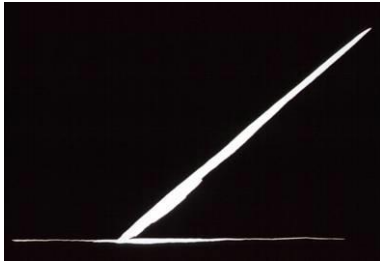


MOSCOW
IAN RITCHIE WORKS _ DESIGN & INNOVATION CULTURE
8 APRIL 2005

IAN RITCHIE

INTRODUCTION

Alba drawing



I believe that inspiration and innovation are important.

I hope to make evident the former by showing how innovation has been an inevitable product of inspiration through some of our work, built and unbuilt.

This drawing is a conceptual mark - at about 40 degrees to the horizontal - it can suggest many things:

- a line or plane that is falling to the earth
- a line or plane that is still rising from the earth
- a line that is searching for equilibrium, between levitas and gravitas
- a flash of light

Is it hot, or is it cold?

Peter Cook (with whom I share the Professorship of Architecture at The Royal Academy of Arts) made a remark to me a few years ago suggesting that he had perceived a tendency to angular forms in my recent architecture. I am not sure that this is so recent.

The first building I was fully responsible for designing was a house in France. It was built by me with the help of my girlfriend in 1976, and at the time I spoke very little French. It was largely prefabricated in Ireland.

Fluy House 1976-78



From the point of view of safety and buildability, it was easier to take the chimney through an elliptical hole in a sheet of toughened glass than through the insulated timber roof that was already finished. But it also served another purpose for me - it symbolised a break with Cartesian convention and my recent architectural education. Significantly, it also reflected my growing understanding of how to make and to construct.

This house was conceived as a well-insulated umbrella - allowing the occupants to be completely aware at all times of the changing weather and seasons. It harnesses the sun's energy, stores and redistributes it. The internal panels are made of compressed linen flax.

Vilém Flusser, the Czech-born philosopher, made a convincing argument in his short essay *The Factory*, that it is through 'the factory', by which he means the place of manufacture, that we, through pre-historians, can understand the science, politics, art and religion of the society of the time, and identify the human being. His sense of humour suggested that *homo faber* (maker) was perhaps a better description of the common characteristic of human beings rather than *homo sapiens sapiens*.

Eagle Rock House 1980-1981



So, the title of my talk *WORKS _DESIGN & INNOVATION CULTURE* reveals my office's exploration of the role of innovation with materials as a condition of an architect's existence.

The second half of the 20th century concluded with the fact that we have to fundamentally reinvestigate design to enable us, hopefully, to be effectively more intelligent in the way in which we negate the status quo. By this I mean that our very existence, as individuals and as a society dealing with our need to survive, changes the balance of nature.

The early reflections of *ecology to design* as a pragmatic search for a clean, green or eco-design methodology has in fact become an investigation into the problem of design in general. The shift from an *industrial reductive* to a *post-industrial holistic* design approach demands a complex inquiry. The new design methodology has to embrace social, political and philosophical criticism of design if we are to redefine design with any sense of value and meaning. The problem is vast, and finding appropriate methodologies that have a real synthetic approach will be difficult.

Opening up critical discussion of the role of design in a post-industrial ecological society can help move forward the paradigm in design thinking that is so necessary.

One action we could take for each and every design decision, independent of its apparent scale of impact, is to question its meaning and impact upon the quality of life on a global level. Of course we cannot expect to answer this with any scientific certainty, but the simple act of asking the question will help us to begin to develop a critical sense along with the new analytical tools and methodologies necessary to change the acts and products of design.

Eagle Rock House



This house was also largely self-built - but this time with students and staff from the Architectural Association in London.

I have previously written that the history of architecture, until the end of the twentieth century, can be viewed through the way builders, architects and engineers have allowed light to penetrate through walls and roofs.

First, they created small openings in masonry walls and roofs, and then they sealed them with small pieces of glass until the advent of industrial techniques in the 19th century when total glass enclosures were constructed. From this simple view of architectural history, its development could be described as the desire to master gravitas by levitas, the means to achieving this being the application of continual technical innovation - towards a 'lightness of architectural being'.

I have been involved in many architectural innovations in glass, stone and metal, and I now propose to explain, albeit briefly, some of them to you. To help you understand why they occurred I will highlight the origin of the concept and design intention.

I will NOT be able to communicate and explain all of the spatial and technical thinking and objectives that went into each project, for each project has been the subject of several lectures in themselves.

(Architectural concepts or intentions in italics)



I will start with *La Villette Cité des Sciences, Techniques et de l'Industrie 1981 to 1986* In collaboration with Peter Rice and Martin Francis, with whom I founded in Paris the design engineering firm of Rice Francis Ritchie, now known as RFR, we developed the world's first high performance toughened glass structural assembly. This originated *with my investigation into defining physical transparency*. President Mitterand had come to power in 1981 and his politic talked of a new open government. He termed this 'La Transparence'. The end result revolutionised suspended structural glass assemblies and created a new architectural aesthetic; *(It led to an architectural measles!)*. The transparent aesthetic was achieved by understanding the importance of its smallest element - the edges of the countersunk hole in the glass. This surface had to be free of imperfections to be able to transfer loads. The machining of these holes, and introducing a rotating bearing within the glass thickness into this hole, removed all bending forces into the glass panel, ensuring that any wind loads would be transferred vertically.

