French seventeenth-century

theologian and philosopher Jacques Bénigne Bossuet was very explicit about their importance when he stated that God had created the world by providing it with order and proportion.[9] At a more modest scale, the architect was in a sense replicating God's fundamental course of action when making use of the architectural orders and proportions.

Although treatises like François Blondel's or Charles D'Aviler's courses of architecture gave indications about what the correct proportions of architecture should be, order and proportion could not be encapsulated in a single set of formulas. They were variable, oscillatory, hence the importance given to problems such as optical correction. Order and proportion were among the virtues of architecture. Through their use, architecture expressed its dynamism, its living essence.

Just like order and proportion, the traditional status of ornament also began to be challenged by the end of the eighteenth century. Until then, ornament had been another expression of the potency at work in architecture. Contrary to our contemporary vision, ornament had no connotation of gratuity. It was not something added to construction; it sprang from necessity, as Vitruvius or Alberti stated it. Like order and proportion, ornament expressed the fundamental regularity of the universe and, above all, its fecundity. Ornament, in general, gave evidence of the creativity and the beauty of the cosmic order, just as the fruits and flowers that it often imitated were the product and the finery of nature. Its reduction to an agreeable but inessential part of the project was synonymous with an impoverishment of the virtual reality at work in architecture.

In the process leading to this reduction and impoverishment, Piranesi occupies a key position. In his work, ornament is already partially gratuitous; but its proliferation enables it to regain part of its former importance. As an isolated motif, Piranesi's ornament is somewhat arbitrary; it remains essential, however, as the mark of an indefinite process of ornamentation.[10] Almost a century after Piranesi, Gottfried Semper also explored this path in his theoretical work, the ornamental impulse playing a fundamental role. From the elementary plait to the richest embroidery, Semper saw this impulse at work in the art of textile production, which he associated with the origin of architecture.[11]

Order, proportion, and ornament—these traditional virtues of architecture have become far less powerful since the decline of the Vitruvian

tradition that began in the late seventeenth century. In the past two centuries, other traditions have appeared that have become even stronger.

Structure is among these traditions. Structure is often misinterpreted when it is seen as a purely static organization. The writings of Viollet-le-Duc or Auguste Choisy may help us correct this view. For these proponents of nineteenth-century structural rationalism, structure was the consequence of a seminal principle, a "means to a product rather than a production."[12] In his *Entretiens sur l'architecture*, Viollet-le-Duc explained, for instance, that structure was, in his eyes, the result of a founding tension between the social needs and the technological culture of a period.[13] According to him, the resulting structure always bore the mark of this fundamental tension.

Another way to understand the dynamic nature of structure is to pay attention to the fact that we actually never "see" a structure, in the ordinary sense. We only perceive its result, an assemblage of parts and materials. Structure is what makes this assemblage possible. Structure is a potency.

At the beginning of the twentieth century, the dynamic character of structure was further enhanced with the appearance of *On Growth and Form* by D'Arcy Wentworth Thompson. In this important book, which influenced generations of architects and engineers, structure became synonymous with the process of growth and development.[14] The virtual character of structure was thus reinforced. With Thompson, we are not so far from our contemporary notion of program. Structure becomes synonymous with program.

This brief review of the virtual dimensions at work in architecture would not be complete without a mention of space—architectural space as it was defined by the moderns. Architectural space was neither the Cartesian geometric space nor the space of sensorial perception: the first was too abstract; the second, too concrete. Geometric space did not take into account phenomena such as human scale or the perception of light and texture. Space as sensorial perception was too rich and complex to allow for any kind of design. Regarding space, the ultimate ambition of modern architecture was to find a compromise between these two extreme conceptions of space in order to stimulate thought as well as sensation.

The importance given by the moderns to movement and its icons, such as the automobile, was part of this general ambition. In their eyes, movement appeared precisely at the intersection of the abstract and the concrete, of geometrical measurement and sensorial experience. Le Corbusier's

famous definition of architecture as a machine for producing feelings was perhaps the best expression of the founding tension between rigor and emotion that gave birth to architectural space.[15]

Like other key dimensions of architecture, space was not a thing but an operator enabling a constant oscillation between the abstract and the tangible, the mobile and the motionless. Such an oscillation allowed the architect to design spaces that were both specific and imbued with universal meaning; in other words, it enabled architects to reconcile place and space.

