intelligent beings in an intelligent universe
PETER WEIBEL

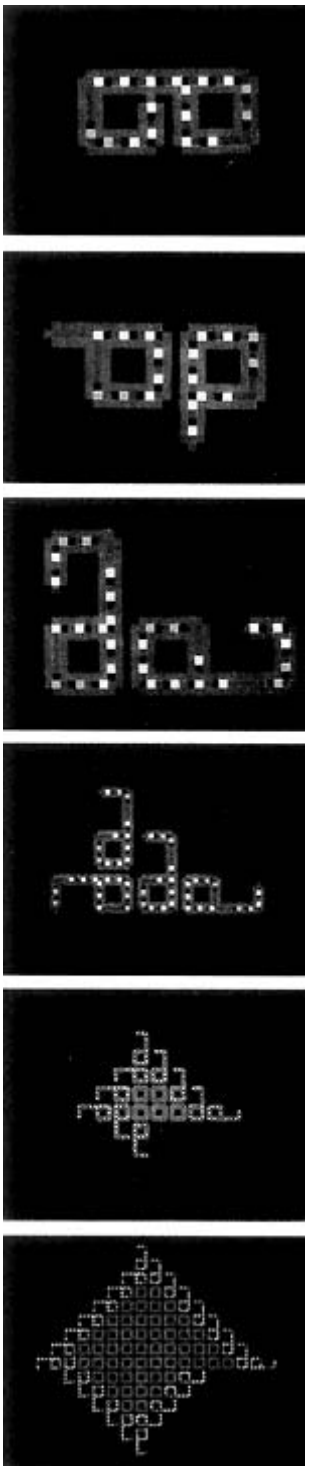
I Intelligent Ambients Environments of Artificial Intelligence

Hegel's dream, of intelligent beings inhabiting an intelligent universe, received a decisive boost when Leo Szillard published his notable work, "On the Decrease of Entropy in a Thermodynamic System by the Intervention of Intelligent Beings"[1]. For not only were the physical concept of entropy and the modern theory of information here set into a precise relation to one another, but also, for the first time, the trauma of "Maxwell's demon" was clearly spelled out, namely, that artificially intelligent beings would intervene in a dynamic system. Following on from this, the next thought to emerge was that artificially intelligent beings could also, themselves, interact with an artificially intelligent system.

The interaction between systems and system inhabitants, in the shape of that would lead to a reduction or generation of entropy, provides the initial models for artificial life processes. So far, the models inspired by information theory have largely aimed at finding out just what it is that happens during interactions and controlling processes enacted by artificially intelligent beings and how the systems are altered by such interactions. Self-organising systems were the next step in the development, where the emphasis was placed on the dynamic systems themselves. The question that poses itself now is, what would happen, if, instead of increasing the intelligence and adaptability of the artificial beings, the intelligence of the artificial environment itself were increased. In other words, what happens, if the natural environment is improved by artificial intelligence? The natural environment no longer remains static, like some mechanical system left to its own devices. Rather, it is trained to support our life processes. Intelligence (in the shape of computers, sensors, chips) is artificially implanted into the environment, causing it to become more reactive and enabling it to engage in an exchange of information. In particular, artificial environments of human beings, such as the city and the home, are being endowed with artificial intelligence.

This novel concept leads us to the point where we no longer think in terms of central control mechanisms oriented along the lines of the Cartesian ideal, such as robots in the shapes of human bodies, which with some considerable effort are supposed to take over the daunting task of imitating the multifunctional complex behaviour of human beings. Instead, we are led to a point where we are now thinking of a multitude of small artificial beings required to fulfil only localised tasks. A swarm of these beings, equipped with intelligence, will become embedded, non-centrally, in the environment and can react to the behaviour of people and their needs, such as the lights in a building, traffic regulation on the freeway, or the information on the data net. Dispersed armies of artificial beings with artificial intelligence will organise the reactions of the environment and thus, in their totality, form an artificial ambient endowed with intelligence. This artificial ambient comprises more than the computer but it does include its artificial intelligence. In the intelligent ambient the computer becomes almost invisible. It becomes the invisible machine that provides support for the sensor-technology and the realm of the artificial senses. A built-up and expanded sensor-technology, implemented in the environment and supported by the artificial intelligence of the computer, will also expand and loosen the human/computer inter-face, the point where human beings and machine intersect. This intersection area no longer operates in a direct and localised fashion but telematically and non-locally. A dispersed, computer-enhanced sensor-technology will form a field of intersection points, which will be variable and almost completely invisible.

Artificial environments such as aeroplanes, ships, cars, homes, satellites and their surfaces or intersection points, such as the multi- and hyper-media, offer a clear demonstration of just how a cornputer-assisted artificial intelligence and an expanded sensor-technology may be able to improve such environments. They arrange themselves into models of swarm-like behaviour of artificially intelligent beings in an artificially intelligent universe. Our civilisation forms intelligent ambients, which, of course, do not contain just the computers that assist us in a multiplicity of decision-making processes and tasks, and which will, in the future, also assist ever-larger numbers of machines in their tasks, e.g., TV-sets used in interactive viewing, in tele-banking or shopping, or, for instance, the viewing-machines of the entertainment industry (video games). But beyond this, intelligent ambients also consist both of intelligent systems, which have been endowed with intelligence, and of artificially intelligent beings that intervene in, and interact with, these systems. In part, of course, the artificially intelligent systems consist of the artificially intelligent beings themselves. We therefore have to distinguish between internal artificially intelligent beings of the system, and external ones. The interactive human being will himself be counted as part of the system. Our surroundings will increasingly consist of such intelligent environments, which can act autonomously. Artificially intelligent beings in such artificial systems act like autonomous agents. Intelligent ambients are, therefore, artificial environments possessed of artificial intelligence. The natural environment, to which human beings have adapted themselves, is being increasingly transformed into an artificial environment, consisting of media and machines adapted to human beings and capable of intervention. The intelligent environments of computer-assisted machines and multi- and hyper-media, are becoming increasingly complex, while artificially intelligent beings in the shape of computers and computer-assisted sensors and products are becoming ever more numerous, so that human beings are even beginning to require intelligent machines able to communicate with these environments of artificially intelligent machines and media. Technology thus changes from a park of prostheses and an ensemble of products to an all-encompassing, infonetted, artificially intelligent environment. The interactive model worlds of Cyber Art and intelligent buildings represent a miniature version of this basic paradigm shift in our environment at the close of the 20th Century from a natural environment left to its own devices towards an artificial environment possessed of artificial intelligence, a shift from a passive environment towards an interactive partner. [2]