The idea of a transparent surface - one that you cannot see - has no sense unless the plane of that surface is defined. By making the point fixings flush, this plane was defined in space. The diaphanous glass surface acts as a stiff plane; the cable structure resisting the wind loads is allowed to deflect substantially; however, through non-linear analysis, the restorative energy within the structure ensured that deformation was not permanent. It was, to our knowledge in 1982, the first time that such non-linear analysis had been applied to 'solid' structures. This enabled the structure to be much lighter than conventional analysis would allow, and with vertical loads of up to 4000kg being transferred via individual holes, the whole design of these bioclimatic facades became synonymous with 'La Transparence'.

La Villette Science Cité Entrance Hall Roof 1981-86

Above the main entrance hall of La Villette Science Cité we set out to achieve a light-transmitting roof over while achieving the statutory maximum thermal air-to-air heat transmission - a value at the time of 0.6W/m²/K. In defining the light, we developed a relationship between the amount of light and the hierarchy of the structure. It began with the large rectangle of the roof (36 x 66m), divided into an approximate square, then an octagon that supported eight flying columns, and culminated in the rotating circular domes. The roof transmitted about 2.5% of incident light (cf 100.000 lux for a bright sky = 2,500lux at the inner surface), and consisted of an outer and inner layer of PTFE coated fibreglass and white thermal insulation (Fibair) with glass fibre strand reinforced Tedlar film as the vapour barrier.

The focus of the natural light composition are the two domes where the light levels are highest and where sunlight can be controlled by mirrors.

Robotic Mirrors 1983-86

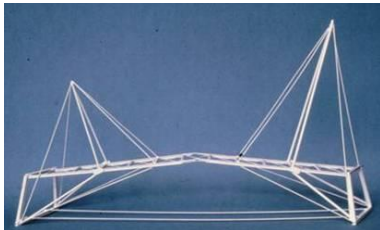


Whereas the fabric roof diffused light, the light was more and more controlled towards the centre of the roof. The domes contain computer controlled robotic mirrors. The central array is capable of both translation and rotation, while the outer arrays rotate only. The balance of the space incorporates conventional horizontal 'Venetian' blinds. A computer within the exhibition area of the central hall controlled the system. The public, under supervision, were invited to choose different programmes to see the effect of focussing, dispersing and parallel reflections of the sun's rays. They were also used at night to create special effects from projector sources.

The mirrors were made of Mylar tensioned within aluminium frames, and were driven by step motors.

Regrettably, many years later someone burned the programme cards when they accidentally connected the computer to 380V. To overcome the dispute, a new Director had the mirrors removed.

Lintas 1983-4



With our increasing knowledge of how to use glass, we proposed an all-glass bridge to Marc Held, the interior designer of this Advertising Agency. It is the first all-glass bridge, hovering above a courtyard in Paris and presented an audacious *image for advertising company*.

Louvre Pyramids and Sculpture Courts 1983 to 1993



We, as RFR, Arup and Ian Ritchie Architects, took design and engineering responsibility for several elements of the Louvre's renovation. First, in 1983, we were asked to erect a full-size mock-up of the main pyramid proposed by I M Pei. This was to demonstrate its scale and impact during the highly charged atmosphere surrounding Mitterrand's direct appointment of Pei, and his controversial proposal to place such an iconic image in the heart of the Louvre - the Louvre of Louis XIV, who said,

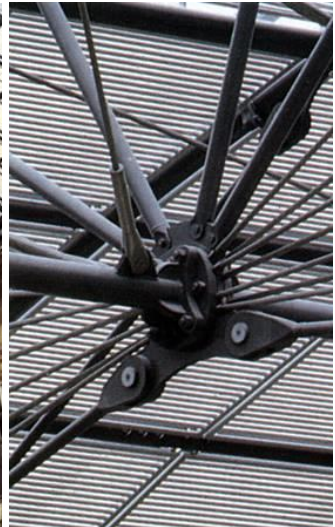
'The State - it is me!'

We made it from Kevlar, subsequently wrapped in pipework insulation because we could not see the lines against the sky.

Following this, we were asked to assess the engineering proposals of the pyramids. We responded positively to the engineering design approach of the Canadian engineer working with I M Pei, but we expressed doubts as to the glazing approach. The latter appeared rather heavy and inappropriate to Pei's conceptual objectives.

Subsequently, RFR re-engineered the structure to reduce the size of the joints and certain structural members, but we were not invited to revisit the design of the glazing.

Sculpture Court glazed roofs 1983-91



Following this we - Peter Rice of Arup and Ian Ritchie Architects - designed the three Sculpture Court glazed roofs. We decided that one of the central design ideas was to avoid casting sharp shadows of the roof structure upon the sculptures beneath. Among Jean d'Alembert's works (he was a philosopher and mathematician who co-wrote with Diderot the *Encyclopédie Universelle* ou *Dictionnaire raisonné des sciences, des arts et des métiers*), is a note about shadows and the nature of the punumbra that results from the distance the object is from the surface upon which the shadow is cast. This led us to determine that the largest dimension of any element of the structure should not be greater than 15cm across. This, combined with certain limits imposed upon us by the Government conservation experts - Batiment de France - including not being able to see any new roof from the Cour Napoléon meant that the structure had to be very shallow while still spanning up to 40 metres. Within the roof structure are hinged panels consisting of aluminium tubes that diffuse light and also create an 'invisible' acoustic absorbent surface.