Design, order and proportion, ornament, structure, and space—the potencies of architecture that I have been reviewing—may help us understand the medium's strong virtual content. Architecture is not something stable. It appears through a series of productive tensions or potentials. Design, order and proportion, ornament, structure, and space are among these tensions or potentials that have made and still make works of architecture and, above all, architectural expression possible.

THE VIRTUAL AS A MATRIX OF EXCHANGE

At this stage, let me return to the general problem of the relations between architecture and science. Like architecture, science is permeated by the virtual. Indeed, science is reducible to neither a set of theoretical results nor to a collection of experimental data. In its development, science appears as the productive tension between theory and experiment or, to put it differently, between abstract knowledge and practice. Science studies have shown convincingly that science is not to be assimilated with pure knowledge.[16] It is no more satisfactory, however, to consider only its practical side. Envisaged as a dynamic, science appears as the potency, the tension or the fold linking these two terms.

The virtual dimension at work in both architecture and science might very well account for the constant circulation of images and metaphors between the two fields. I should note in passing that such a circulation is by no means unidirectional. Throughout its history, science has repeatedly made use of architectural notions. In their quest for the regularities of the universe, sixteenth- and seventeenth-century scientists, for instance, often referred to the architectural principles of order and proportion. Peter Galison has shown how early-twentieth-century German science was obsessed with the notion of *Aufbau*, which was clearly imbued with an architectural meaning.[17]

From order and proportion to space, the various expressions of the virtual dimension at work in architecture appear to have played a major role in its recourse to scientific images and metaphors. These expressions proved all the more influential for being linked to instruments and operations shared by architects and scientists. As previously discussed, from the Renaissance to the end of the seventeenth century, the reference made by architects to order and proportion was linked to the use of geometrical constructions as well as to surveying techniques that were also used by scientists. Hence, the capacity of order and proportion to provide a base for convincing exchanges between the two domains.

These expressions were also inseparable from a cultural shaping of the senses—of vision in particular. Such a relation is evident in the case of order and proportion, which presupposed a specific education of the eye. But it is also true of structure and space. If we do not actually "see" structures, we perceive them through the combination of visual and muscular intuition. The Spanish engineer Eduardo Torroja had this combination in mind when he stated that structural design required an understanding "to the backbone" of the mechanical principles of inner equilibrium.[18] Combining the eye's power of appreciation with kinesthetic sensations, this type of understanding is a cultural construction.

Through this kind of sensory construction, architecture, just as science or technology, contributes to the respective definitions of man and his nonhuman environment; it contributes to the structuring of their interface. As a cultural production, architecture is more than a mere combination of solidity, commodity and beauty; it is as much about what man is as what he is not, about the relations between the subject and his environment. As Nelson Goodman has said, architecture, like science, is about the way we "make" worlds, worlds populated with subjects and objects the definitions of which are always historically determined.[19]

Today, the computer is symptomatic of a profound change in the way we make worlds. Through the generalization of notions such as information, code, and program, it affects both the way we construct the subject and the interpretation we give the subject's environment. In between these extremes, society is changing also. We live in a new type of society, an information-based society that is the basis for the process of globalization we are experiencing. Many of today's sociologists and historians are tempted to assume that this society preceded the invention of the computer. Whether

this is true or not, one thing is certain: the possession of information, such as a file of potential clients, has become often more vital than the possession of physical goods.

How could architecture remain untouched in such a context? To the various critics who tend to play down the impact of the computer on architecture, there is this response: the computer is only the tip of the iceberg. It is not that the computer in itself has changed architecture; it is that, because both nature and society have changed, architecture is confronted with new challenges. Its intensive use of scientific metaphors appears as a consequence of such a situation.

A NEW VIRTUAL REALITY

For architecture, the virtual reality so often invoked today corresponds in fact to the emergence of a new virtual dimension. To understand its most salient features, those that explain to a large extent the connections with science that are claimed by contemporary architects, one must pay attention to its historical origins.

The origins of computer-based reality can be traced back to the end of World War II and the development of the Cold War. At this time, a new space was emerging, a space of phenomena that could be visualized only through the use of screens, maps, and diagrams. These phenomena could be almost anything: attacks by bombers or armies, the state of military supplies, economic trends. They were sometimes "real," sometimes mere hypotheses. They were studied using radar, strategic maps, and charts in places such as control or war rooms. In such a context, the effective and the simulated were in constant interaction one with another. To the strategist, what mattered were events and scenarios, either realized or simply possible.