Christopher G. Langton: Entwicklung einer Kolonie sich selbst reproduzierender Schleifen, ausgehend von einer einzigen Schleife; aus Christopher G. Langton (Hrsg.): "Artificial Life", Redwood City 1989

II Virtual Architecture[3]

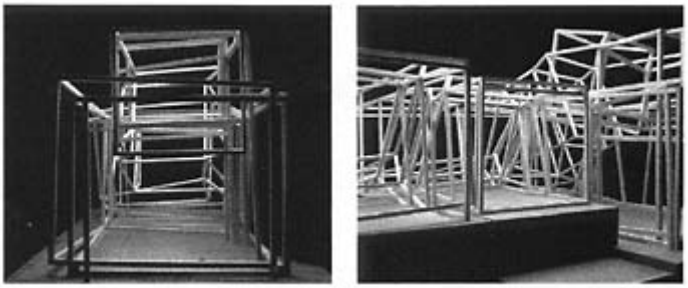
The concept of virtual architecture can be explained from two points of origin. One is the interface of architecture and media, the other the system theory of complex behaviour. Christopher G. Langton, writing in the introduction to the book, "Artificial Life", which he edited, states that: "The simplest way to distinguish between linear and non-linear systems can be seen in the fact that in linear systems the behaviour of the whole is only the sum of the behaviour of the parts, whereas in non-linear systems the behaviour of the whole is more than the sum of the behaviour of the parts." This formulation originates from the insight that life is

not something inherent in matter, but rather a result of the organisation of matter, a feature of its shape. For this reason it is not possible in systems of a certain complexity (such as those represented in non-linear systems) to analyse the parts in isolation and to gain from their combination an understanding of the system as a whole. The relevant feature of non-linear complex systems is that primary modes of behaviour are characteristics which emerge from the interaction between the parts and not from the characteristics of the parts themselves. These system-characterising qualities which are based on such interaction necessarily disappear when the parts are studied independently of one another, since it is not the parts themselves, but only their interaction which constitutes the characteristics of the system. For that reason these parts are called virtual parts. The inhabitants and the work within a building become such virtual parts of a complex system of interaction. If one wanted to isolate the physical parts, then the virtual parts would cease to exist, since the virtual parts, i.e., the modes of behaviour, are dependent on the non-linear interactions between the physical parts for their existence. Virtual parts are "the fundamental atoms and molecules of behaviour" (Ch. G. Langton)[4].

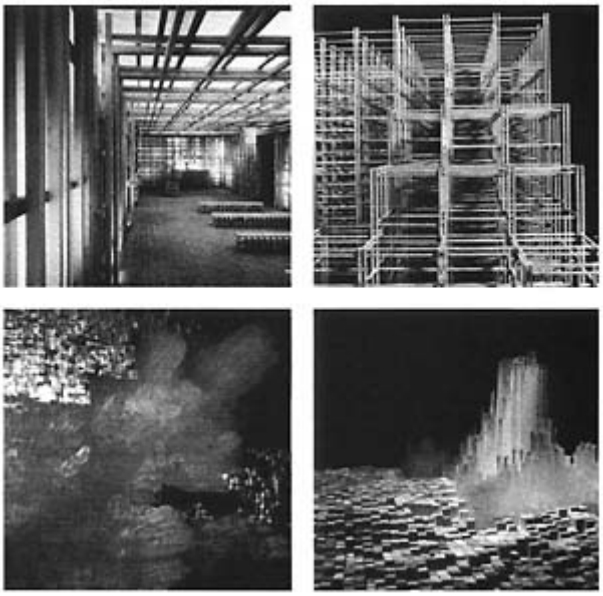
This system-theoretical approach to the behaviour of complex systems is now transferred to use in architecture and the media (visual information). The inhabitants and their environment, an artificially erected architecture, are to represent a kind of non-linear complex system where, through the interaction between the architectural modules and the viewer, a living system is created. The inhabitants and the architecture are therefore themselves parts of a dynamic flexible system. The significant features are generated in the interaction occurring between them. In this kind of architecture, therefore, the type of matter involved is irrelevant; what counts is the organisational form. Architecture and its inhabitants, through their interaction, form a system of artificial life. In his "Programmed Architecture" of 1969, Leonardo Mosso (Turin), had already put forth many situations later espoused by virtual architecture:

"Towards an architecture as an organism for the self-management of form, the memory of the computer for the programmed city shaped directly by its inhabitants informatively indeterminately-programmed architecture where every part of the whole objectively has the same significance and consequently accepts the mutual exchange within the framework of a super-complex, yet absolutely controllable system with possible mutations"[5].

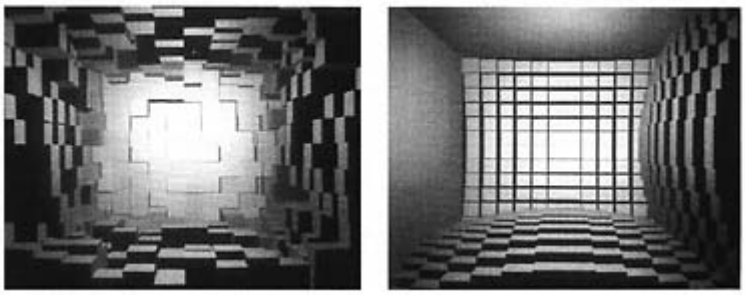
He also expanded his thesis to encompass a "programmed city-territory". My own attempts at a self-programmed computer-assisted architecture, architecture of autonomous agents with genetic algorithms, show surprising similarities.