Inverted Pyramid 1986-93



For this pyramid we used PPG's starphire low-iron glass - colourless - for the first time in France. The edges are cut and polished at 45 degrees to produce 'rainrods' - straight line spectra across the floor and walls. Again the inherent strength of toughened glass is used. However, the concept sought to further the notion of the chandelier - for this is essentially its purpose - to conduct light, this time natural light, and its special feature is the effect produced by the polished chamfered edges. The glass roof covering is independent of the pyramid structure.

Pearl of Dubai 1987



From the knowledge gained with Boussois on the bioclimatic facades at La Villette, we were able to develop the first structural fixing using only one leaf as the load carry element of a laminated glass pane. We named the technique the Phantom Glass Fixing.

We developed it specifically in response to the competition winning idea of constructing a 20m diameter 'Pearl' as a symbol/monument for Dubai. In the Gulf waters off Dubai were the richest pearl oyster beds in the world. There are now none left. The Pearl of Dubai sought to establish this memory. The Pearl is composed of a double curvature glass skin, whose surface, translucency, iridescence and "depth" we researched to re-create that ephemeral quality of lustre associated with pearls.

The spherical arabesque geometry of the glass panels and stainless steel structure is unique and was developed especially for the project. The "phantom" glass fixing enabled the structure and glass skin to move independently from each other in the harsh environment of the Middle East, while ensuring that the external surface had no visible metal. Prototypes of doubly curved glass and the phantom fixing were fabricated and tested and shipped to Dubai. (*water and pearl surfaces*).

The project was never built.

Terrasson 1993



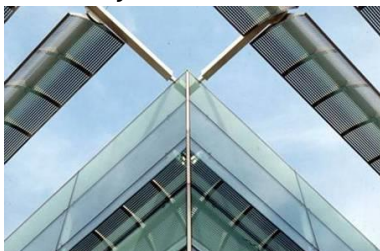
Later, we successfully applied this principle in 1993 for the roof of the *Terrasson Cultural Greenhouse*

The Ecology Gallery 1989



This was the first application of both a low-iron glass and of using structural glue only to hold up a glass wall in a public building. Low-iron glass was developed in the 1970's to improve solar transmission glass as a covering for photo-voltaic cells, and had been made between 2-4mm thick. We wanted a white, crystalline and fragile quality to the entrance route to this exhibition. To help convey the fragile nature we decided to experiment with the idea of using structural glue - one that cures with UV light. This application of (*a physical manifestation of the idea of a fragile environment*)

B8 Stockley Park



We knew that Pilkington had been impressed by our work at La Villette, and they had marketed their Planar system from around the same time. Although our system was far superior in structural performance, the Pilkington Planar system being capable of 700kg per fixing, it was more economic and was being very well marketed.

At our invitation, in 1989, we suggested developing a double glazed version, and we had a project in London which we felt would be suitable. Pilkington responded very positively, and an elegant double glazed flush structural glass fixing was produced and installed. Our client gave us 52 weeks from the first briefing to deliver the constructed office building of 9,000m². To innovate within this time frame was a challenge - but one I felt sure would be of benefit to all. It was also the most extensive application at the time of a low-emissivity coating. This enabled the building entirely of glass facades to perform thermally far better than the then current building regulations' requirements, while its facades remained entirely of glass. (*technical performance*)

Reina Sofia, Madrid



In 1991, we used glass used to transfer wind load at the corner of the building through the glass edges (*transparency achieved through emptiness of the corner*). We had a strong desire to conceive the lift towers as the antithesis of the heavy stone ex-prison hospital building - with its caged windows. We also set out to capture the essence of hope and liberty contained in Picasso's painting, Guernica. This painting was destined to be housed in this new modern art museum, and in many more ways we drew upon its visual qualities to compose the lift towers of planes - with only the suspension rods of the glazing structure as reminders of the prison bars being pulled apart, made of non-flat material.

Bermondsey Station 1992



We designed the first public glass seat for London Underground at Bermondsey Station.

(*lightness in darkness - levitas in gravitas*)

They consist of two sheets of untoughened glass.

Leipzig Glashalle 1994, Germany



This is the 25,000m² entrance hall for the Leipzig International Exhibition Centre. A spectacular and enormous glass hall, over 250m long with a clear span of 78m which incorporates the first combination of an extruded silicone/liquid silicone glass to glass jointing; the first installation of inclined toughened glass fire escape doors; and two cleaning robots developed by the Fraunhofer Institute in Magdeburg. (*Maintaining architectural form, and by default overcoming Din Standards*).

The in-plane and out-of-plane behaviour of the grid shell led us to allow the grid shell to move relative to the stiff glass vault by means of having only one fixed point between each glass sheet and the shell. This geometric suspension, together with the principles of the design of the stainless steel glass suspension assemblies allowing movement has been subsequently patented by one of the two companies that formed the joint-venture contractor that built the glass hall. The principles of this were defined and drawn by us before either company was involved, and were included in the tender documentation, and as result, the other company challenged the right to the patent. We were embroiled in a legal battle that has since been satisfactorily resolved.

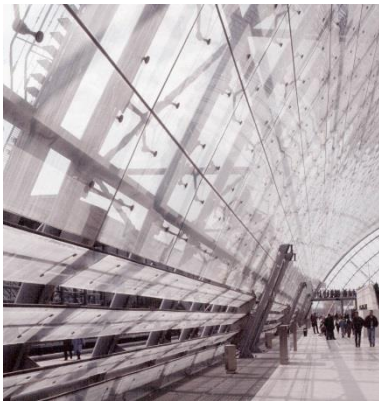
The non-structural waterproof jointing system developed with Dow Corning enabled the entire sealing operation to take place externally using the maintenance cradles.

