Going Public

Science museums, debate and democracy

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TEN YEARS LATER, A PROLOGUE.

It is now ten years since I wrote this paper, which was included in a collection of essays resulting from a professional seminar I organised with the support of UNESCO and the European Union at the National Technical Museum in Prague. The meeting was entitled 'Planning Science Museums for the new Europe'. The Berlin Wall had come down, the Velvet Revolution was past, and the collapse of the Soviet Union imminent. It was clear that museums in the former Warsaw Pact countries were looking for ways to renew their museums, and to make them relevant to new audiences with new interests. It was equally clear that they had to take on a new role. In the years under Soviet influence, museum-going had been part of the obligatory curriculum – and many saw museums as part of the State's heavy-handed ideological machinery. With new opportunities to exercise their autonomy, it seemed important to discuss the ways in which museums – and other institutions of informal learning – were in the position to support the acquisition of the skills of citizenship, in the broadest and most activist sense.

At the same time, the museum world in Europe and America was at a turning point. After the initial enthusiasm for interactive science centres, mostly unsuccessful

copies of the San Francisco Exploratorium, many museum thinkers had called into question the ways in which underlying assumptions about the scientific and educational agenda had remained deeply traditional. The term ‘edutainment was just coming into vogue, Disney was looking at the possibility of putting science centres in shopping malls, and museum directors were being exhorted to think of their visitors as ‘clients’. Above all, the same interests that had always controlled the educational agenda were still largely in control, and the underlying messages that were being communicated were still largely the same – science was good for you, and questioning scientific progress was next to heresy. Museums in Europe and America – like their counterparts in the former Soviet countries – were seen as part of the machinery used to convey the dominant ideology.

The paper below was an attempt to look at the ways in which one could make museums – and the interests within them – more transparent, and thus transform them into places for debate and discussion.

Rather than trying to update the essay with the benefit of ten years experience, I have chosen to leave it intact, a witness to its own time, and to a specific time in the development of my own ideas. Following the essay I will continue by describing a series of experiments conducted since the essay was written, and argue for a rethinking of our approaches to museums as sites for informal learning.

GOING PUBLIC: SCIENCE MUSEUMS, DEBATE AND DEMOCRACY

In the latter part of the twentieth century, museums in general, and science museums in particular find themselves in a unique position. Whereas until just prior to the second war, museums, if anything, were considered the exclusive domain of an educated and largely privileged elite, events since the 1950s have contrived to make museums one of the last truly public spaces in our society. How has this transformation come about?

On the one hand, there has been an increasing pressure to make the museum experience open to the broadest spectrum of the public.

The first seeds for this transformation were sown in the turbulent decades prior to the French Revolution, when the call for a broad and democratic participation in the cultural capital was a radical demand on the part of representatives of the disenfranchised. France's first modern museums, the Museum de l'histoire naturelle

and Conservatoire des Arts et Metiers were direct products of the Revolutionary government of 1793. Yet, as in the case of the earlier American Revolution, the benefits of the dispersion of the cultural and economic capital devolved largely onto the middle classes, and the lower strata of society, while able to participate in principle, were effectively denied access to the machinery of capital and culture alike. Large segments of society had to wait another century for even the limited benefits of public education, reduced working hours and wages sufficient to permit access to the great palaces of culture.

In the early part of the 20th century, museum studies in US in the first decades of century became concerned with visitor, her experience and her understanding. Soon after the 1939 New York world's fair, the idea of storyline, the idea that every exhibition should have an internal narrative coherence, began to dominate museum planning, championed by designers on behalf of a public it contended needed mediation/interpretation. Curators alone, it was said, were unable to communicate their specialist knowledge to the new museum public.

In the 30s and then again in the 60s, social turbulence and intense debate, not so different than the debates of the Convention in 1793, brought with them demands for a broader diffusion of cultural, social and economic benefits. Museums, and the objects they contained were seen to be far from open to huge numbers of the general population; the working classes, rural inhabitants, women. In the case of a museum like the Centre Georges Pompidou in Paris, for example, the planning brief explicitly called for an institution whose visitor profile would match that of the French population: if France had 4% of its people working on farms, the Pompidou would have among its visitors 4% farmers.

Science museums in particular have been accused of remaining the preserve of the educated few, and the early decades of this century saw new museums of science designed to break down traditional barriers to participation, such as the new Deutsches Museum in Munich (1925), le Palais de la Decouverte in Paris (1937) and the Chicago Museum of Science and Technology (1939). These attempts, many cut short by the second World War, were resumed in the 60s and 70s, and found expression in science centres dedicated to communicating the principles of science in an engaging and tactile form; "hands-on science". The San Francisco Exploratorium, the Ontario Science Centre and the Cité de la Science et de l'Industrie, along with their many admirers worldwide attest to the vigour of the movement on the part of museum professionals away from an object-based museum

experience towards new methods of ensuring an increased accessibility of scientific and technological culture to a broader public.

Since the 60s, the idea that science should be communicated to a broad and diverse public has been largely unchallenged, and a new generation of museum professionals: the evaluators, whose goal is to increase the effectiveness with which museums reach target publics, now criticise the design community for being unable to communicate effectively. The social and political imperatives of training the next generation of scientists, of combating widespread ignorance of science and preparing the public to accept technological change have fuelled the move to reach the widest possible spectrum of the public with science information. Travelling exhibitions, new science centres (over 200 in the US), science networks and science theatre have been used to great effect. Increasingly important among the political aims of science education is the need for the public to understand contemporary science and technology, and to be able to participate in debate about the implications of its use. The need for this debate is evident with regards to the rapid technological change of the past 4 decades: computer technology, nuclear power, environmental pollution, the depletion of the ozone layer and genetic engineering

On the other hand, and in contrast to the very public debate about access to scientific information, genuine public spaces have all but disappeared from the life of most western societies.

This transformation is much harder to situate historically, and insofar as it is comparatively recent, it has largely escaped notice. The erasure of public places can perhaps be said to date from the widespread introduction of the automobile in the early decades of the century. The automobile demanded a new infrastructure of roads, created the possibility of new dispersed suburban communities, and changed the character of existing urban spaces. The car has made discussions while standing in the street difficult and dangerous, and public squares are either dominated by the automobile or rendered lifeless by artificial pedestrian zones. The loss of the wide sidewalk to road widening in the 50s and the corresponding loss of social activity in the street was documented as early as the 1950s by Jane Jacobs in the *Death and Life of American Cities*. As a consequence, the public life of the sidewalk evaporated, and the spaces once home to thousands of interactions became empty, or worse, dangerous.