Peter Eisenman: Center for the Arts, Emory University, Atlanta 1993, Views of concept and site models



Leonardo Mosso: Programmierte Architektur, 1969

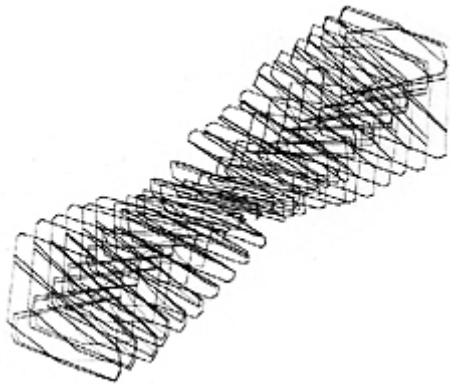


Peter Weibel: Zur Rechtfertigung der hypothetischen Natur der Kunst und der Nicht-Identität in der Objektwelt
Virtuelle Welt 1: Raum und Architektur, eine interaktive Computerinstallation, Köln, 1962

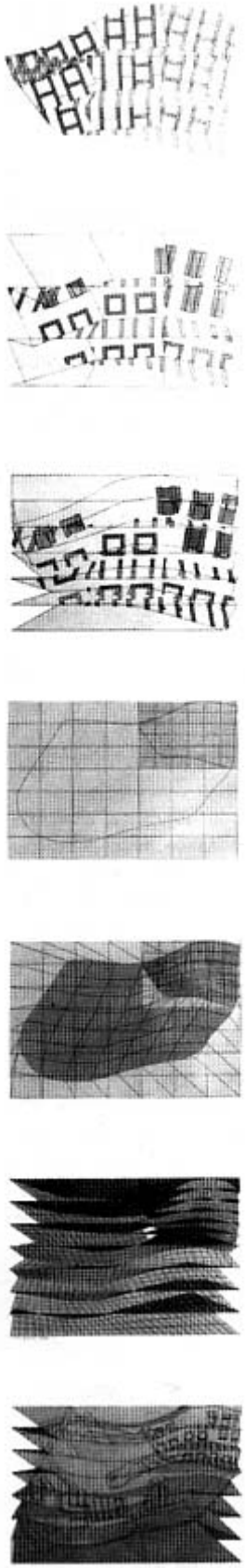
These mathematisations of architectural space have led to highly complex geometrical constructions and buildings in post-modern architecture, which were generated under the application of the catastrophe theory of Rend Thorns and the philosophy of the fold of Gilles Deleuze. See the architecture of Peter Eisenmann (Rebstock Park in Frankfurt, the Alteka Office Complex in Tokyo), Frank Gehry and Philip Johnson (Lewis Residence in Cleveland), Frank Stella (Museum of the Hoffmann Collection in Dresden), Bahran Sidel (Nava Convention Centre in Nava, Japan)[6]. There is a second experience of the theory of complex behaviours to be taken into account here, namely, the disappearance of a central controlling machinery. Complex systems — such as life itself, or intelligence — have dispensed with concepts of a centralised global control, such as may be found in a rotating drum or a motor, and instead, rely on mechanisms of a distributed control of behaviour. The local determination of behaviour under local rules is more suitable for generating complex behaviour than is the application of complex global rules. There is no longer any Rome acting as a central authority; the post-modern world consists of many local dynamic systems. This has the advantage that, whereas earlier, once the central motor had collapsed, the whole empire would be put out of action, now, with many local motors, a system continues to remain operative even if several smaller individual motors should break down. This also explains the heterogeneity of our postmodern culture, where the cosmos itself becomes a kind of consumer-shop. Earlier, under a centralised, global control, a work of art by Michelangelo was only to be viewed in the metropolis, e.g. in the Sistine Chapel. Today a picture by Ad Reinhard may be hung in New York as well as in the so-called provinces, such as Baden near Vienna. But this apparent chaos is, in truth, only the result of the virtuality of the behaviour of

highly complex systems. Building systems should be of an equal complexity and should, therefore, abandon, for instance, the structure of centricity.

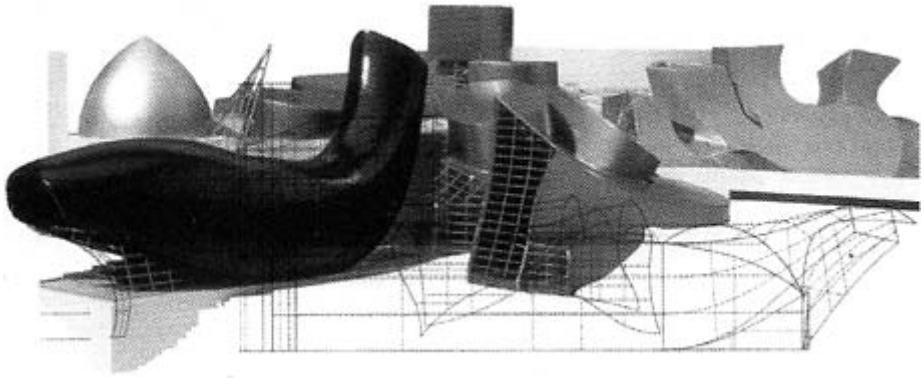
Rem Koolhaas: DIE BIBLIOTHEKEN VON JUSSIEU, 1962-63
Die Geschoßebenen werden so eingeschnitten, verformt und miteinander verbunden, daß ein koninuirliches Band entsteht.



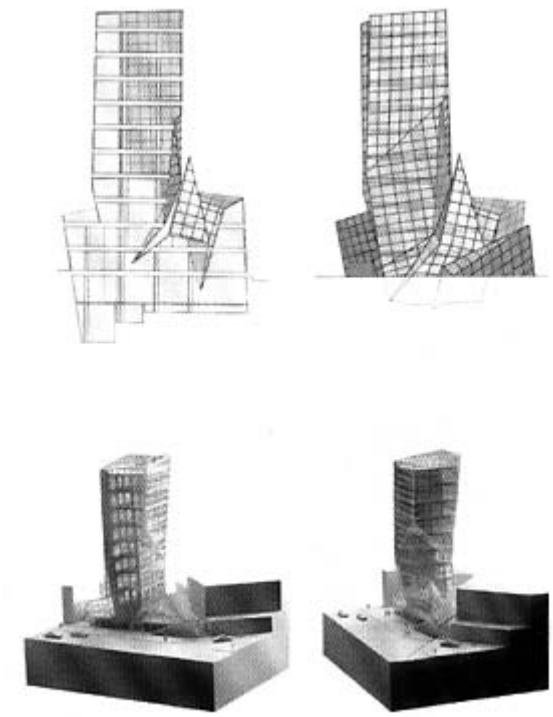
Axonometric View of the René Thom Catastrophe, Section drawn by Jeffrey Kipnis