There was surely something paradoxical in the importance given to events and scenarios whose realization could not be predicted; the new strategic space of the Cold War was, to a large extent, the result of calculation. From predicting financial markets to political voting, we have become so used to this strange coexistence of calculation and chance that we no longer pay attention to it. It does not mean, however, that the paradox has disappeared.

Historians such as Paul Edwards have shown how such a context was to shape the subsequent development of the computer and the emer-

gence of cyberspace.[20] From its beginning, architects and engineers were intrigued by virtual reality. They were also well aware of its military connotation. In an enlightening article, Mark Wigley has shown the influence of virtual reality on Buckminster Fuller and his "World Game," a proposal for a global simulation that was clearly inspired by the key principles of the war room as well as by the perspectives opened up by electronic calculators.[21] Transposed by NASA, these principles were also present in Archigram's theoretical projects.[22]

Although the military connotation has become less evident today, the virtual dimension that computers help to produce retains some of its original features, such as the preeminence of events and scenarios over static entities. From an architectural standpoint, the major consequence of this preeminence is the destabilization of form, a destabilization all the more paradoxical since it is the operations of the designer and the calculations of the computer that simultaneously, and rigorously, define form.

Architectural form used to appear as the ultimate result of a process of research. Its beauty was the beauty of the end, of the point of equilibrium. The equilibrium was often dynamic, but the form was supposed to dominate the movement, to encapsulate it. The beauty of architecture could be somewhat analogous to the pleasure derived from the spectacle of a dance or a flow. But it was the underlying structure of the dance or the flow, the choreography or the mechanics, that was made visible through the architectural medium.

A computer-generated architectural form can no longer pretend to achieve this status. Even if it appears as the most satisfying configuration for its designer, it remains the result of an arbitrary stop in an endless process of geometric transformation, the type of process that Greg Lynn calls "animation" (fig. 1).[23] Architectural form becomes similar to a cross-section in a continuous geometrical flow. Whereas the traditional status of architectural form suggested a comparison with the human body, its new status renders it closer to the snapshot or the videogram.

New problems arise from this situation. There is certainly a problem of aesthetics. How are we to judge the beauty of the blobs and all the other creatures that appear on our computer screens? Even when the projects are supposed to be realized in the physical world, even when they are actually built, this problem remains.

Part of the problem is linked to an impression of arbitrariness. Why has the designer stopped the process of geometrical transformation at one stage and not the other? Justifications are not always visually evident.

When the process is haulted, architectural form becomes similar to an event, although design is more and more comparable to the writing of a scenario. The architectural form literally appears on the screen, while its production from carefully selected parameters looks like the layout of a plot. The similarity between form and event is probably one of the most important effects computers have had on architecture. From the elementary bit to the geometrical transformation made visible on their screens, computers are machines that produce sequences of events. But this link between architecture and the computer is rooted in something more profound, namely the fact that information is nothing but a production of events. That fact was made clear as early as 1949, in Claude Shannon's *Mathematical Theory of Communication*, which played a seminal role in the construction of the modern notion of information. Indeed, for Shannon, information was linked to the problem of the selection of a given message in a set of possible ones. Selection, choice: the notion of information has definitely something to do with the production of events.[24] From the elementary bit to the determination of the final form of a project, selection and choice remain the fundamental issue in our computerized architectural world.

The fascination exerted by scientific metaphors on so many young contemporary architects is probably a consequence of this new status of architectural form. In particular it explains the interest taken in the nonlinear dynamic systems that have invaded entire fields of scientific research. The latter systems are often described as chaotic. The atmosphere and the weather are paradigmatic of this chaotic nature.[25] What happens in these systems cannot be predicted because of their high sensitivity to initial conditions. Does it mean that the ultimate justification of the architectural form is that it happens just like rain?