Other technological advances of the twentieth century further eroded the physical presence of public space: the spaces in which people could meet, discuss, exchange

ideas and debate, by allowing communication to become channelled, or more recently, entirely personal. The party line was replaced by the individual telephone, the radio was supplanted by the television, which diminished the importance of the cinema and is in turn being supplanted by the video and by increasingly specialised cable channels. Communication, once a many to many experience, made up of multiple chance encounters, small meetings and larger ones, has increasingly become either one to one, in the privacy of the home or automobile or one to many, as the media bombard individuals with a huge volume of information. Political activity, on the other hand, has become a periodic many to one experience, as every two, for or seven years the public has a chance to send a signal to those who wield political power.

Increasingly, the places in which people met, discussed and debated have been replaced by individual appropriated spaces. Hence the city has been robbed of its character as a forum; its squares turned into roundabouts, its sidewalk *agorae* eliminated to make room for wider streets, as a procession of individual spaces, drivers at the wheels of their private worlds, listen to the radio alone or shout into cellular telephones. Along the narrow sidewalks file passersby, each listening to their own private soundtrack, plugged into the world of their Sony Walkmen, rushing home to their televisions to watch the videos they have just rented. Activities that were once shared, and hence created places and occasions for discussion, have all but disappeared. We have almost seen the demise of repertory cinema, and even mainstream films face stiff competition from made-for-video productions. The market, also once an activity in and of the street, has been largely replaced by the shopping mall, a public space completely appropriated by the commercial concerns that define it. Unlike the street market, which was always part of a public place, the shopping mall is a private space that has appropriated an ostensibly public function. Where are the places in which people meet to talk, to share ideas, to discuss?

On the other hand, and in contrast to the very public debate about access to scientific information, genuine public spaces in which this information can be shared, discussed and debated have all but disappeared from the life of most western societies. In largely eliminating the means by which people can act on information, even in a limited sense, they have been gradually reduced to being passive receivers of information, rather than generators. This transformation has resulted in a widespread feeling of impotence in the face of an ever-increasing flood of what Niel Postman calls 'garbage information'.

Because of the nature of the museum experience, almost in spite of its origins,and largely because of its perceived neutrality with regards the political dimension of science, the museum has become one of the last remaining civic spaces in which debate actually can take place. It is therefore incumbent upon the museum community to recognise this, and to take into account the social character of the museum visit in designing new facilities, exhibitions and experiences.

It is the position of this paper that the museum experience is primarily a social experience (confirmed by many writers, including Paulette McManus). This experience takes place in an environment wherein there are three principal participants: the visitor, the specialist, and the museum. These three participants interact in the artificial space of the museum, and in particular, in a space which we can call loosely the space of the exhibit, or following Baxandall, the space of the label, the space of interpretation.

Normally these participants are largely invisible:

1. The scientist, on whose authority the museum's rests, is not seen at work, and science is seen as a process that guarantees truth. The scientific method, and the myth of the power and progress of science, mask the contingent and tentative nature of science

2. The museum specialist (for example the curator or designer) is largely invisible, and is rarely credited: texts are written in a passive, neutral, detached tone, seeking to be transparent, and to be the voice of impartial science

3. The museum visitor is often given little role to play, in any but the best science centres (such as the San Francisco Exploratorium). Often only role is to repeat the designer's (museum specialist's) experiment. Open-ended exploration is rarely found

I would like to look at the activity of each of the three participants in the museum experience in some detail:

The first participant in the science museum is the scientist, and the role that science and technology play in the life of society is largely linked to the authority of science and the scientific community. Whence derives the authority of science?

The authority of science depends on witnessing. The history of witnessing goes back many centuries, and became of fundamental importance as the claims of a nascent experimental science had to supplant the claims of rival systems such as alchemy, geomancy and neo-platonic cosmology. A preoccupation with the presentation of results comes to us from the approaches to experiment developed in the Age of Reason. Following centuries of neo-platonic speculation, the rationalist scientist, while privately recognising the tentative nature of means he used to seek out the putative mechanical nature of the universe, nevertheless had to vouchsafe the validity of his results. Observation was certainly central to their experimental practice, but public corroboration of results was essential for science to triumph over its rivals.

Because of this need to claim public authority at the expense of rival systems, since the seventeenth century, the *public* emphasis in our culture has remained largely placed on the *results* of scientific enquiry, rather than on the process of generating questions, linking disparate phenomena or formulating hypotheses which underlie the real authority of scientific work. This public demonstration of the truths of science, necessary in order to combat "false belief" in rival systems, nevertheless masked the real nature of scientific investigation. Whereas scientists themselves have laboured for centuries in their laboratories trying to make sense of the messy and puzzling phenomena they studied, the public has been presented increasingly with a picture of science that advances surely and steadily towards the truth, never making mistakes.

Within the rationalist framework, the ultimate warrant for knowledge consists of witnessing. Moreover, this witnessing has to be impartial, untainted by bias or conflict of interest. In seventeenth century England experimental results could only be corroborated by gentlemen. When in 1667 the Royal Society wished to experiment on the transfusion of animal blood into a human being, resolved the dilemma of testimony by using an indigent who was possibly mad, (and thereby expedient to use him), as well as a Cambridge graduate, so his testimony could be credited.

On the other hand, toolmakers and technicians, so important to an experimental enterprise based on observation, were still largely "chemical servants", and had the skill, but not the credentials to make knowledge. The Royal Society was born from a desire to create a community of equals, disinterested free men attending to experimental phenomena without prejudice. This community of equals was, however, a community of gentlemen, and it was as such that Glanvill noted "the

relations of your Tryals may be received as an undoubted Records of certain events, to be as securely be depended on, as the propositions of Euclide."

And, although the private experiments of Hooke, Boyle and others were of course fraught with failure, and still carried with them the possibility of mistaken hypotheses, technical failure or defective materials, in order for these private experiments to become public knowledge, they had to be presented on the public stage. This stage was the Royal Society, and the Society wanted results on which they could discourse, and sharply reprimanded Robert Hooke when his experiments failed; "He made an experiment of the force of falling bodies to raise a weight; but was ordered to try it by himself, and then to shew it again in public." The message remains with us to this day, scientific practice, fraught with false starts, mistakes and failure, is to be confined to the laboratory, while scientific truth is a matter of public record.

The second principal participant in a science museum is the museum professional.

Even now there persists a naive belief, a residue from our 19th century past, that the universal approach to science made necessary by history and politics, often cobbled together with the putative universally salutary effects of a "hands-on" experience, can be translated into a universal approach to science learning. This ideology, often proclaimed by the champions of a certain kind of "scientific literacy" suggests that scientific information conforms to a single international standard, and moreover, it suggests that science can and must be absorbed by people with dramatically different social and cultural backgrounds, and to count as scientific knowledge, must be reconstituted upon demand in the same form as it was given.