Peter Eisenman: Rebstockpark, Frankfurt, Concept drawings



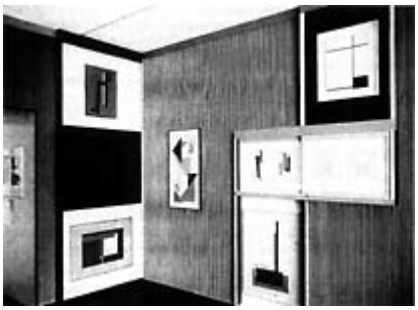
Frank Gehry and Philip Johnson: Levis Residence, Cleveland, Ohio



Peter Eisenman: Alteka Office Building, Tokio, Japan

Video-technology with its rewind-, fast forward-, and repeat-functions destroys the linearity of time. Time in the cathedral of video becomes a pattern of recombinant fictions. But the logic of the combinatory also encompasses space. For space is, so to speak, the body of time. If time is fragmented, then so is space. All the more since in the electronic world we are dealing with temporalised space, with a space that is measured in partitions of time (rather than units of space). In this combinatory logic of spatial and temporal patterns, the visual pyramid splinters and breaks and multiplies itself into a hyper-cube, a polyhedron, a recombinant torso, a Rissler-attractor or some other chaotic figuration. (See deconstructivism in architecture.)

My intention, therefore, is to create preliminaries towards a virtual architecture which will have abandoned a central controlling mechanism with global rules and which, instead, facilitates a local determination of the behaviour of the viewer at local level.


El Lissizky: Kabinett der Abstrakten, Sprengelmuseum Hannover, 1927-28

The famous Alexander Dorner-initiated "Room of the Abstract" (1927) by El Lissitzky at the Sprengel Museum in Hannover can not at all be comprehended in its structure without an activated, mobile viewer. Alexander Dorner wrote about the "New Concept of Space in the Visual Arts" as early as 1931: "The traditional notion of space is the perspectival one born half a millennium ago, whereby space is viewed from a fixed, absolute point as an infinite, homogeneous, three-dimensional expanse. The decisive innovation of cubism involves pushing aside the absolute viewpoint in favour of the relative one. What artists now experience as the significant aspect of space is its unreal multifaceted nature — and the fact that one must move about within it in order to really experience it as three-dimensional. Thus, in the further course of the development of abstract art, and thus also in late constructivism, the absolute extension of bodies (Lissitzky) disappears. Matter is finally dissolved into pure shapes and lines which, being translucent and without body-mass, interpenetrate one another. Thus space comes into existence as a cross-penetration of streams of movement and energy." Perspective, proportion, and scale become freely floating values. For this reason, electronic architecture must start from the assumption that within it the perceptual situation of the viewer is different from that in the localities of real space and that it must reproduce within itself new concepts of space, which have been generated by an increasingly immaterial visual technology. So there are indeed going to be streams of movement of the viewer as a virtual part & participant shifting within the space or image (in cyberspace) and experiencing the concert of pure spaces and lines on the massless and translucent screens. There is in virtual architecture no fixed, absolute standpoint, either for the users or for the products. Sound no longer comes from a fixed source; rather, it accompanies and follows the inhabitant through the rooms of the house. Insubstantial pieces of information penetrate the space, sensors create an "unreal omnipresence". The house becomes a data-suit, which is locally controllable. Inside each house location, and even outside of it, I remain in contact with the totality of the house.

In an ideal virtual architecture — unlike the perspectively-dominated Città Ideale of the Renaissance — the users can freely move about, their attention may oscillate, their gaze may veer from the centre, and the visual pyramid may be altered in shape according to local needs and rules. Visual pyramid and virtual parts are therefore opposites. The inhabitant interacts within virtual architecture in accordance with local rules in a non-linear system. Image and viewer, inhabitant and building, are therefore virtual parts of an interaction which follows the dynamics of isomorphism. The ideal situation of such interactive isomorphism can of course only be achieved upon a digital basis, e.g., with computer-enhanced simulations. Computer-generated architectural images in motion are, for this reason, frequently termed virtual architecture.

But a true medial architecture is one where the emphasis is placed on interactivity. If architecture information and the user form movable interactive virtual parts of a complex dynamic system subject to dissipations, chance occurrences, bifurcations and decentralisation,

then this virtuality does not merely apply to the space and the viewing-machinery, but also to time. The vision does not merely open itself into virtual space, this space without space, this Cartesian, mathematiccal space, the vision also opens up into a diachronous, virtual time. Chance odysseys on the fine grid of time and reversible time-trips become possible in medial architecture. In virtual techno-space, also, techno-time, which is a machine-time, is unfolded. But just as the viewing-machine is broken as a mechanical system and has become merely a virtual part within the dynamic of the viewing-act, so machine-time, too, is merely a virtual part of the thermodynamic of seeing. Techno-time, therefore, is equally stochastic, non-linear and local.

Computer animations of collapsing objects, cars in collision, and other catastrophes of gravity can be understood as experiments in opposition to the forces of gravity and compared to an architecture beyond gravity. An anticipation of virtual architecture has therefore been delineated in deconstructive architecture.

III Endophysics — the Space of the Internal Observer

The question, how does a machine or a system look, if the viewer operates within this machine or as part of this system, is the endo-approach to the world. The endo-approach refers to the viewing of the world as an interior observer, it signifies the observer-relativity of the world and it also means admitting to the incompleteness of the description of its distorted and bent synchronised-hyper-spaces. Electronics suggests such an endo-approach to the world. Genuine electronic art, therefore, does not take as its point of departure the space of classical physics, natural space, the space of perception, but rather the space of endo-physics, of blind-sight experimentation, of simulation, of virtuality. Sculpture anchored within the space of classical 19th Century physics is founded on continuity, the human body and complete visibility. Contemporary spatial art is based on non-local phenomena, on the machine and the dislocated object, on language, on the immaterial shape of the wave, on numbers, on distorted and bent spatial layers, on the observer-relativity. Electronics forms the endo-gate to the world. What is now required, therefore, is an architecture that will create the endo-gate to the electronic world.