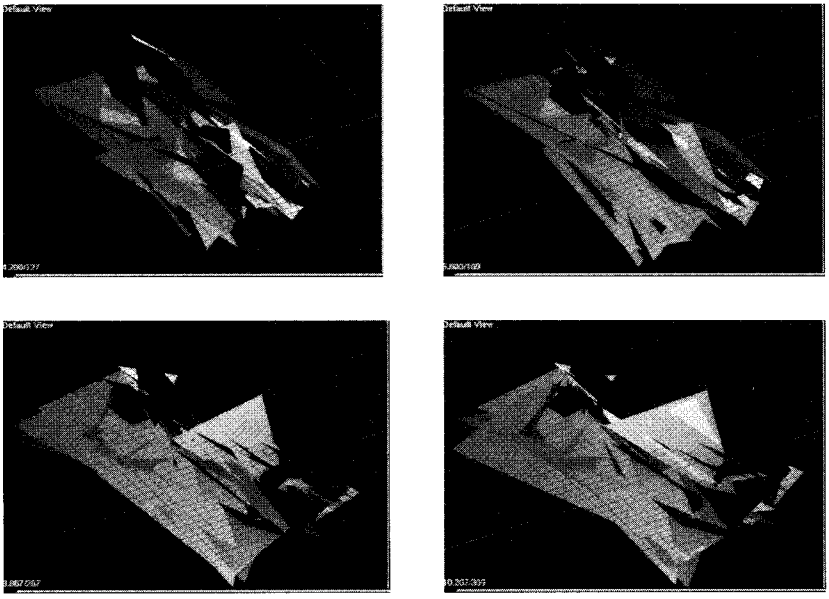
Until now, one of the functions of virtual reality was to anchor architectural production to some kind of necessity. Design was synonymous with the quest for the necessary form. Order and proportion, structure, and, above all, space were supposed to be essential and thus imparted with an internal necessity. One of the most disconcerting features of virtual reality is

that it seems to be synonymous with a high degree of arbitrariness. In other words, nothing can now guarantee the designer that his project is the result of the best possible choice.

The recent fascination for diagram—a fascination again rooted in the observation of scientific practices and an attempt to imitate some features of science—might very well stem from this situation of uncertainty and doubt, with diagram acting as a possible antidote.[26] Apart from its various philosophical justifications, borrowed from thinkers such as Michel Foucault and Gilles Deleuze, one of the major interests of the diagrammatic approach is to re-create an internal necessity in the design process. According to its proponents, diagram appears as an abstract machine or as a program whose unfolding is synonymous with a new rigor.

More specifically, the two partners of UN Studio, Ben van Berkel and Caroline Bos, have related the use of diagrams to what they call "deep planning" (fig. 2).[27] In their projects, like the Arhem station, they aim at depth by integrating as many data as possible. Technical and functional data must, of course, be taken into account, but the ambition is to master other fac-

(fig. 1)



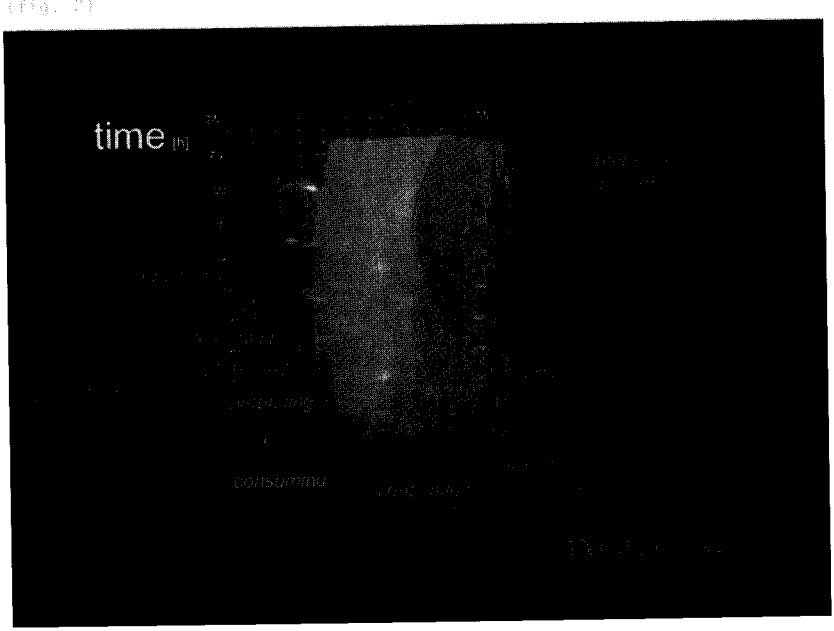
Greg Lynn, "House Prototype"

tors—economic and even political factors. From this perspective, the use of diagrams is meant to avoid any preconceived idea of what urbanism and architecture should be about as well as to stave off any premature recourse to form. Urban and architectural design is supposed to be generated through the analysis made possible by diagrams. Thorough analysis, however, is not the only dimension that is mobilized, for diagrams are also supposed to encapsulate a specific dynamism at the intersection of social rhythms and their programmatic translation. For van Berkel and Bos, understanding and orienting this dynamism toward the completion of the project is far more important than any formal recipe. MVRDV has a similar ambition with its so-called datascapes. Measurements and statistics are supposed to allow form to appear without any prejudice, in the same way that scientific laws are supposed to emerge from the gathering of experimental data.[28]