These cradles suspend the cleaning robots.

Cleaning robot



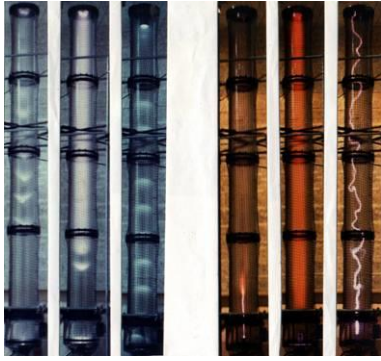
Inclined fire escape doors



The glass fire doors are inclined. We were informed that these would not meet the German Din standards for escape doors. Through early design, prototype fabrication and testing we saw them successfully incorporated into the building, thus maintaining the form of the barrel vault.

The entire barrel vault structure is uniform, with lateral stiffness provided by the arches every 25m along its length.. We designed the entire vault structure without expansion joints - the structure being supported on bridge bearings every 3.125m along its length. The end walls, each 5,000m² in area are free standing cantilevers which enabled us to keep the vault structure simple and standardised.

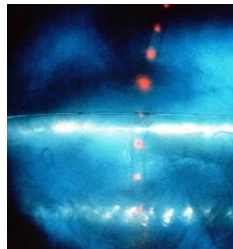
3D visible light forms 1985



The first creation of controlled 3D visible light forms, with J-L Lhermitte and François Bastien at the EDF laboratories in Clamart, France; (*desire*). I was interested in lightning as a boy, and had been made aware of Dennis Gabor's inventions, including the high pressure quartz mercury lamp in 1927 and since used in millions of street lamps; and holographic microscope research at Imperial College, London, in the late 1940s. Research in these fields led to the development of Lasers. Why try to make 3D light forms from electrical discharge? The interest was triggered by the La Villette Facades, and a desire to see them 'occupied'.

The theme developed around the idea of natural phenomena - from untamed energy and untamed landscape. The idea of lightning inside a glass box was intriguing. It led to research by Jean-Louis Lhermitte (artist) and Francois Bastien (physicist) in France and a visit I made to the Atomic Energy Authority laboratories in England. There, I had been convinced that high discharge energy could be manipulated to create forms. We proposed a research programme to the French Government via La Villette. Three months work proved successful. Lines, balls and rings were produced from a 20,000 volt charge.

Spheriscope 1984 / Stephen Hawking Spacetime Centre 1999



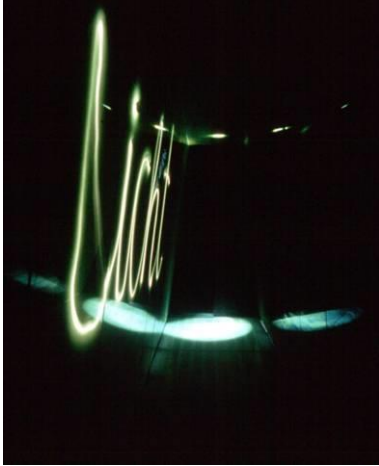
This project began in 1984 at the invitation of the then Director of the National Maritime Museum, Dr Neil Cossons (now Chairman of English Heritage). He wanted the top of the hill, the Royal Greenwich Observatory to be brought into the late 20th century. We proposed a radically new planetarium to replace a small existing one.

The radical aspect was the idea of a full spherical projection of the star field and planets to achieve an experience of being in space, rather than simply looking up at the 'sky'. This involved researching how to spherically project the night sky. This included investigating vector video projection; computer simulated projection and doubling conventional optical projection systems. The lights in the space are on and the floor appears solid when people, wearing space slippers, enter the spheriscope. As the lights dim and the night sky appears the glass floor becomes transparent and people sense space all around - above and below. The glass is laminated and incorporates a liquid crystal film.

Externally, the glass sphere is illuminated using diode arrays - the first blue diodes we received from Japan in 1984 - and were arranged to represent the high energy using areas of the world - and to outline the earth's oceans.

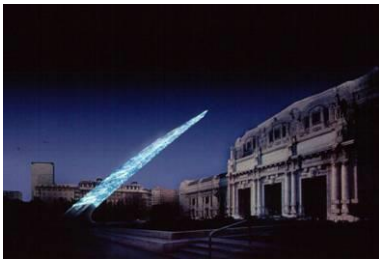
(*Collective virtual reality*).

Light Memory Tunnel 1992



This project was undertaken with Pilkington and was the first installation of a light memory coated glass structure, erected within a castle, as part of Ingolstadt's international garden festival. The idea was to create an interactive exhibit where people's desire to mark territory is amusingly produced by an automatic response - a flash of light leaving the footprints of the visitor on the floor; and by the visitor personally writing messages or drawing on the walls with the light pens suspended in the space. There is not much value of such coatings on glass other than for exhibitions, and possibly for applying as a partial frit to glass fire escape doors. They would glow in the dark and maybe seen through smoke. (*research, inter-active short life graffiti*)

Alba di Milano 2000



This project was the result of winning an open international competition that produced more than 700 entries from all over the world. The design concept was based upon the weaving together of randomly fractured optic fibres (warp) and stainless steel wire (weft) to create a floating 'cloth of light'. The proposal symbolised our telecommunicating society where the centre of power is no longer evident. It was inaugurated in Milan in January 2001. (*light / poetry*)



The light source consisted of mercury halide projectors and the changing colours produced by rotating dichroic coated glass discs.