As Drew Ann Wake, Canadian museum planner and anthropologist stated in her address to the Canadian Council of Museums in 1990, "In the museum community, this myth is dangerous because it puts a small elite of curators and exhibit designers in control of the way science is interpreted through our most powerful cultural institutions. It is pernicious because it weakens the demand for science exhibitions that respond to a variety of needs and learning traditions. It is my belief that these supposedly "universal" science exhibits are a form of scientific imperialism, in which science educators from privileged, urban backgrounds in Europe and North America define the scientific enterprise for the rest of the world."

The French particle physicist Jean Marc Levy-Leblond is also highly critical of the assumptions that underpin this belief, assumptions which underpin the majority of

surveys done into the "public understanding of science" in which respondents are asked whether the sun goes around the earth, or vice-versa. Rather than be aghast at the common finding that less than half of the respondents answer correctly, Levy-Leblond directs our attention to the assumptions that inhere in the question itself. On the one hand, he argues in his paper *Some Misunderstandings about Misunderstanding*, the question itself is badly put. As a physicist who asserts quite canonically that all phenomena are relative to the observer's position, it is obvious that the sun indeed does go around the earth, daily at that. The real question, he contends, should be instead, "what do the other planets do"? On the other hand, he argues that the ability to abstract is already a hallmark of belonging to a particular elite, that this ability, which comes from higher education, is alien to the thinking of many social groups, but its absence does not necessarily indict them of ignorance.

A second dubious premise stems from the idea that science can be communicated outside of a social context - that is, without reference to those who are on the receiving end of the communication. There is a profound belief in the museum community that exhibitions communicate equally to all visitors, without respect to their gender, class or background. Museum professionals, embedded in and loyal to the institutions they serve, treat museum visitors as empty vessels, coming to our institutions to be filled with information. Instead, visitors are more like full vessels; they come to museums with their own knowledge, interests and preconceptions, based on where they live and what they do for a living.

A study conducted last year by Dr. Brian Wynne, of the University of Lancaster, interviewed sheep farmers in the Cumbria, England, where the effects of the Chernobyl nuclear accident had forced farmers to close some of the country's oldest sheep farms. Wynne's team found that the British farmers possessed a high level of scientific understanding in their own realm of experience. Moreover, the farmers had a keen interest in radioactivity and had developed theories of their own as to the rate at which radioactive byproducts would leach out of their own, clay-like soil. Wynne concluded that the farmers of Cumbria had integrated the information they received from experts with the information that they saw to be true from their experience of the world. Far from being empty vessels, they were active participants in the construction of scientific understanding.

Brian Wynne's results suggest that members of the public may filter the information they receive from museums and science centres through a social context that has been affected by many factors: age, gender, class, and generate knowledge from their own daily experience, experience coloured by occupation, education and gender. As

Gerard de Zeeuw of the University of Amsterdam points out "... new actors can introduce new points of view, with new 'obstacles', and solutions of new problems can change the solutions of other actors. That is to say, actors cannot be replaced by their models, and remain an unpredictable resource."

Science is fundamentally messy, fraught with debate and with failure, with loose ends, false starts, dead ends and unexpected discoveries. The attempt on the part of the museum professional to build in certainty is to rob the visitor of a rich and profitable form of engagement, and an experience that lies at the root of scientific creativity. It is in this egregious way designers of science exhibits often fail their audience, by building in correct answers; preventing the visitor from formulating their own questions or constructing the means to seek their own answers. The challenge is for the museum community to resist the temptation of building-in, imposing strategies "from the top down", however well meaning and however cleverly disguised.

All too often, museum professionals put the visitor in the role of receiver, rather than generator, of scientific thought, the same position they find themselves in when confronted with news of political events. While passive in front of the TV screen, museum visitors participate, certainly. They push, pull, blow and bellow, but only rarely can they actually investigate a question that is of personal interest to them. The underlying message to the public is that only scientists can define the subject matter of science. This deprives visitors of the chance to experience one of the most satisfying aspects of scientific behaviour - the pleasure of finding new answers to their own questions.

Finally, the third participant in the science museum is the visitors themselves.

In the museum setting, the activity of visitors in particular is enhanced by 'supports', whether this be in the form of labels, text panels, exhibits or demonstrations. It is important to recognise that techniques are not in and of themselves supportive of the visitor. For example, the Musée national des techniques in Paris recently opened its collections to nocturnal visits, wherein visitors explored the collections with the aid of small electric torches. Objects in glass vitrines, mute and ignored in daylight, were the object of intense examination by visitors armed with a means of seeking out and examining what was of interest to them personally. On the other hand, a 'hands-on' exhibit demonstrating the principle of coupling frustrates any attempts at turning it to other uses, and is quickly abandoned by visitors whose interest in pendulums and frequencies is minimal. It is not the support itself that does the supporting.

Instead it is the ability for the support to be appropriated by the visitor, and used to explore, to examine, and to ask questions relevant to the experience and competence of the visitor. A support amplifies the reach of the visitor, and like the flashlight, illuminates and guides at the same time.

In this respect, supports must be developed that take account of the individual visitor, allow them to chart their own direction, amplify their existing competences, and enlarge the sphere of their own activity so that it becomes communicable, thus taking account and advantage of the social quality of the visit. Supports in a museum must be seen as a way of empowering the visitor, of not only recognising the visitor's role as a participant, but of conferring true actorship on this participation. For the visitor to truly matter, their involvement must really count. The visitor must actually be able to determine, in a non-trivial way, their own learning experience.

Evaluation can be used as a tool to permit the visitor to actively shape the exhibition, and insofar as this constant feedback and involvement can be made possible, evaluation can both recognise the competence, intelligence and activity of the visitor, as well as give them a direct involvement in the shaping of the exhibition itself, unmediated by specialist, designer or evaluator.

By first taking as our starting point the competence and activity of the visitor, and second, by insisting on a team approach to exhibition production, wherein scientists, designers and evaluators work together as equal partners, we can now begin to imagine creating exhibitions wherein the activity of the visitor, whether by means of interactive computer technology or by means of less-structured, open-ended exhibit environments, can actively change, revise and tailor the museum experience to fit their own actual needs. In this way evaluation serves not to model the user, and project this model as a constraint on future visitors, but to allows each actual visitor to shape the experience for themselves, and is thereby capable of taking into account not only past visitors, but future visitors as well.

How can debate be encouraged in a science museum setting?