There is a certain degree of naiveté involved in this quest for objectivity. Science studies have shown that, in science itself, results are always "constructed" rather than the purely logical outcome of observed facts. But the naiveté is only partial, for there is more at work in the use of diagrams than the mere desire to imitate scientific procedures.

In addition to these procedures, marketing techniques are also a reference. The aim is to shape the project in the way products and services are

(fig. 2)



UN Studio, Ben van Berkel and Caroline Bos, "Move Diagrams"

defined, produced, and commercialized. Deep planning and datascapes claim to be in profound accordance with market forces. Such a claim has become quite general among young designers. What seems to be at play is a trend toward a new realism. The aim of the architect is no longer to propose an alternative, and allegedly better, world but to take the world as it is, to contribute to the further actualization of its potential rather than bring about the advent of a remote utopia. Another way to put it is to ask, as Sanford Kwinter has, for an architectural discipline taking "the flow of historical conditions as its privileged materiality."[29] Rem Koolhaas and OMA have been pioneers of this new attitude.

Among the criticisms raised by the acceptance of market forces, there is the accusation that true generosity is missing; a realistic architecture runs the risk of being cynical. Massimiliano Fuksas may have wished to exorcize the risk by choosing the theme "less aesthetics, more ethics" for the 2000 International Architecture Exhibition of Venice.[30] Jesse Reiser also addressed this issue in his *Solid-State Architecture*, in which, following Deleuze, he contrasted power and potential (fig. 3).[31] According to this distinction, the aim of the architect is not to exert power but to express the creative potential of the existing world, a potential that might prove emancipating in the end.

Faith in the emancipating power of the present is often rooted in a strange, vitalistic conception of the world, a notion that verges on pantheism, with its belief in the auto-organizing power of the universe, which man must divert and master for his own purposes. Here, again, we find all the rhetorical figures that are borrowed from dynamic systems and their capacity of auto-organization. The use of that type of metaphor by architects often approaches the ideological agenda at work in the creation and development of the Internet. Just as with the Internet, the realistic architecture of our time claims to be both compatible with the invisible hand of the market and capable of revealing a potential for generosity and altruism.

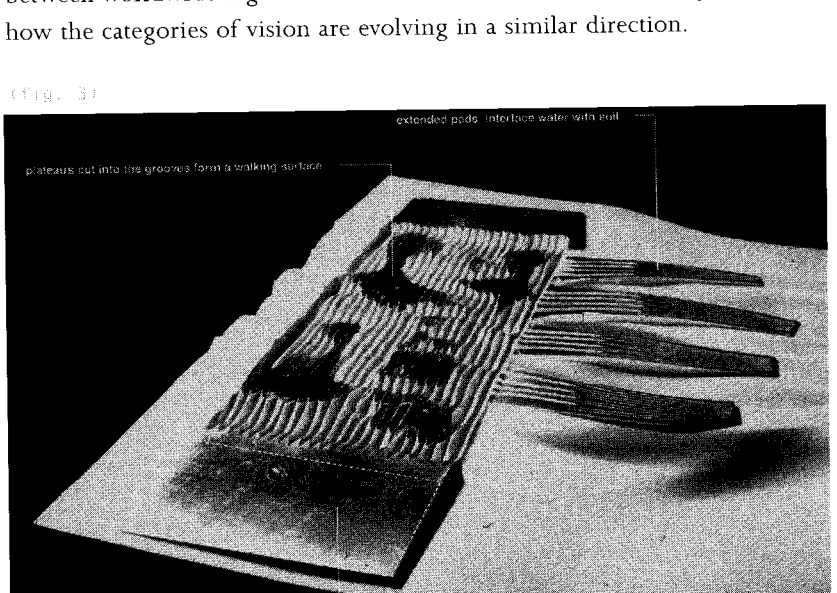
All these assumptions are questionable. But even if we take them for granted, other problems related to contemporary virtual reality remain. The problem of scale is especially striking. In many computer-produced projects, scale is not absolutely evident. One might be facing molecules, spaceships, planets, or constellations. Whereas man used to be the measure of architecture, such is no longer the case, at least on computer screens.