The new space of the electronic world no longer distinguishes between outer and inner spaces. Instead, they appear perforated, discreetly intertwined. The space of the internal observer, the endo-space, has a second exo-objective side. The space of the external observer has a second endo-objective side. These two layers of reality, exo and endo, as a product of the observer-relativity of the world, turn outer spaces into inner spaces at anytime, and vice versa. The problem of the interface takes over from the question of absolute space and the Ding-an-sich.

IV Viable Architecture

Hans Hollein in his 1968 manifesto "All Is Architecture" put forth the premise, that architects should at last "stop thinking only in materials". An echo of this utopian form of architecture, which no one, including himself, has ever attempted, can possibly be found in the present deconstructive architecture. Its struggle against the forces of gravity, the denial of the laws of matter, is a remnant of that utopia-addicted time. The actual message of deconstruction would be a mathematisation of space as a partial solution of an architecture of the media. The Cartesian cube, as a basic module of architecture, would then still persist as a point of departure, but would appear as an object that would now be capable of being mathematically transformed and distorted. These transformations would aim towards a process of immaterialising static architecture, i.e. transforming it into a dynamic system that would be

context-dependent and could be locally controlled. Architecture would thus become a medium of perpetual change, both in time and space, a context-directed event-world. The customary factors of architecture, energy, weather, warmth, the usual elements of door, staircase, window, facade would become variables which themselves form the context or would be contextually defined. The house becomes an interface between human beings and the environment. Architecture is made into an interface-technology that seeks to find answers to the question: How can I connect the needs of the inhabitants, who themselves represent a local control system, with variable points of intersection (ranging from the window to the telephone, from other human beings to the weather), to the outer world, in as multi-dimensional, multi-functional and intermedial a way as possible? From the variability of the architectural elements, from the virtuality of the information stored, a building would emerge that would present a life-simulating behaviour: viability. The building as a living dynamic system should be able to effect change upon itself on the basis of the input from its inhabitants and its environment. Viable architecture is a Black Box wherein the old equation between environment and inhabitants no longer applies. The user himself can be input and output, and equally the house and its environment can be input and output. Yet, through this multi-dimensional input/output-relationship, whose prefixes are in a continuous state of flux, the structure of the Black Box itself also changes; it can change from a camera obscura into a camera lucida, from a closed Black Box into an open White Cube.

The house becomes an interface between inhabitant and environment: The environment is made more intelligent through computer-assistance. The architecture of the media, for which in 1989 I coined the phrase "virtual architecture", was the first dissolution of the substantiality of architecture. Architecture was to be freed of its invariance, its languor. Observer-relativity, context-dirigibility and interface-interdependence were henceforth to be the determining factors in architecture. The house should become the location of an "intermedial activity" (G. Lischka). This is only possible through the employment of high-tech and digital technology. A car knows more about its and my condition than does an apartment. Basically, architecture is behind the kitchen stove in the development stakes. Architecture as a container houses apparatus that is more intelligent than itself. For that reason, we call for intelligent buildings, for architecture as an intelligent ambient, capable of reacting to the local input of the inhabitants and of carrying through intelligent alterations of states of being. Interaction between inhabitant and architect, both seen as correlated parts of a dynamic system, that would be viable architecture.

Vilém Flusser, in a paper presented at the first symposium on Intelligent Building", in KarIsruhe in 1989, has enlighteningly remarked: "The industrial revolution was based on scientific theories in the manufacturing of tools. But there were then no employable theories in existence relating to living matter: oxen could not be technologically manufactured. So people began to displace jackals and oxen. Now we are beginning to have at our disposal the rudiments of biological theories. We can now, for instance, simulate the functions of the nerve system in non-living matter. Machines are becoming more intelligent. All this is just a beginning stage, and soon we shall also be able to produce viable tools, artificial living beings. Up to now buildings were non-viable machines. They will become more intelligent. One will become aware of the fact that they can assimilate the skin's functions, and artificial sensory and motor nerves, and will probably, sometime in the future, even build a central nervous system into them. And even further into the future one may perhaps inhabit artificial living beings. The communications revolution basically consists of the fact that the receptors of information no longer need to go to the disseminator, but that the information is directed straight towards the receptors. One no longer needs to go to the theatre, parliament or school, instead, one can watch television, read the newspaper or learn at a terminal. With that, the

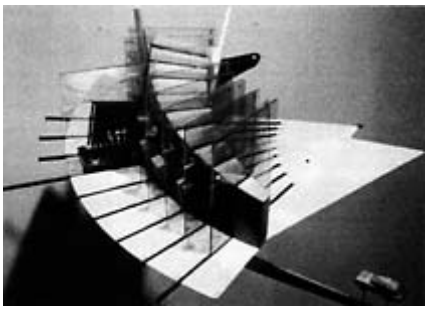
public building (and the city, and politics as such) have become superfluous. And thus, material and immaterial cables have broached the private building. It has become flooded with the public sphere.

"Just how these buildings will look — whether they will be like floating egg-shells or pulsating microbes, or even like central nervous systems sheathed in an electromagnetic skin — is at present difficult to imagine and not all that crucial."[7]

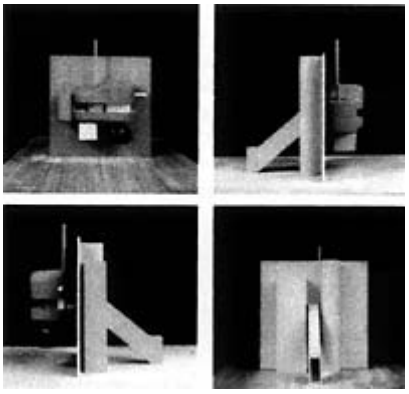

Future System, Projekt 1986. Die Hülle des Bürogebäudes 'Blob' ist selbsttragend und umweltaktiv

We ourselves move too slowly, which is why we have the car; we cannot fly, and for that reason, build aeroplanes; we cannot carry out computations quickly and accurately enough, so we have a computer. We are by nature handicapped, only we are not aware of it. The so-called handicapped person is merely a specialised case, who makes the general human state visible. The origin of technology is founded in this universal condition of shortcoming. Technology forms the prostheses, which make up for the deficiencies, mistakes, shortcomings and insufficiencies of human beings. The handicapped person, therefore, offers the central metaphor regarding the function of technology, which consists in breaching the gap where the human beings' physical endowments fail. The physicist and cosmologist Stephen Hawking is the best example of this. Without the technical prostheses, this wonderful spirit would have been lost. Technology is becoming more advanced and more intelligent, because human beings with an increasing complexity of their environment are in ever greater need of assistance from intelligent machines. Especially since that environment itself more and more often consists of just such intelligent machines. This artificially intelligent environment and human beings then become a dynamic system of co-variance, where the technical apparatus and the human beings form variables that mutually influence one another.