First, by making each of the three participants a true actor in the museum setting:

- scientists must be constantly involved, and the process of doing science made evident. This can include workshops, laboratories, active involvement in the exhibit-making process and identification with the exhibits. In this way

different scientific points of view can be recognised and conflicts in science made evident. It is here that difference between the means of resolving scientific debates, and the political character of scientific decision making can be shown

• the museum specialist should be made to account for exhibits, and authorship ascribed (the Exploratorium already does this with artists). This allows the visitor to see the role the museum's own "voice" plays in the *mise en evidence* of the exhibition contents

• the visitor should have a real role to play: in being able to pose and answer their own questions, in interacting/engaging intellectually with the material, by recognising the expectations, competences and fundamental activity of the visitor in creating new understanding

Second, by making the roles played by each actor public and valuable:

As so much of the debate in, and about science is a function of its relation to authority, the activity of each of the actors, in the space of the museum, must allow the authority on which statements are made and conclusions drawn to be challenged. Insofar as claims can be made openly, their authorship established, and their authority corroborated or challenged, the science museum experience can become one in which the visitor's authority to question, explore, challenge and contribute can be reaffirmed.

• the scientist must be seen as an actor, engaged in a process open to question and inherently tentative and questioning

• the museum must be seen to exist, and if it is the museum's neutrality that confirms its role as a public space for debate, its own point of view must be seen to exist. The corruption of the museum's neutrality can be seen in museums who do not openly claim their corporate support relevant to exhibit design – the Sainsbury-financed Food for Life exhibition at the Science Museum was widely criticised for ignoring topics considered sensitive by the sponsor, such as genetically modified foods.

• the social dimension of the museum visit must be explicitly recognised, and the way in which the exhibit functions merely as a support for exploration, discussion and debate also made explicit. The exhibit does not exist in itself,

and if it exists in a social context, perforce it must allow for as many social interactions/dimensions as possible

By taking into account the activity of each of the principal participants, and second, by making the roles played by each participant public and valuable – by making each of the three participants actors in the fullest sense of the term – the museum can become a place for discussion, debate and learning, and the right of all participants to question, explore, challenge and contribute can be reaffirmed.

Scientific practice, fraught with false starts, mistakes and failure, was once to be confined to the laboratory, while scientific truth is a matter of public record, and is presented as a series of immutable facts, proven, demonstrated and beyond reproach. Technology is often the place where science becomes real for the public, and gains its cultural, ethical, political and moral dimension. If we wish to continue to live in a world where moral, political and cultural choices are a public, as well as a private concern, it is the role of the new science and technology museum to take advantage of its function as a public space, and to reclaim the openness inherent in the practice of science, to put this spirit of challenge, question and discovery into the hands of its visitors, and to become a place where debate about technology, science in action; its benefits, its liabilities, its role in modern society, can be conducted in the manner of science itself, thereby providing a model, not only for museums, but for debate and democracy in a world rapidly closing in on itself to the exclusion of both.

TEN YEARS LATER, AN EPILOGUE.

In the ten years that have separated the writing of this paper from its revision, the ideas contained have remained relatively constant companions of my work in museums. As a consequence of trying to implement them, they have naturally matured. Other people's ideas have also matured, and phenomena which were just beginning to emerge have in the meantime become fullblown.

In the late 1960s, the museum sector was heavily criticised for being old-fashioned, ineffective, and irrelevant. In particular, science museums were singled out for their inability to keep up with changes in science and technology, and to excite the younger generation about the material in their collections. Starting with the San Francisco Exploratorium, a new generation of informal learning institutions - the so-called 'hands-on' science centres - came into existence. There are now nearly 1000 such centres worldwide; most of which based in some measure on the original

Exploratorium. As these new centres did not generally have collections of objects, they were obliged to concentrate on the attractiveness and the educational value of their exhibits.

From the outset, ambitious claims had been made on behalf of interactive exhibits, largely at the expensive of the vitrines and the protected objects in the traditional museum. However, in a study conducted at Canada's largest science centre in 1989, Drew Ann Wake and her colleagues recorded the following startling findings: visitors tended to use hands-on exhibits for an average of under two minutes, and rarely completed them[2]. One the other hand, the same visitors were often prepared to spend over ten times as long with simple wooden puzzles. Moreover, while working on puzzles, visitors tended to talk with each other, share experiences and strategies, and use the opportunity for exchanging information.

Establishing whether learning has occurred is a difficult business, particularly in the informal setting, where as Frank Oppenheimer argued, ‘no-one ever fails’. Many hands-on science professionals responded to these criticisms by saying that the cognitive learning aspect wasn't important, it was the affective experience that mattered - the memory of the science centre would trigger future Einsteins to take up careers in science. Nevertheless, as informal educators, we were reluctant to throw away all our claims to being an educational environment, so it seemed to us that if a visitor spent no longer than 40 seconds with an exhibit, it was unlikely whether any serious learning had occurred, while still admitting the possibility of the occasional epiphany. On the other hand, while we could not say with conviction that learning had occurred if the visitor spent twenty minutes, it certainly seemed more probable. We therefore started to look at exhibits in a different light, and posed different kinds of questions.

It seemed to us that one of the most telling criticisms of many earlier science centre exhibits was the little time visitors engaged with them, the relatively low percentage of completion, and the low percentage of exhibits actually engaged with during a typical visit. Clearly something wasn't working. Part of the solution seemed to lie in redefining what sort of activity should be happening in the first place. Thus instead of looking for 'learning' in terms of observable cognitive gains - a series of facts learned - we had to look for sustained engagement with the activity. Instead of looking at our job as creating 'exhibits' to <u>show</u> visitors scientific principles, we had to look at them as 'supports' that helped structure and sustain interaction between <u>users</u>.

This shift entailed two important moves away from the way designers and educators had traditionally looked at their role. First, it meant that our task was to support action (or better, interaction), rather than broadcast facts - we had to become an informal learning environment, not an exhibition. Second, we had to see our visitors as users, which is to say that our success could no longer be measured in terms of numbers of visits, but in terms of repeated, thus sustained, action.

At roughly the same time, we discovered the research of the American psychologist of creativity Mihaly Csikszentmihalyi, a professor of psychology at the University of Chicago. In his first book, *Beyond Boredom and Anxiety*, he made a systematic study of people who engage in creative and intellectually challenging activities. In this work, Csikszentmihalyi dismantled the traditional distinction between work and play. He attacked the assumption that people engage in challenging activities – 'work' – only to solve basic requirements, such as income, for food and shelter.

Instead, he focused on vocations and activities that involve a high level of challenge, but are enjoyed for their own sake: chess, dance, music, art and sport. Csikszentmihalyi's theory was that '...people enjoy work, danger, and stress. The acts are 'work' in the sense that they require concentration and discipline, yet they give enjoyment and meaning to life.' To test this hypothesis, Csikszentmihalyi interviewed a number of people who engaged in these challenging spare time activities. He discovered that these activities offered intrinsic rewards to the participant in the form of 'self-confidence, contentment and a feeling of solidarity with others'.