At this stage, it is interesting to note that the question of scale is quite general nowadays. We live in a world in which scale has become highly problematic because of the shift of our visual and perceptive categories. On the one hand, with satellites or computer-generated global models, we see at a much broader scale than our immediate ancestors did. On the other hand, we are able to look at microstructures as if they were right under our eyes. We have difficulty dealing with our environment at a traditional distance.

Science and the often computer-generated images that illustrate it play a role in this crisis of scale. Scientific notions and representations shape our vision of the world. Among them, information plays a key role. Contrary to the traditional notion of structure, information ignores the distinction between the large, the medium, and the small, between the macro and the micro. Hence the suggestive power of fractal geometry to describe a world where complexity is to be found at every level.[32]

The blurring of the very big and the very small, and the crisis of scale that is its main consequence, tends also to reflect the fundamental evolution of our society. Specialists often say that globalization is characterized by the suppression of the intermediaries between the global and the local, between worldwide organizations and individuals. It is fascinating to observe how the categories of vision are evolving in a similar direction.

Fig. 31



Reiser + Umemoto, "Water Garden"

Digital architectural forms truly belong to this context of globalization. What is their real size? Are they big as mountain chains or small as pebbles? Indeed, they evoke two apparently contradictory terms: landscape on the one hand, texture on the other.

Critics have already commented abundantly on the recent impact of landscape on the theory and practice of architecture. Let us here discuss the strategic importance of the notion of texture. Texture is the level on which abstract information and tangible sensation meet today. Computer images are based upon textures. But texture is also a fundamental feature of materials. Texture seems to abolish the distinction between the abstract and the concrete. In the field of digital architecture, the importance given to texture, to the play between grain and light, goes hand in hand with the desire to reconcile the immaterial and the material, the conceptual and the tangible.

In the modern creed formulated by architects like Le Corbuier, reconciliation between the conceptual and the tangible was realized by architectural space. The new interest in textures is part of the crisis of the notion of architectural space as the moderns defined it. Jean Nouvel gave this crisis striking expression some years ago when he announced the definitive abandonment of Albertian perspective for a two-dimensional universe of mobile textures and lights.[33] The announcement of the death of Albertian perspective has proved a little premature, but we have indeed entered a world full of textures and lights.

Texture implies a new attitude toward reality, as if things were seen at much broader or, on the contrary, much closer range. Their reality becomes both problematic—since nothing is more abstract than a surface seen from very far or very near—and more intense. *Hyperrealism* is an apt term for this suspension of the traditional scale of perception and the specific intensity that it generates. We live in a hyperreal world of surfaces and textures in which we can see either entire worlds or only small particles.

Seen from very far or very near, the universe seems always on the verge of breaking open to allow glimpses on another world. Hypertext is very similar; it is possible with a click to open up parallel or derivative textual contents. As with the World Wide Web, the reality that surrounds us is in a state of constant multiplication; it is populated with thresholds that can be assimilated to events. The most meager computer screen appears as a door

open on alternative spaces. Computer-generated architecture is about the unstable reality of infinite connections.

As already mentioned, this new version of Blaise Pascal's two infinities surely has something to do with the major economic and social trends of our time. In a context of globalization, the acceptance of the invisible forces of the market is part of hyperrealism, and the interplay of these invisible forces is part of the intensification of our perception of the reality of the world.

In such a world, the contemplative distance of the past is becoming more and more difficult to locate. We are either too far or too near. This difficulty might very well be the symptom of a radical destabilization of the subject/object polarity. Who is producing architecture? Above all, for whom is architecture being produced? The modern movement had postulated a posthumanist subject, as K. Michael Hays has shown it in one of his books.[34] The posthumanist subject is perhaps no longer the one that computer-based architecture has in view. Indeed, digital architecture is contemporary with a shift from the anonymous individual of the early technological age to the self-developed personality of the Internet civilization. In our competitive society, self-development and assertiveness have become a rule of life.

Are we back to the humanist subject of the Renaissance? Certainly not, if we pay attention to the disconcerting importance technology is now playing in the very definition of the subject. The early-third-millennium individual is defined to a large extent by his or her capacity to be hooked up to giant networks. A recent essay of mine hypothesized that one of the easiest ways to conceive this new individual is in reference to the figure of the cyborg.[35] This compound of flesh and technology has been haunting science-fiction literature and film for quite a long time. More recently, it has begun to influence anthropology and history, from books and articles on feminism by Donna Haraway to the study of the Cold War by historians such as Paul Edwards.[36] The cyborg's shadow is now beginning to appear in the background of many architectural projects.