Howard Roggatt: House for the Superman, external view


Elizabeth Diller + Ricardo Scofidio: Slow House: 1/8" scale model with X-ray sections, collection of FRAC.


John Hejduk: Mobile Housing Unit, Milan 1986


John Hejduk: Wall House 3, 1968-74. Views of model


Laura Kurgan: Information Overlay, New York Museum of Contemporary Art, 1992

Jean Nouvel: Projekt für die Fassade des Verlagshauses DuMont, 1990


Matteo Thun: Intelligent Bathroom, Phillips/Keramag, 1991

J.C. Maxwell, the discoverer of the electromagnetic waves (1873), upon which our entire telematic civilisation is built, in 1871 described the first artificially intelligent entity, a hypothetical being of molecular size which would autonomously interact with thermodynamic systems. Soon this hypothetical being was referred to as "Maxwell's intelligent demon". The intelligent demons of today are called personal computers. Today the artificial intelligence of the universal machine named computer is ubiquitous. Architecture, too, has begun to realise that it must carry through the change of paradigms from the mechanical to the electronic age. A large palette of computer-controlled products in various categories and size today forms an environment, which exhibits intelligent behaviour.

The computer, with its artificial intelligence, directs the behaviour of the environment, from the telephone facility to the intelligent building. It registers our behaviour and reacts to it independently. It is not only us who adapt to our environment, but the environment, too, adapts itself to us. By means of this adaptive function the computer becomes, to all intents and purpose, invisible. It is being implanted into intelligent products (ranging from the washing machine to the information highway) and into a technical environment in such a way that this artificial environment (on account of its viability) surrounds us like a seemingly natural organism.

The aeroplane-, car-, and shipping industries have built artificial, man-made and controlled environments on the water, on the land and in the air at an extraordinarily high technological level. Their current sales crisis will lead to a transfer of this know-how to other areas. Another stable protective outer hull, comparable to the nomadic protective shells of the car, aeroplane and ship, will reap the benefits: the house. Compared to aeroplanes, cars and ships, which represent interactive environments reacting to human beings, and capable of imparting information about the environment, the condition of the vehicle and of the self, houses are relatively simple machines. The interactive interface technology will be transferred to architecture within the next few years. Intelligent buildings with local control mechanisms will react autonomously to the environment as well as the inhabitants.

Computer culture is now poised before a new step, the intelligent ambient, the intelligent house. As a result of using the world-wide internet and its interaction through TV, radio, telephone, e-mail, fax, etc, the environment as a whole has already become more dynamic and more nomadic. Yet up to now machine intelligence has largely been used to improve human beings. While intelligent machines so far have largely been implanted into humans, the next step now will be the implantation of intelligent machines directly into the real environment, e.g. the directing of traffic. Machine intelligence will improve the environment, making it more intelligent. In this way, the real environment will more intelligently and more interactively relate to human beings. Following the computer-aided design of virtual reality will come the computer-aided environment and the intelligent, interactive environment. This environment, supported by the intelligence of machines, will be known as intelligent ambient. Taking us from the Tron-ambient to the Tron-city.


Driendl & Stiexner, Solarhaus, Tulln, Austria, 1989-90

V The Space Between Tele and Tron: Telematic City and Tron House

When the growth of populations in the cities exploded in the 19th Century on account of the Industrial Revolution, thus laying the foundation for the modern mass society, scientific methods had to be adopted to guarantee the growth and survival chances of the cities. The concept of urbanism, which appeared around 1910, was the scientific attempt to get a grip, both theoretically and practically, on the city as a highly complex machine and as an artificial dynamic system. It could no longer be denied: the dictate of productivity under which all areas of life were placed since the Industrial Revolution had led to a comprehensive citification of the entire society, within which the city itself represented a kind of central machine.

No single person could ever hope to perform, alone, the inordinate number of operations required every day and night to maintain the supply of energy, materials, food and information to millions of individuals. But these operations can be coordinated and synchronised with the help of machines, so as to fall, as it were, under the heading of "symphony of the big city". Indeed, it must be admitted that such operations can only become

possible with the help of analogue and digital machines — productive machines, tele-machines, computing machines, etc. The range and speed of production, communication and distribution required necessary for the cities is only feasible with the help of machines. In this, a distinction must be made between two types of machines: the mechanical ones, e.g. car, necessary for the transportation of goods; and digital ones, e.g. computers, necessary for the mass handling of information. Electronic machines, in this scenario, are acquiring an ever-increasing, central significance.

1987, AT&T opened its new Network Operations Center in Bedminster, New Jersey. It controls the AT&T Worldwide Intelligent network, the most advanced telecommunications network in the world.

The network of computer terminals, telephones, telegraphs, textual systems, satellite-TVs etc, upon which our entire communications system is based, could be compared to a kind of orbital outer layer or perhaps a structure without which our civilisation, and in particular, the cities, would collapse. By means of the ubiquitous telepresence and global synchronicity created by tele-machines and computer-assisted networks, the continents become like pieces of furniture within the living room of the world — entire countries become like plates on the dining table of the cities. Internet, the worldwide computer network, exists in 55 countries of the globe and is being used by 20 million people. All that is required to enter this world of electronic information exchange is a PC, a modem and a telephone cable. Netsurfing within cyberspace, within the hidden world of electronic data, does not happen along a line stretched between two points as in cable-TV, rather, lines emanate from a single point, like from a telephone, to millions of points in the world outside. And, after all, one can be part of a wider hook-up.