He also sought to find out if there were any factors that would erode this sense of well being. The participants told him that when the activity was too difficult - beyond their abilities - they became anxious and unhappy. However, when the activity was too easy, participants became bored, and lost interest altogether. Here the chess analogy is useful. Playing chess against a stronger opponent produces anxiety, while playing against a poorer opponent can be dull. This research led Csikszentmihalyi to conclude that between the states of anxiety and boredom is a state, which he called 'flow'[3], where the level of challenge matches the abilities of the participant. It is this flow experience which draws people to an activity and maximises their enjoyment of it.

Activities that manifest 'flow' are self-initiated, self-sustaining, and often self-structuring. Csikszentmihalyi defines flow as 'a subjective state that people report when they are completely involved in something to the point of *losing track of time*

and of being unaware of fatigue and of everything else but the activity itself.' [italics in original] The experience should ensure that the opportunities for action are more or less matched by the visitor's ability to act at any given time. In order for this experience to be self-sustaining, it must also 'create the possibility for increasing complexity, to differentiate new challenges in the environment, to integrate new abilities into our repertoire of skills.' In order to continue the 'flow' experience, the visitor should want to return, to try the exhibit again, to do it better a second, third, or fourth time.

To survive in the 21st century, we began to argue that our museums must reason in terms of users, not visitors, and the user – in all her agency – must be at the heart of the museum project.

Since the time the paper was originally written, the overall political landscape – especially in the United States – has shifted dramatically to the Right. In the museum field, this can be seen in the trend towards unreflectively importing business models from the private sector. This means that the museum sector is increasingly described as part of the 'leisure industry', that informal education is increasing presented as 'edutainment' (just as the news has become 'infotainment', with 'reality shows' and re-enacted events). Museums are told they must compete in the marketplace with other leisure activities such as baseball games, theme parks, visits to the shopping mall and performances of light opera. Museums are exhorted to codify and imitate 'best practice', and the diminishing subsidy from the public purse is measured by 'performance indicators', 'value for money' and 'best value'. As McGuigan noted in 1996, 'the public sector has been required increasingly to function pseudo-capitalistically, which is not only an organisational phenomenon but a deeply imbibed ideological phenomenon and one which has had enormous impact on cultural agencies… and the network of arts-subsidising bodies'. Most pernicious among the rhetorical shifts is that museums are now encouraged to treat their visitors as 'clients'.

This innocuous change masks a far deeper shift towards a society in which our agency is defined increasingly in terms of choices we make as consumers – and not as social and political actors empowered to democratically determine the conditions under which we live together, and co-incidentally, produce, distribute and consume. As McCullough says looking back to the transformations wrought by the Industrial Revolution, 'just as artisans had become labourers, now citizens became mere consumers.' 'I shop therefore I am', says Barbara Kruger, but surely citizens are more than merely consumers – and museum users are more than 'clients', purchasing an experience. Consumption plays an increasingly important role in contemporary society, a consequence of late industrial economics, but surely the challenge is,

on the one hand, to educate a generation of critical consumers, and on the other, to recognise and encourage a model of citizenship that includes the right to challenge, debate, question, and ultimately restructure the terms of the social contract. A museum is a privileged site for informal learning, potentially an important environment in which one can discover new cultures, test one's assumptions against the material evidence of the past, explore the differences that stem from different times and places – ultimately feel the uncommodified experience of wonder and inspiration while confronting the best expressions of human culture. Although it would be naïve to think that the museum is completely neutral, and that markets, politics and ideology play no part in the museum experience, nevertheless, facing a Book of Hours, a Vermeer, or a Beuys, one is a long way from being a just a 'satisfied customer'. If the customer doesn't experience epiphany – can she demand her money back? If the user is a client, it is not clear what the museum client is buying, what is being consumed, and what measures one could use to assess its value. Instead, I would argue that museums are not to be seen as sites of consumption at all, but as 'motors of the learning society', whereby the better the learning environment, the more the critical agency of the user is enhanced. In modern American, museums are places to 'empower' the user – not just as a consumer of pre-determined choices, but as an active member of society – as much a generator of experience as a receiver.

The best theories meet each other on the field of practice. Therefore I would like to describe four projects undertaken in the ten years since 'Going Public' was published to illustrate how some of the concerns voiced in 1991 were addressed by means of specific exhibition and museum projects.

Two distinct aspects of the demand for the recognition of and legitimation of the user - a 'bottom-up' strategy, which would address the criticism that the agenda for informal science learning was set from above (a criticism that applies equally to informal learning in general), can be seen clearly in two initiatives taken in the late 80s and early 90s - the Science Alberta Foundation, and the exhibition Mine Games at Science World, in Vancouver, Canada, both developed by Drew Ann Wake, in partnership with the author.[4] These initiatives express different aspects of the bottom-up strategy. The first looks at ways in which the skills of communication can be passed into the hands of non-professionals, and ways in which this allows interested citizens to set their own agenda for learning - to become generators, rather than just receivers, of scientific and technological information. The second looks at ways in which the exhibition visitor can become an active participant in framing questions and finding answers, not only to the de-contextualised scientific topics normally found in science centre exhibitions, but to the deeply inter-related social,

economic, and political issues that characterise much of the debate about contemporary science and technology.

The Science Alberta Foundation 1991 – 1993

In 1989 Drew Ann Wake and the author were asked to work with Coopers & Lybrand in preparing a feasibility study for an informal science network in Alberta, Canada.[5] The Board of the Science Alberta Foundation set off on its mission with the assumption that its primary role would be to raise money and give it to the province's major museums and science centres, which would in turn create science exhibits and programmes and send them to smaller communities. This was, very clearly, a top-down strategy. But it didn't last long. After consultation with various Alberta communities the Board of the Science Alberta Foundation re-examined the Foundation's starting point. From the beginning they had committed themselves to creating a broadly based science culture for Alberta, and they realised that a structure that was bottom-up could be the key to developing a model of science education for the twenty-first century. The Board developed a strategy that had these key features.

First, the network was to *decentralise* the access to science and technology exhibits and programmes, so that rural and small town residents would have equal access to stimulating ideas. Second, the network was to *deprofessionalise* the development of exhibits and interpretive programmes, so that a broader range of citizens would have the opportunity to make a contribution. Finally, the network was to *deinstitutionalise* the task of science communication, transferring some of the responsibility for science interpretation away from the large museums and science centres, toward individuals and communities willing to play a role in the public communication of science.

In most cases, institutions have relegated the audience to being the *receivers* of the museum experience. The challenge of the Science Alberta Foundation was to stand this traditional mandate on its head, encouraging citizens to become *the generators* of the experience. This approach was reflected in the kinds of model exhibitions developed by the Foundation – exhibitions which encouraged an entirely different form of interaction than that found in the science centres following the Exploratorium ‘hands-on’ exhibit model.