Its position in front of the baroque main railway station was disliked by a senior Italian politician in charge of culture. In his opinion it blocked the view of the station. It now lies disassembled in a warehouse.

Dublin Monument 1999-2002



This project was also won through an open international competition, a month before Alba di Milano. We called it the Spire of Light. Irish humorists have other names for it. It is now known as The Spire.

Our aim was to capture the ever-changing light in the skies over Dublin, and to create a form that gave a sense of optimism to the Irish people.

To capture the light we went upwards 120m towards the clouds, and used the technique of shot-peening to both harden the stainless steel shell structure and to give its surface a soft reflective quality. It is this surface which changes with the light, and even the velvet black of the night is visible on it.

At its tip we were obliged to provide an aviation warning light. The perceived quality of this specific light at its apex is crucial for it to be a successful national monument. The aviation authorities required a continuous light output of 2000 candelas (lux) on a horizontal plane (+2 and -1 degree about the horizontal plane, through 360 degrees). This was quite demanding given the form of the Spire's top. The Spire is a cone, 3m in diameter at its base and tapering to just 15cm at the top.

We asked Hewlett Packard and Phillips to develop a diode-based system to achieve this, and the design of the white diodes took 3 years to reach the consistency required. The additional lighting of the top ten metres of the Spire is not as bright, and is also based on diodes. The system will not require replacement for about 15 years. (*light from the sky to become an urban point*)

London Regatta Centre s.s. Roof 1997-2000



There are two innovations in this project. One is architectural and the other a piece of rowing equipment. We designed with Arup a stiffened catenary roof using 4mm flat stainless steel sheet. This realised a desire to make use of sheet metal structurally without it having to be industrially preformed into a profiled and hence stiffer material. (*more with less*). We had developed this idea earlier for a factory in Germany, a competition we won but was never executed - the client decided to go by a factory in the Czech Republic. The sports equipment is a dynamic rowing machine. This is a pool within which is placed the fixed seating and the water is driven to simulate the effect of actually rowing. It is designed

for two speeds of water flow.

High Voltage Pylons for Electricité de France 1994-2000



This international competition win for a new generation of 'aesthetic' pylons was based upon our analysis of the relationship of infrastructures and landscape, particularly its topology. Their form also resulted from a desire to reject the industrial aesthetic of 'the diagonal line'. The aesthetic issues raised are profound, and I spent a great deal of time investigating the meaning of progress today, the fundamental grammar(s) used in aesthetic expression, and its manifestation in formal design language. They are complex engineered steel shell structures that are subjected to quite severe loading conditions.

The design to prototype and successful testing took 5 years. The first four pylons were erected either side of the Rhone river in the south of France. (*form follows desire and function*).

France-Japan Communications Monument 1987



loads by titanium

Designed in 1987 as a competition entry (final shortlist of 4 projects); it is composed of a 365m diameter and 10 m wide ovoid structural ring clad in woven titanium wire (weighing approximately 200 tonnes). Its publicly accessible interior houses the 'generateur poietic', (approximately 200 tonnes of installed screen, cabling and people loads). The monument is levitated off the ground by 15m² of supermagnets, and restrained against wind rods back to the foundations that anchor the magnets.

This monument is a metaphor for how we relate to our planet, and how we transmit information and try to communicate as a global society. The software of the 'generateur poietic' was developed by Olivier Auber in 1986. The project did not come to fruition - perhaps a symbol of our times!

(Levitas - literally).

Plymouth Theatre Royal Woven Phosphor Bronze Cladding 1999-2002



I have been concerned with the fact that most 20th century buildings were not very tactile. This is because so many of them are made of metal and glass. Leaning against steel columns and glass walls is not a natural reaction. Architects and Engineers need to assess whether they are taking account of all our senses, and not just our sight.

The walls of the rehearsal spaces facing the river are wrapped in phosphor bronze, and these are soft -designed to be leant against, stroked and to change colour and patina with time. They need no maintenance. (*return to sensuality*). The phosphor bronze cloth is woven of 0.3mm wire - and although water can penetrate, the geotextile behind acts as a collector and the water drains out at the base of the walls.

Terrasson Cultural Greenhouse 1993-95



The first cantilevered 'gabion walls' (7m high) in Terrasson, France.

(modernity in visual relationship to history; unprocessed, tactile, ecological walls in contrast to a sophisticated, highly processed glass roof). (Not seen as a building - more a wall and a lake).

The idea of using gabions came from the steep slope of the site (30 deg.) and the obvious need to retain the soil for the 5 hectare landscaped gardens. It seemed to be appropriate to use them as walls because of their high thermal mass, and the fact that some of the interstices would over time support plants and nesting opportunities. Our use of gabions elevated this humble civil engineering product of steel mesh caged stone to the status of an 'architectural aesthetic'.

Like fashion, many architects are now using them, sometimes in the most perverse places. We have continued to develop this technique, and two other projects exploited new design approaches.