Two characteristics of the cyborg are especially remarkable from this perspective. The first is his full acceptance of the world as it is; the cyborg is not a utopian figure but the result of the full use of existing technologies. The second is that technology enables it to see things differently, at very con-

trasted scales and with an intensity that traditional vision does not possess. Hyperreality is meant for cyborgs.

The cyborg is, of course, a fiction, but the humanist subject, the ideal man of the Renaissance, was also one. Architecture's virtual dimension is ultimately about the constant invention of the subject. Design, order and proportion, ornament, structure, and space were already about the possible definition of the subject. Computer-based design has perhaps to do with a new emerging definition in a rapidly changing world.

In addition to this aspect, digital architecture represents also an opportunity for architecture to reestablish strong links with contemporary science and art. These links are synonymous with the even greater importance of experimentation and the experimental attitude in the architectural field. Digital architecture is often accused of being based only on formal manipulations. The very notion of manipulation, however, goes hand in hand with experimentation. What, for instance, is MVRDV's Data Town if not an experiment comparable, to a certain extent, to what is going on in science?

The possibility to experiment is further enhanced by the flexibility of computer programs that can be diverted from their original purposes to be used by architects. The latter are not alone in this process of diversion. Artists can also benefit from applications developed in domains like industry or medicine. Often their use produces surprising designs. New relations between architecture and art based on the extensive use of the computer are also emerging.

The reestablishment of strong links between contemporary science and art does not mean that architecture will regain its former status as an all-encompassing discipline. The architect can no longer appear as both a scientist and an artist, as Vitruvius wanted him to be. William Mitchell's ambition to transform the architect into the chief planner of cyberspace is perhaps unrealistic as well.[37] Rather, the new virtual dimension of architecture is synonymous with the possibility to participate fully in the development of the world, with modesty and determination. Beyond utopia, there is still a lot to do for a practice that Diderot and d'Alembert once placed under the aegis of imagination.[38]

NOTES

1. Such, for instance, is the meaning of the word in Claude Perrault's writings. See Antoine Picon, *Claude Perrault 1613–1688, ou la curiosité d'un classique* (Paris: Picard, 1988).

2. Martin Bressani, "Science, histoire et archéologie: Sources et généalogie de la pensée organiciste de Viollet-le-Duc" (doctoral diss., Université de Paris IV, 1997). See also Caroline van Eck, *Organicism in Nineteenth-Century Architecture: An Inquiry into Its Theoretical and Philosophical Background* (Amsterdam: Architectura & Natura Press, 1994).

3. Michael Baxandall, *Formes de l'intention. Sur l'explication historique des tableaux* (Nîmes: Jacqueline Chambon, 1991), 176; originally published as *Patterns of Intention* (New Haven: Yale University Press, 1985).

4. Gilles Deleuze, *Le pli: Leibniz et le baroque* (Paris: Minuit, 1988).

5. See, for instance, Paolo Galluzzi, ed., *Renaissance Engineers from Brunelleschi to Leonardo da Vinci* (Florence: Istituto e Museo di Storia della Scienza, 1996).

6. Dominique Clayssen, *Jean Prouvé: L'Idée constructive* (Paris: Dunod, 1983).

7. Etienne-Louis Boullée, *Architecture: Essai sur l'art*, ed. J.-M. Pérouse de Montclos (Paris: Hermann, 1968), 46.

8. See, for instance, Manfredo Tafuri, *Architecture and Utopia: Design and Capitalist Development*, trans. Barbara Juigia La Penta (Cambridge, Mass.: MIT Press, 1976).

9. J.-B. Bossuet, *Introduction à la philosophie, ou de la connaissance de Dieu, et de soi-mesme* (Paris: R.-M. d'Espilly, 1722), 37–38.

10. See Didier Laroque, *Le discours de Piranèse: L'Ornement sublime et le suspens de l'architecture* (Paris: Les Editions de la Passion, 1999).