The *Body in the Library: Forensic Science and the Art of the Murder Mystery,* treats a subject we chose because of its links to popular culture. The exhibition was, in effect, a three-dimensional murder mystery in which visitors were challenged to research a number of scientific clues to discover who was behind the murder of a scheming young entrepreneur.

This exhibition challenged many of the traditional assumptions of museum and science centre exhibitions. Taking the role of the curator, for example, we chose a number of skilled individuals from the community. We sought the help of the Chief Medical Examiner of Alberta, who drew up a murder to our specifications. The Royal Canadian Mounted Police found and fabricated the exhibits. Librarians and lawyers from across the province developed interpretive programmes. Only two members of the twenty-person team, ourselves, had ever worked on a public exhibition before.

The exhibits, when they emerged, functioned very differently from the norm. For one thing, the visitor was not allowed to stand back and absorb the conclusion of the experts. Instead, they were asked to be participants in the process of solving a scientific dilemma. In effect, our non-professional curators, scientists and police officers, designed an exhibition that mirrored their professional lives. Of the myriad of pieces of evidence, for example, only a few were actually germane to the case, a frustrating fact of life for most officers of the law. Moreover, there was not one single correct answer to the murder. As in experience of many forensic scientists, the scientific evidence could be interpreted in a number of ways. Then too, the visitors were expected to do their own research. The exhibit areas included books so that visitors could carry out their own investigation. In effect, this exhibition shifted the locus of responsibility for study away from the curator, toward the visitor.

By framing the exhibition in terms of a problem to be solved, instead of the 'pinball effect', activity in the exhibition was more like that of a puzzle table, a similarity encouraged by the provision of worktables and chairs in each of the forensic 'labs'. Visitors sat, looked, read, and discussed their conclusions with each other. They often came back to the exhibition to complete a challenge or look up new information.

A bottom-up strategy is not limited to community development. Shifting the emphasis away from the institutions and towards the user is equally a powerful strategy at the level of the exhibition itself. At the exhibition level, bottom up means taking into designing based on the real concerns of the user, creating exhibits in which the user has a real role, and giving the user a real means to express opinions. In doing so, the institution moves away from being a purveyor of objective truth, to

being a forum in which competing views can be heard. Science, in this model, is less a body of facts to be learned, than a process of debate, discussion, and careful consideration.

Mine Games 1992 - 1994

Unique among our institutions of public education, the science centre can provide an alternative to the street as a forum for debate about the effects of science and technology, for three reasons. First, the science centre is considered by most citizens as neutral territory, where science and technology can be presented without political bias. Second, it is a place where discussion and debate can be supported by exhibits with a strong factual content. Finally, the science centre has trained staff who can create programmes that can be used to guide discussion and debate among its visitors.

It was shortly before the clashes over proposed logging at Clayoquot sound and the cancellation of the Tatshenshini copper mine in 1992 that the Wake/Bradburne Partnership was invited to develop a new gallery for Science World, a large science centre located in downtown Vancouver.[6]

It struck us that there were two clear ways to tackle the subject. On the one hand, the earth sciences could be treated as they have been in traditional science centres. Visitors would learn about geological time, the development of rocks, faulting and continental drift. Following the example of other science centres, we could link geological themes to newsworthy geological events that captured the public's interest - volcanoes and earthquakes. By treating the earth sciences as a subset of geophysics, we would follow a traditional path: separating scientific fact from social issues. We would treat the earth sciences as lofty, aloof, unsullied by concerns of survival.[7]

The alternative was clearly more challenging. Instead of an exhibition on the earth sciences, we proposed to look at how the geological sciences are applied in a political and economic context: in short, we suggested an exhibition on mining. This exhibition, entitled Mine Games, would deal with the issues surrounding the mining industry in our province, issues that have been increasingly the subject of heated debate in the press, on television, in parliament, and in the streets.

This single change - from earth science to mining - entailed a complete re-examination of the way in which the exhibition would be planned and designed. With a mining exhibition, we could initiate a debate about the future of the province, teaching visitors to evaluate scientific positions arrayed in support of any number of competing positions. An exhibition on mining would call into question the role the science centre should play in the life of the community, suggesting that the role of the science centre is to prepare visitors to participate in the social and political life of their community.

If the exhibition were successful, Science World would become the focal point of a unique social experiment. Visitors would be given the opportunity to learn a wide range of scientific information, not all of it in agreement. They would be invited to explore this information through debate and develop skills that would help them to understand, and to alter, the political process in the province.

Central to our exhibition strategy was the creation of an electronically supported, multi-media interactive theatre - a forum for public debate on the role of mining in the province. As the issues that face the mining industry in British Columbia are at once scientific, social, economic and political, the interactive theatre seemed to us the ideal vehicle for meeting the challenge of making the science centre a forum for debate. When we began designing the Mine Games exhibition, we took two starting points for the interactive theatre. First, we rejected systems that limited the audience's answers to yes or no questions. Second, we sought to find new ways to empower the visitor, to recognise their competence and to encourage their participation, in order that they can regain control, in some measure, of the information they are being asked to absorb. Interactive theatre is one means of reaffirming the visitors' control over information.

We hoped to demonstrate that by deliberately structuring the exhibition by means of games, and by providing an overall coherent narrative context in the form of the fictitious story of Grizzly, B.C., we could make visitors aware of the variety generated by other visitors (as well as by the actors in the story), and thus encourage them to invest a greater amount of time exploring the exhibition in an engaged and concentrated way. We were looking for the concentrated, social visitor behaviour that characterised the puzzle table-type of exhibit, rather than the frenetic activity that characterises behaviour around many exhibits that present isolated phenomena[8]. Our experience in Alberta had shown that there were several fruitful avenues for exploring ways in which

one could simultaneously increase both variety and coherence, and create an exhibition that while remaining non-linear, was nevertheless cumulative and coherent.

By using games consistently throughout the exhibition, the exhibition also encouraged new learning styles. The stand-alone exhibit commonly encourages a particular kind of interaction - visitors engage with the exhibit, and push and pull every available protrusion until some identifiable pattern occurs, allowing them to discern the workings and intent of the exhibit. This learning style often characterises the behaviour of young boys. On the other hand, young girls more often read the instructions or study the exhibit before trying their hand at it, which when they do, they often do with a greater engagement and a higher level of participation than do their male counterparts[9]. By insisting that information be gathered prior to playing the computer games, the 'Mine Games' exhibition attempted to address the gender asymmetry in exhibition behaviour by encouraging all visitors to adopt a learning style (at least with regards to the computer games) that is normally associated with girls. Other exhibit elements throughout the exhibition permit different kinds of engagement and take into account the large variety in learning styles of the museum visitor.