Royal Opera House, Tower Bridge, London 1995



The challenge - build a 2,350 seat opera house for £10m. Faced with this, one's thinking starts not with architecture. The walls, made of sheet piling, were faced with gabion. However, we sought to create a horizontal 'pillow' effect and achieved this using cables periodically anchored through to the sheet piling inner structure, and a stainless steel mesh. Windows were deep 'punched' holes, reminiscent of the Tower of London directly across the river. The inner auditorium was also made of 2 steel profiles, with bronze fixings. *(elevating very low-cost basic industrial products to architecture).*

The acoustic space of the auditorium was conceived as a unity - with no balconies or floors connected to the walls. This simplified construction while creating a spatial tension between enclosure and auditorium.

London Regatta Centre gabion walls, Royal Albert Dock, London 1997-2000



Here, the design creates a vertical 'pillow' effect. The site, great expanses of water and dock edge, informed an architectural concept that required having a strong physical 'presence' to what would normally be a metal or timber shed. (*walls as visual strength in an open landscape*)

Crystal Palace Concert Platform 1997



With Paul Gillieron, acoustic designer, we integrated an "active acoustic system" outdoors for the first time. (*non-visual performance, more than just visual*). This system is based upon sound energy being picked up by microphones and processed through a computer and the sound returned instantaneously to the performer via speakers housed within the shell structure.

This system enables, for example a concert pianist to 'feel' as if he is performing in a great concert hall; a choir to feel inside a cathedral or a jazz musician to be in a 'club atmosphere. This building has been designed with little or no maintenance. It is entirely made of Corten A steel - a naturally rusting material that stabilises after a few months.

A final two examples concern habitable space.

Roy Square, The Watergarden



Designed nearly twenty years ago, this residential scheme of 80 apartments is located in Limehouse, east London. It set an urban dimension by its form and scale. It creates a landscaped sanctuary in an area of urban dereliction. This semi-private garden is in addition to the private balconies, greenhouses and roof terraces. It provides a sense of shared space and community. It was designed for the private sector, but was first occupied by local council residents when their tower block was demolished to make way for a major underground road. The apartments were subsequently sold to owner occupiers.



This project, won in a competition in 1998, set out to define key issues facing urban housing at the dawn of the 21st century. We presented a paper on the human senses, and how architecture must respond to them. If we do not, then we are designing as if we are part robot. The spatial development was the idea of the 'outdoor' covered and wind protected room - not in front of the living room, but as part of the entry threshold, an extension to the kitchen and an extension to the bedroom. I believe that this type of space, of some 10-12m² is absolutely essential to civilised living if we are to concentrate people more and more within our cities. We cannot afford to make the mistakes of 50 years ago when we built so fast, so cheaply that we produced endless territories of soulless environments, and apartments without such spaces.

A significant fact about most of the above innovations is that they all had to meet stringent construction codes for safety.

I would like to believe that some of these innovations have been valuable to architecture, and that as an architect, it is still possible to have a direct input into industrial innovation.

If we cannot innovate, we die.

WHAT IS THE RELATIONSHIP BETWEEN ARCHITECTURE AND INDUSTRIAL INNOVATION?

Superthin glass and holes + fly

Reflecting upon this relationship throughout my career, has given me an insight into architecture and society, and a better understanding of the manner in which we build. This relates directly to Vilém Flusser's observations - the artefacts that we make and leave behind, and the marks that they have made upon the landscape.

Understanding the context is the first investigation of architecture.

The context is physical, intellectual and sensual.

The architectural process and architecture itself is synthesis, not separation - the synthesis of ideas, of people, of materials and ultimately should give us a sense of the degree of man's union with nature.

Creativity and innovation in architecture works through the investigation of memory and the way buildings can be constructed.

These investigations take place with both a sense of freedom and discipline.

A blank sheet paralyses creativity; it is the context (or parts of it) that acts as the conceptual trigger to creative freedom. The context also imparts the discipline through the architects' response to it.

Historically, towns and cities have always conveyed a sense of gravitas through their architectures.

Gravitas in architecture reveals a sense of belonging to the earth, of connection and of foundation. Gravitas recognises the idea of captivity, of being attached to the earth.

Levitas is about being above the earth.

Levitas recognises the idea of freedom.

Levitas suggests an inclination towards lightness. Lightness is fundamentally about the essential. Lightness is an exercise in reductivism - of the problem, of the concept, of the design, of the structure, of the materials.

Spiders web

Superfluosity is an anathema to lightness.

Lightness tends towards minimalism, not necessarily transparency.

Levitas should not be confused with transparency.

Transparency is about a feeling, of openness, or of emptiness.

Symbolically, lightness suggests a victory over gravitas, even gravity.

This search for architectural levitas has been the force behind much of the construction industry's innovations.

In individual buildings, the tension between gravitas and levitas is not equal, but can symbolize the degree of connectedness of the one to the other.

This tension has also been at the heart of technological innovation in building.

I would also suggest that this tension lies at the heart of differences between those that advocate traditional architecture in the west, and those that search for contemporary solutions.

The improvements in materials have been based upon one single objective - to be able to better predict their performance, thereby improving performance and reducing costs.

Timber, steel and concrete are still the predominant frame materials of structures today.

With the domination of the frame came the innovation of the infill. During the twentieth century, and in particular during the past two decades, glass has become the dominant material of building façades, replacing the "punched holes" in masonry.

Glass in architectural façades can be used to embody and convey our present ideas about our union with nature (ecology), our attitudes towards society (surveillance), as well as our notions of both gravitas and levitas, and transparency.