11. On Semper's theory, see Wolfgang Herrmann, *Gottfried Semper: In Search of Architecture* (Cambridge, Mass., and London: MIT Press, 1984); Harry Mallgrave, introduction to Gottfried Semper, *The Four Elements of Architecture and Other Writings* (Cambridge: Cambridge University Press, 1989), 1–44; Kenneth Frampton, *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture* (Cambridge, Mass.: MIT Press, 1995).

12. Eugène-Emmanuel Viollet-le-Duc, *À Monsieur Adolphe Lance, rédacteur du journal L'Encyclopédie d'architecture*, extracted from *L'Encyclopédie d'architecture*, January 1856 (Paris: Bance, 1856), col. 11.

13. Eugène-Emmanuel Viollet-le-Duc, *Entretiens sur l'architecture*, 2 vols. (Paris: A. Morel et Cie., 1863–72).

14. D'Arcy Wentworth Thompson, *On Growth and Form*, rev. ed. (Cambridge: Cambridge University Press, 1942).

15. On the scope and meaning of the reference to the machine in Le Corbusier's work, see, for instance, Alexander Tzonis, *Le Corbusier: Poétique, machines et symboles* (Paris: Hazan, 2001).

16. See Dominique Pestre, "Pour une histoire sociale et culturelle des sciences: Nouvelles définitions, nouveaux objets, nouvelles pratiques," *Annales histoire sciences sociales* 50, no. 3 (May–June 1995): 487–522.

17. Peter Galison, "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism," *Critical Inquiry* 16 (1990): 709–52.

18. Eduardo Torroja, *Les structures architecturales: Leur conception, leur réalisation* (Paris: Eyrolles, 1971), 28.

19. Nelson Goodman, *Ways of World Making* (Indianapolis: Hackett Pub. Co., 1978).

20. Paul Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, Mass.: MIT Press, 1996).

21. Mark Wigley, "Planetary Homeboy," *Any Magazine* 17 (1997): 16–23.

22. See *Archigram* (Paris: Editions du Centre Georges Pompidou, 1994).

23. Greg Lynn, *Animate Form* (New York: Princeton Architectural Press, 1998).

24. "[A] bit is neither a particle of matter, nor an elementary idea, it is an atomic occurrence." Pierre Levy, *La Machine univers: Création, cognition et culture informatique* (Paris: La Découverte, 1987), 124.

25. James Gleick, *Chaos: Making a New Science* (New York: Viking, 1987); Jean Louis Chabert, Karin Chemla, and Amy Dahan-Dalmedico, eds., *Chaos et déterminisme* (Paris: Le Seuil, 1992).

26. On diagrams, see, for instance, "Diagram Works," *Any Magazine* 23 (1998).

27. Ben van Berkel and Caroline Bos, *Move. I: Imagination, II: Techniques, III: Effects* (Amsterdam: UN Studio & Goose Press, 1999).

28. Winy Maas and Jacob van Rijs, eds., with Richard Koek, *Farmax: Excursions on Density* (Rotterdam: 010 publishers, 1994).

29. Sandford Kwinter, contribution to *Flying the Bullet, or When Did the Future Begin?* (New York: Princeton Architectural Press, 1996).

30. Massimiliano Fuksas, ed., *Less Aesthetics More Ethics* (Venice: Marsilio, 2000).

31. Jesse Reiser, *Solid-State Architecture* (Academy Editions, dist. New York: John Wylie, 1998).

32. Benoît Mandelbrot, *Les Objets fractals: Forme, hasard et dimension*, 3rd rev. ed. (Paris: Flammarion, 1989).

33. Jean Nouvel, "A Venir," *L'Architecture d'aujourd'hui* 296 (1994): 50.

34. K. Michael Hays, *Modernism and the Posthumanist Subject: The Architecture of Hannes Meyer and Ludwig Hilberseimer* (Cambridge, Mass.: MIT Press, 1992).

35. Antoine Picon, *La Ville territoire des cyborgs* (Besançon: Les Editions de l'Imprimeur, 1998).

36. Donna Haraway, "Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s," *Socialist Review* 15, no. 2 (1985): 65–107; idem, *Simians, Cyborgs and Women: The Reinvention of Nature* (New York: Routledge, 1991); Edwards, *Closed World*.

37. William J. Mitchell, *City of Bits: Space, Place and the Infobahn* (Cambridge, Mass.: MIT Press, 1995).

38. Denis Diderot and Jean Le Rond d'Alembert, "Système figuré des connoissances humaines," in *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers*, 17 vols. (Paris: Briasson, 1751–72); see vol. 1.