If we consider how communications in the centuries to come will spread from a global to an interstellar dimension, we may get an inkling of the digital data highway. One such vision of this telecosmic communication in the third millenium, without television and telephone as we know them in their present shape, but with computerised networks, is given by George Gilder in his book "Microcosm" (1989).

If everything becomes close anyhow, then space, too, can no longer be measured as distance. Then it makes little sense to speak of space as near or far, as distance, then the spatial parameters lose their meaning. Then "tele" (distance) and "tron" — the suffix "tr(on)" signifies a comparison, a magnification — become the new parameters of the city. Tele and tron replace, as electronic parameters, the near and far of the cities. They are the new, open, permissive, perforated borders.

Virtual space, the extinguished space of tele-communications, which today permeates the city, can best be exemplified through the development of the orbital gaze.

In the orbital gaze of a satellite camera, things become smaller, space is shrunk or shrinks, natural orders of scale are destroyed. Continents become like postage stamps. A city, when

viewed from a distance, looks like a microchip — and a microchip does, indeed, carry out many of the services of a city population. The microchip replaces the city and IS the city - the city as chip, the chip as city. When the science of urbanism emerged in about 1900, a discovery was made at about the same time which already began to make history of the classical conception of urbanism as a material and administrative order of time and space, of body and matter. For it was John Joseph Thomson who, in 1897 and in the course of experiments he carried out with cathode rays within vacuum valves (developed by Crookes), discovered a body that was smaller than an atom. This small body, originally named a corpuscle (after the Latin word corpus, for body) by Thomson and which destroyed the traditional concept of matter, was a negative particle of electricity and was, for that reason, later renamed an electron. The tron-forest was beginning to be seeded.

The tron-forest, consisting of electron, pliotron, magnetron, axiotron, vapotron, klystron, cyclotron, cosmotron, asf., which delivered the requisite technological preconditions for the establishment of the entire realm of electronics, ranging from the domestic household to the military, from television to radar, now became the actual site and foundation of any city. Just as matter was shot full of holes by atoms, so, too, electronic and electric media now perforated the city. It became TronCity, with its tron-urbanism. The city lived not only on amplifier- and accelerator-valves. It became, itself, an accelerator-valve with super-conductor capacity. From this tron-forest, too, emerged the arsenal of "intelligent warfare", the intelligent products of war making, ranging from listening devices to satellite supervision.

The conductivity of the city increased as micro-electronics and miniaturisation set in. Transistors replaced valves, and silicon, the elementary semiconductor in transistors, became the new basic plan, the blueprint of the cities. Cities are only seemingly founded on concrete; more important by far are its silicon foundations. Without the technology of transistors, semi-conductors, integrated circuits, and chips, the millions of operations that make up a city would neither function nor exist. The intelligent tron-houses of the future, which will collaborate with the vehicles and machines of nano-technology, will also afford conceptions of space whose measure and module will no longer be provided by human beings (as was still the case with Le Corbusier).

Circuits integrated into silicon crystals, chips the size of millimeters (fractions of millimeters), contain several thousand transistors. Thousands upon thousands of such chips form the building blocks, upon which the cities are founded today, and, in the future, will be the houses. Electronically organised and administered cities, and houses, tron-houses, electronically controlled from the facade down to the garage, from the bathroom to the kitchen, will in the future form a conglomerate, an artificially intelligent ambient. Computers and fuzzy logic will assist in controlling these conglomerates, these tele-matic tron-houses and tron-cities. Cities and houses become ever more locked into the information network. They no longer communicate globally, but orbitally. A network of satellites will form a global intelligent ambient, such as orbitally extrapolated libraries, cinemas, shopping malls, universities. Whoever owns the monopoly on these orbital channels and info-nets, on these data highways, will be the ruler of a vast digital empire.

Peter Weibel: The city as chip, Computergraphik 1987

The speeded-up city, founded upon silicon crystals, consists of real and virtual spaces. The electrical cords, the electromagnetic waves and digital networks permeate every city. The virtual spaces of the electronic machines penetrate the material real spaces of the city. In each city there exists a virtual city, an urban digital shadow. It is precisely these electronic virtual spaces of the cities, where imaginary journeys are possible, which have become the true urban spaces. For we no longer live within the streets alone, but also within cable-channels and telegraph-wires, within fax-machines and the digital internet.

VI Technology: The Language of Absence

From the one common root, that is, the experience of want and need, and from a longing for a symbolic overcoming of absence, sprang the development of both language and technology. As a "language of absence" (S. Freud), technology continues the work begun by scripting. In the technical language of pictures, in the polytropism of electronic culture, which ranges from artificial intelligence to artificial images, the complexity of audiovisual language reaches a culmination appropriate to the complexity of a techno-society. The invention of writing, some 5000 years ago, was the first communications revolution, because here, for the first time ever, direct local communication, took place isochronously and isotopically. In other words, between individuals, who were living at the same time and in the same place, which had hitherto been the sole possibility of communication — was abandoned. The invention of the printing press represents the second communications revolution. Mass communication became possible. But the local universe of communication was breached quite early on, e.g., with the use of smoke-signals or drum-messages. But the media, by means of their almost universal penetration of space with the aid of electromagnetic waves (1887) have altogether transformed a multitude of local universes into a single universe of non-locality where, virtually speaking, anything can happen everywhere. The symbols of the third, the telematic communications revolution are far more immaterial and disembodied than the previous ones, on account of the separation between (material) messenger and (immaterial) message. Disembodied communications and machine communications became possible. In this way, the borderlines, between space and time were either compressed or expanded. Tool technology is the key to the mechanical evolution. We need technology for our survival. The more compressed space becomes, and the larger the population, the more necessary becomes an overlay and simulation of spaces, times and bodies, so that several objects and individuals can be present in one location simultaneously. Technology, therefore, needs to develop towards tele-technology, tools need to become tele-operators and tele-factors and society needs to change to a tele-technotronic civilisation. Equally, the tools used within the arts need to develop further, if they want to be among the strategies for survival.