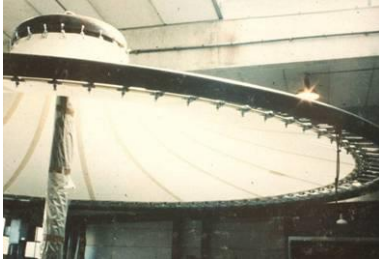
WHO INSTIGATES INDUSTRIAL INNOVATION?

Pylons



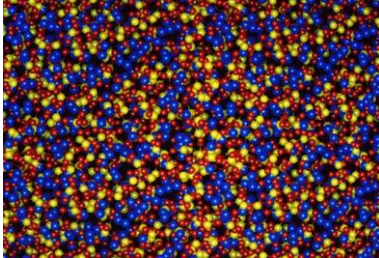
It is rarely an architect. Architects are generally too far removed from industry, and as such industry simply does not have sufficient confidence in architects. Architects are rarely industrialists. In fact, since the creation of a professional apartheid of architects and civil/structural engineers during the 19th century, architects have ceased to be at the forefront of constructional innovation. Innovation has been largely led by industrial entrepreneurs with an engineering background, such as Eiffel, and engineers, such as Freyssinet (pre-stressed concrete). Even some of the more spectacular spatial explorations and innovations can be seen to have come from engineers who also practised as "architects" - Owen Williams, Candela, Nervi, Otto, and Calatrava today.

For architects to have an influence on constructional developments, their ability to collaborate is a precondition. The fact that architects, engineers and the construction industry are using the same, or compatible computer programmes, suggests that this collaboration could be easier than it has been.



To develop a new structural fabric material would inevitable require research either directly with industry, or at a research institution, or collaboratively between both. In 1983, I had been successful in bringing together three industries, (two French & one Belgian) to produce a 50% light transmitting permanent structural fabric.

Molecular simulation of glass © Professor Greaves



In 1994, when I read about nano-composite research work being undertaken on "ormocers" (organically modified ceramics) in Saarbrücken, I was reminded of previous articles I had read in New Scientist about nanotechnology and I wondered if it could be possible to dope glass at the molecular level to overcome the inherent inability of glass to resist crack propagation, while retaining the optical properties and essential surface qualities which we associate with glass. This seemed to me a far more interesting line of research than one based upon further exploration of laminating transparent plastics with glass.

So far, exploratory discussions with different glass industries of the dream of a new glass material, and the need to develop it, have yielded nothing. Yet one is sure that this industry should be interested, and maybe some are secretly researching it as I talk. As an architect it is too often the case that one's credentials and ideas are not those that industry will accept. The alternative is academia, and the specialist research institutes. Here, there are several involved in new materials, but collaborating with them is constrained either by budgets and existing programme commitments, or by secrecy, a quite reasonable precondition of the research contract when they are being financed by a particular industry. Convincing people to finance new scientific/industrial ideas, is a very difficult one to crack for an architect - but it can happen.

WHAT ARE THE CHARACTERISTIC CONDITIONS FOR INDUSTRIAL INNOVATION?

Leipzig Concept Drawing 1993



One presumes that the most significant agents of change are the individuals on the Boards of the industrial companies. It is they who confirm R&D policy, not just in product research, but also with regard to the education and development of those people who work within the company, and those who supply the company with products and services.

I would also suggest that an innovation culture exists within the company, and that it does not reside solely in the Boardroom.

However, in my experience of the construction industry, there are far too few companies that have this culture.

WHAT ARE THE KEY INGREDIENTS OF AN INNOVATION CULTURE?

2001 A Space Odyssey (© Kubrick)

Crucial to this culture are confidence, skill, judgement, understanding, and notably foresight - a sort of early warning system for the next 10 to 20 years.

A company structure that incorporates foresight thinking as an integral and shared part of its operations builds in the recognition and potential to innovate, and to survive.

The most difficult commodity to introduce into companies is the recognition of the importance of thinking ahead. This means making available both time and money to think ahead. Everyone everywhere seems to be fully occupied with the pragmatic issues of the present.

The most difficult attitude to get rid of within companies is the belief that holding onto information is to the benefit of the company. It is a notion that should be consigned to history.

Sharing information is neither dangerous nor detrimental to companies.

Sharing information is essential if we are to help create a better world.

It is what we do with the information that will differentiate companies more and more.

It will reveal those companies that are better able to manage change, to innovate and to be successful.

Innovation is not only evidenced through products, but also in the way information is applied throughout the process.

I have not attempted to identify differences between incremental innovation or quantum leap innovations. In architecture and construction, few companies will pioneer, (the risk of arrows in your back) because it is often felt that the financial risks are too high, or the source of the financing of the development dictates that the risk shall not be taken.

As we all know, architecture can be read as a record of technological change and innovation.

Technologies do get supplanted: timber - cast iron - steel - reinforced concrete - fibre structures - polymers etc.

Architecture - or rather the construction of buildings - has nearly always been produced from man handleable components.

However, for more than a hundred years, new construction components have got bigger and bigger to such an extent that the “hand” has lost its primary role to the machine, and the machine in due course will lose its role to the robot. This has led to the alienation of much contemporary architecture.

Also, the component is becoming more and more standardised - whether it is the humble brick or the most sophisticated 3D knitted titanium fabric.

In the future, the art of architectural composition will probably be measured by the designer’s ability to innovate using standardised components or standardised processes.