Finally, the exhibition provided a way to challenge the traditional assumption that the museum experience is primarily individual, and that the defining relationship is between a single visitor and a single exhibit, despite ample research that demonstrates that the single museum visitor is exceptional, and that most visitors arrive in groups: school classes, families, friends[10]. Nearly all of the 'Mine Games' exhibit areas depended on groups being encouraged to work together to solve a problem (particularly problems depending on interactions between people, as given by the roles in the story), and structured the exhibits in such a way as to encourage the kind of social, information-sharing activity associated with puzzle tables.

If the purpose of our institutions of informal learning is in part to empower our citizens, they can only do so by taking into account the full agency of those citizens. In a world increasingly dominated by technology, and by those who would direct or dominate that technology, our science centres – and our museums of applied arts – must contribute to the public debate by showing that despite the rising tide of technical answers, the questions underlying are not solely technical questions, but social ones that the citizen has the competence to understand. Moreover, it is the responsibility of the citizen is to engage with these issues, and to become part of the broader debate on the uses of science and technology in contemporary society. The Mine Games exhibition put the visitor in the centre of social debate on science and technology - the visitors seem ready, willing, and able, to take that responsibility. In

putting an emphasis on the complex relationship between scientific argument and social debate, the Mine Games exhibition put the museum at the heart of the democratic process, and sketched out a new role for the museum for the future.[11]

newMetropolis 1994 - 1997

By way of further illustration of the dramatic shift in thinking about informal learning environments, I would like to use the example of newMetropolis, Amsterdam's national science and technology centre[12]. newMetropolis was, both implicitly and explicitly, a site for new research into strategies for supporting interaction in informal settings, and research played a major role in its development.

In order to describe a new kind of institution, and develop a new approach to informal learning, it was important to define what we were trying to improve. This was done in a deliberately rhetorical document that served as our guiding principles for the design process - a process that involved us becoming a community of learners ourselves, committed to change, new ideas, and experiment. This document spelled out the 'traditional' approaches in informal learning, and proposed new approaches in their stead. To begin with, the following obstacles were identified:

> ***The myth of the single visitor.*** *Exhibits are designed as stand-alone elements, each one demonstrating an isolated scientific principle or phenomenon, each one meant to work best with a single visitor.*
>
> ***The myth of pure science.*** *Many museum professionals believe that the role of a science museum is to teach scientific facts [...]. These science centres often shy away from subjects the public finds interesting, including issues in which the science and technology are mixed with social, political and moral elements.*
>
> ***The need to beguile.*** *Many science centre designers feel the need to make their subjects more 'fun' - by adding gratuitous interaction, by cloaking conventional subjects in the guise of popular culture, by using new technologies for their own sake. This approach betrays a fundamental belief that the science centre is school with a sugar coating - its goal to trick the visitor into the distasteful task of learning.*
>
> ***Top-down learning.*** *In many science and technology exhibitions, exhibits are reminiscent of textbooks. These science centres have created large numbers of*

> *'hands-on' exhibits designed to elicit specific phenomena or demonstrate certain well-known principles. [These exhibits] have a built-in 'right' answer, which, once discovered, exhausts the potential for further visitor interaction.*

The development of a new science centre, particularly one of this size and scope, gave newMetropolis the opportunity to draw together the lessons of the last several years.

Let me briefly describe one of the settings in newMetropolis.

Get Connected is a network of computer stations, each equipped with its own video camera and microphone which allows players to communicate with each other. The central feature of this area is an interactive game based on 'Quartet' (the English equivalent is 'Fish') in which players negotiate with each other to exchange 'cards' to complete different sets, using a dynamic interface which responds to their choices and prompts new ones.

In many significant ways, Get Connected is among the closest newMetropolis came to creating an environment in which the activity - and its content - is completely user-driven. Get Connected registers every player's activity, and makes this activity available to other users. At the same time, the user decides for himself among an unlimited number of strategies for game play - the players are free to shape the game in any way the wish, regardless of the original assumptions of the designers. This open-ended, endlessly modifiable game structure, which is continued as long as there are players to play it, we hoped to get close to what Carse calls an 'infinite game.' And, just as Superbankiers starts with the trade as the fundamental unit of financial transactions, in the centre of the circle of video-conferenced computers in Get Connected is a circular bench around which people can sit. In the centre of the circle are projected surprising and sometimes startling images, which we hope will prompt people to initiate conversations - the fundamental act of communication.

Our experience with the first 15,000 visitors showed us the importance of the user understanding, and more importantly, appropriating, the intention of the activity. When the game was first put on the floor, the emphasis was on the process of exchange. An introductory sequence explained the 'rules of the game', how to make sets, how to exchange, and established a value for each successful exchange, in one of four languages. After very little time it was clear that the experience was confusing. The user was not prepared to follow the introduction, and was more interested in using the microphone and video link to contact other players than in playing the game. This in

itself we took to be a positive signal, and in fact we observed teenagers using the video links to flirt with each other. In one case a teenaged girl covered up the video lens when contacted by an unknown young man - in another case we saw a young couple chatting briefly, an hour later we saw them spooning in a corner. Clearly the exhibit could be called a success - at least in some respects!

We saw that users grasped the idea of making contact, and that they engaged quickly in communicating with each other - contact was sustained. What was missing, however, was a clear and intuitive understanding of the latent possibilities of the exchange, of structuring the nature of the contact. The graphic interface was modified several times to make the exchange process more clear. The cards of the other players were displayed more easily, the cards to be exchanged were highlighted, the length and complexity of the introduction were reduced. None of these modifications seemed to increase the amount of structured activity among users.

We decided to take a more drastic measure. We replaced the sets of images with real cards - from ace to ten, in the four suits. Almost immediately we noticed an increase in structured and sustained activity. Visitors whose microphone failed could be heard to shout to other visitors 'I'm looking for tens!'. Another modification also increased structured activity. This was to replace point reward for making sets with a time reward. The user was given a fixed amount of time in units on a 'phonecard' to start with, and the number of units decreased with time. More units could be added to the card by successfully completing sets. Almost as soon as these changes were implemented we observed as harp increase in activity, co-operation, engagement, and concentration.