We have moved closer than ever towards the idea that machines can think, i.e., process signs autonomously and to make sense of them, which has hitherto been considered a human privilege. Autonomous signs are indeed a sensational development within cultural history. No longer do human beings paint animals or other human beings onto the walls — now machines paint the autonomous signs. Symbol-processing machines, such as the computer, have turned the signs into autonomous agents. The art of the media shows us this new segment of the autonomous symbol-processing machine. The tool culture has entered a new phase, into the very own heart of the apparatus world.

Tools did not come into being before language, and language did not occur before tool development. Rather, both language and tools have a common origin in the human capacity for symbolisation. It is from this joint root that language and technology have evolved. In this respect, the technology of tools, particularly, of those tools, such as intelligent machines, that can autonomously process symbols, is the key to human evolution. Tool culture has always been symbol culture. Without symbols there is no storage potential, without storage or, respectively, memory, there is no experience. Writing was the first means of storage, the computer, for the time being, is the latest. With the help of written information, spatial and temporal distances could be bridged. Disembodied, dematerialised information could be shunted about in space and time.

In the electromagnetic age (J.C. Maxwell, 1873), signs travel at electronic speed, freely and autonomously. The signs of the third digital communications revolution are liberated from human beings and, with the aid of sign-automats, lead their own lives. The tools have emancipated themselves and are entering autonomous lives as symbol-processing machines. This rise of the tools brings to an end the (final) privilege and monopoly of human beings.

Peter Weibel: Hypothetische Produkte, Prodomo-Wien, 1994

VII Psycho-Techné, Prosthesis-Civilisation

The technical subordination of space and time also basically implies an overcoming of absence. The media are becoming a second, virtual body that never leaves human beings. As long as the television is running, as long as a telephone has breath to speak as a second mouth and as long as a photograph can raise the mirage of somebody's presence, that is how long humans can ban the fear and also the devastating consequences of an imaginary castration

complex. Technology helps to fill, symbolically, the deficiency generated by this absence and to overcome it psychologically.

All technology is tele-technology and serves to overcome spatial and temporal distance. But the overcoming of distance and time is only a phenomenological aspect of the (tele-) Media. However, the actual effect of the media is to avoid all those psychological disturbances, fears, control mechanisms, castration complexes etc. which have been brought about by spatial and temporal distance, and by all forms of absence, of being away, of being far off, of disappearing, of breaking off, of missing out, of losing, of withdrawal, of loss. That is, in overcoming distance (in all its forms) the media also allay the psychological disturbances caused by it. The technical media, by overcoming, or shutting out, the negative horizon of absence, become technologies of caring and of presence. In imagining that which is absent, and making it symbolically present, the media also transform the hurtful consequences of such an absence into pleasurable symptoms. In overcoming distance and duration, space and time, the media also overcome the horrors these categories exact on the psyche, i.e., the psychological defects and deficits of absence and insufficiency.

All forms of technology, therefore, are also therapeutic and prosthetic technologies. Whether we view them as extensions of the body (McLuhan) or as extinctions of the body (Baudrillard), technologies always deal in artificial organs, which help to liberate us from the prison of space and time. The technical prostheses, the artificial organs, increase insufficiently extant capabilities (such as accuracy of computation or range of voice: computer/telephone) or replace non-existent capabilities (from the wheelchair to the hearing aid). These technical prostheses become ever more complete through the artificial intelligence of the computer. The handicapped person, who, for a long time, has been living with the help of technical prostheses that substitute or make up for the physical functions he lacks, becomes a role model that throws new light on the aims of a technical civilisation. We may sit belted-up in a wheelchair, because we lack legs; this is a fact that clearly attracts our attention. But we also sit belted up in a car, because our legs are not fast enough. We sit belted up in an aeroplane, because we do not possess wings. We sit belted up in a boat, because we do not have fins. These are less noticeable shortcomings, because we have become accustomed to our natural limitations. But out of discontent and dissatisfaction we have developed tools and technologies, with which to overcome these deficiencies. Yet, intelligent products, intelligent ambients and the entire evolution of technology show us, that we are, in fact, at all times handicapped, without being aware of it.

Hegel's dream seems to have been fulfilled. But the intelligent beings, ironically, are not we ourselves as human beings, but our products: artificially intelligent entities. Even the intelligent universe is not the same that we inhabit, but one we will first have to create.

ANMERKUNGEN / ANNOTATIONS:

1 Leo Szillard, Zeitschrift für Physik. 1929, Nr. 53. S.840—856.

2 Siehe auch: Ezio Manzini, Artefacts. Vers une nouvelle écologie de l'environment artificiel. Centre Georges Pompidou. Paris 1990.

3 Peter Weibel, Virtuelle Architektur. In: Programmzeitschrift zum Steirischen Herbst, "Chaos", Graz 1989.

4 Ch.G. Langton (Hrg.). Artificial Life. Addison-Wesley, Redwood City. CA 1989.

5 Umbro Apollonio, Carlo Belloli (Hrg.). Leonardo Mosso. Programmierte Architektur. Studio di informazione estetica. Vanni Scheiwiller.

6 Folding in Architecture. Architectural Design, London 1993.

Peter Eisenhardt. Dan Kurt. Emergenz und Dynamik. Junghans Verlag, Cuxhaven 1993.

Die folgenden Aufsätze in "Arch +", 119—120. Aachen 1993

"Die Architektur des Ereignisses" sind besonders lesenswert: Peter Eisenman: "Die Entfaltung des Ereignisses", Sanford Kwinter: "Das Komplexe und das Singuläre". Peter Eisenhardt. Dan Kurth. Horst Stiehl: "Emergenz — die Entstehung von radikal Neuem".

Sanford Kwinter: "Landschaften des Wandels".

Ebenso die Nummer 111 "Vilém Flusser. Virtuelle Räume — Simultane Welten", 1992 und Nr. 121 von 1994 Die Architektur des KompIexen. Nr. 117 von 1993 "Rem Koolhaas — Die Entfaltung der Architektur". Nr. 108 von 1991 Fassaden". Nr. 109—110 von 1991 "Der Sprowl — Die Auflösung der Stadt in der Region.

7 Vilém Flusser, Vom Unterworfenen zum Entwerfen von Gewohnten. In: Arch+, Nr. 111, März 1992, S. 56—57.