Condensation - finger trace on glass

I would like to quote from my erstwhile friend, Peter Rice, an engineer:

“To build quickly we must standardise. We must use industrial techniques. Components become industrial elements that are used and re-used to create giant façades. Similar buildings multiply over the landscape and the building components dominate the architecture and the growth and power of technology is given the blame. To counteract this architects and designers have returned to the forms and images of old. But to do this is to miss the point and the problem. What is needed is something that returns the human scale and human involvement to buildings. It is the feeling that people are unimportant when compared to the industrial processes which is so damaging. The Victorians succeeded where we do not.”

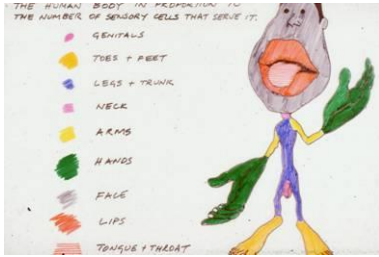
Peter wanted to reveal “La trace de la main”.

Innovation is recognisable as individuality, and the means available to us through computers to be innovative have never been stronger.

It is a question of attitude. One can use computers creatively to design, to analyse, to fabricate. If we do not innovate, we stagnate.

CONCLUSION

Cartoon of human sensory distribution



We have to find ways to bring back our senses, our bodies, back into the centre stage of design thinking. This is a first step in our desire to have the process of design working towards a better union with nature.

**TOUCHING SOMETHING CONVINCES US OF ITS EXISTENCE
ARCHITECTURE ONLY COMES ALIVE WHEN YOU ARE ACTUALLY THERE
AND
YOU FEEL IT THROUGH YOUR EYES, YOUR NOSE,
YOUR FEET...**

**HOW CAN AN ARCHITECT DESIGNING ON A COMPUTER
SCREEN FEEL THE ARCHITECTURE HE IS CREATING ?**

WE ARE LIVING MORE AND MORE IN THE IMAGINARY WORLD OF THE SCREEN

**THE SCREEN WORLD WE ALL LIVE IN IS DISTANCING US
FROM THE SENSORY WORLD**

**IMAGES HAVE NEVER BEFORE HAD SUCH POTENTIAL TO CONTAIN SO MUCH
INFORMATION**

**BUT AT THE SAME TIME THEY HAVE NEVER HAD SUCH POTENTIAL TO CONTAIN
DISINFORMATION**

THE LINE BETWEEN FACT AND FICTION IS DISAPPEARING

**WE HAVE TO DISTINGUISH NOT ONLY BETWEEN FACT AND FICTION BUT ALSO
BETWEEN COMMUNICATION AND DISCOURSE**

Since the industrial revolution, maintenance has dictated the environment we experience. We have to recognise in our current design thinking that we are creating the need for long-term maintenance.

I know that the only way forward to develop better results is to work closely with industry at all stages of manufacture, and to understand the fundamental nature of the material. Most architects are not interested in the fundamental process by which this can be achieved. Architects are concerned primarily with what products are available on the market (and accept the manufacturer's data about their performance), how much they cost per square metre, and how best they can serve both the aesthetic and environmental standards, including safety, for their designs.

One aspect that is less well documented is how architects can work better with:

- those companies which produce the glass, timber, masonry and metal products for buildings;
- those companies which process these materials into the components;
- those companies who undertake the installation, and
- those companies who produce or use the maintenance systems necessary for keeping the design looking as it did on the first day it was completed.

Chameleon

I am concerned about how, as architects and engineers, we can contribute positively to the future, and in the context of materials, this leads inexorably to thinking about new products and how to obtain a higher technical performance from these materials, and to imagine synthesising these improved technical performances with new aesthetics.

We are not at the dawn of another renaissance, but in the stream of a continuous technical evolution where we have the opportunity through the intelligent synthesis of art, nature and technology to make decoration performance and performance decoration; and where dynamic behaviour is understood as a fundamental characteristic of materials and constructions.

WHAT IS THE COLOUR OF THE WIND?

As history has shown us, it is through our imagination, unhindered but informed, that we will improve architecture.

It is also through cooperation and collaboration that we can become better informed, and our imaginations better nurtured.

I believe that innovation that has lasting value can come from the dreams of architects.

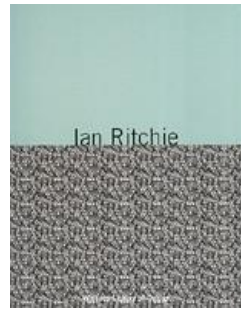
I have always tried, through using innovation, to achieve a poetic quality within the work.

We may feel that we are up against a well-designed wall in the sense that our design actions dictated by the question 'Will it attract the customer?'

We have to look beyond the consumer society to one that is characterised by sensitivity, intelligence and collaboration.

"I have spent much time on a new interest; the future of our industrial civilisation. I became more and more convinced that a serious mismatch has developed between technology and our social institutions, and that inventive minds ought to consider social inventions as their first priority. This conviction has found expression in three books, *Inventing the Future*, 1963, *Innovations*, 1970, and *The Mature Society*, 1972. Though I still have much unfinished technological work on my hands, I consider this as my first priority in my remaining years." Dennis Gabor 1971, from his autobiography, after receiving the Nobel Prize for Physics.

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I hope that I have succeeded in conveying to you how our work, in close collaboration with others, is not innovation for the sake of it, but is derived from a profound desire to improve our built environment and to stimulate ideas for advancing architecture in the service of society. I have always hoped that through this approach to produce beautiful spaces and structures, and to try and do so more intelligently and not with a simple end game of satisfying personal egos or publicity.