Let us recall De Zeeuw's definition of the features of a support system, which in many ways can also function as a model for citizenship: ‘a support system is open to any individual without any form of prior constraint other than the desire to use the system to maintain or increase their competence. A support system suggests to users a specific form of use, and possible extensions to this use, where a flow of information will provide the user with the additional resources needed, and, at the same time, be available to other users. A support system has only linguistic constraints on the information flow, and these constraints constitute the “user-language” of the support system. A support system supports the activities of the user, which stem from the user's own interests, experience and existing competence. A support system does not impose a model of the user, nor a model for the activities or the variation brought by the user. A support system maximises variety on the part of the users, and maximises the continued use of the support system in such a way that this activity is augmented and encouraged. In this

way, the support system serves as a means of recognising, responding to and enhancing the user's competences.'

newMetropolis can be clearly described as a support system. It succeeeds by putting the emphasis on the user - not by modelling her in advance, but like a good library, allowing for and supporting the activity of an infinite number of unknown and unknowable future users. The initial success of newMetropolis serves to confirm the usefulness of the approaches described above in creating new kinds of informal learning environments, and ultimately, new kinds of museums.

mak.frankfurt (1999 – present)

Perhaps even more than the science centre, the applied arts museum is an informal learning environment par excellence, but where can we put the skills we learn in the museum to use? The hard-won ability to distinguish between a Ming cup and a Q'ing bowl, a skill well within the reach of every attentive visitor, remains stillborn. The ability to detect the subtle difference between Kitsch and collectable leaves the museum unexercised. But it is precisely in the act of informed choice that one brings to bear one's critical skills. The act of choice - especially when it comes to choice that matters - is a fundamental part of creating the world around us. These choices can have political importance, such as voting, or joining a union, or demonstrating in the streets. More commonly, however, they involve a choice about how to deploy limited resources - of time, and of money. In a world in which identity is increasingly defined by what one buys - 'I shop therefore I am', according to artist Barbara Kruger- the choices one makes as a consumer increasingly define who we are and the shape of the world around us - at home, at work, at play. And it is in our museums of applied arts that we conserve the artefacts with which we shape our world, and in them we can hone the critical skills we need in order to exercise our citizenship in every respect.

On May 10, 2000, the former Museum für Kunsthandwerk re-opened its doors with a new name – mak.frankfurt – a new identity, new visitor facilities, and newly installed collections. What distinguishes the mak.frankfurt project from nearly all apparently similar projects, however, is the degree to which every aspect of the renovation is linked to an explicit ambition to experiment with a completely different relationship between the museum and the society in which it is embedded. Given a rapidly changing society, the threats to existing institutional structures, and the strategies designed to realign the museum with its users – how does mak.frankfurt function as an example of a new

institutional model? What changes at mak.frankfurt go beyond the merely cosmetic? Let us look at the mak.frankfurt project briefly.

There is now a new name outside the museum – the Museum für Angewandte Kunst – mak.frankfurt. This is not just a fashionable change of clothes to dress up an old reality. The new name means a new direction – with a broader mission, a new emphasis on families and young people, and an ambition to become a new 'piazza' in a multicultural city. From 1935 to 1999 the museum was called the Museum für Kunsthandwerk – the Craft Museum. But the meaning of craft had always been too narrow to properly describe the museum's collections – particularly of Asian and Islamic art, and it had also become too narrow to encompass the applied arts of the 20th century – notably the industrial design and digital appliances that are shaping our lives. The new name was no caprice – it was a necessity. The new identity is also an important signal. mak.frankfurt is not a traditional museum any longer – and its identity as mak eclipses the importance of its identity as 'museum', 'applied', or 'art'. mak.frankfurt is mak.frankfurt, and must take on a meaning uniquely its own.

If they are to avoid becoming marginalised, museums must concentrate once again on creating a cultural practice based on use - not visits. For the past few decades, in response to falling visitor numbers, museums have increasingly relied on 'blockbuster' exhibitions to bring in the crowds. While the visitor numbers have indeed soared, museums lost their identity and specificity. The museum of the 21st century, if it is to become more than just an empty shell for temporary exhibitions, must think in terms of users - not merely in terms of visitors who may come only once. Like the library, the museum must place the emphasis on its own collection, and find ways to encourage its use. If mak.frankfurt is to become a 'piazza', as part of its commitment to increasing the number and variety of museum users, it must offer facilities that *can* be used – rather than just visited. This means enhancing the features of the museum that are currently used – the café/restaurant, playground, the neighbouring park – and adding new facilities that encourage repeat use, such as a shop, reading tables, and frequently changing its permanent collections.

If the museum is to play a role as a new learning platform, it must have new facilities. mak.frankfurt now has wireless Internet throughout the museum, a multi-purpose reading room and lecture hall for debates, discussions and presentations, and three digital laboratories – in addition to its traditional applied arts workshops. It is not enough to have the facilities alone, however, they must be used. The museum has already developed a strong reputation for its courses and workshops, and these will remain a central part of mak.frankfurt's activities. As the museum's mission grows,

however, so do its possibilities.

For instance, in ROBO.mak, children can learn ‘hands-on’ with LEGO’s digitally programmable ‘Mindstorms’ building blocks – and can programme their own robots to follow trails, avoid obstacles, or climb walls. In conjunction with JP Morgan and the Bill Forsythe’s Ballett Frankfurt, children can learn about how they move – and use this knowledge to choreograph their own ‘ROBO ballet’. In 2002 ‘three-generation’ teams will be organised in conjunction with the largely immigrant population of nearby housing projects, whereby grandparents, parents, and children can work together to create the most entrancing robot ballet. In ‘Test Drive’, teenagers use the museum’s computers to evaluate the latest computer games – and to help pick the best games and websites for the museum’s ‘digital craft’ collections. The best of the young computer experts will be encouraged to work with the museum on a longer-term basis, forming the core of a volunteer crew that will help museum visitors of all ages learn the skills of surfing the Internet or making their own website. By the time they are in their teens, many young people have already far outstripped the possibilities of merely playing with computers – they want to get inside and tinker with them. The interactive programme hack@mak let’s would-be programmers tinker to their heart’s delight – and makes ‘hacking’ a positive learning experience.

Traditionally museums have often considered their visitors - when they considered them at all - as ignorant, or at best, as blank slates on which to write new information. In fact, the opposite is true. Far from being ignorant, our visitors are competent and intelligent, if we are to believe countless visitor surveys, often highly educated. Far from being blank slates our visitors come with existing experience, education, and opinions. Visitors create their own understanding, and the museum gives them opportunities to create new knowledge during and after their visit. We cannot insist on dictating the specific new knowledge they create - a museum is an informal learning environment - not a school classroom. The role of the museum is to create an environment where the visitor can explore the ways in which she can actively modify her relationship with culture, by enhancing her knowledge, piquing her curiosity, by honing her critical judgement. Learning is not an undifferentiated concept – learning can either be seen as the acquisition of new information, transmission from those who know to those who do not – or it can be the acquisition of new skills, directed by the learner and serving the learners own needs.

If museums are to fulfil their promise as privileged sites for learning in the next century, they must rethink the way in which they function, and become increasingly user-driven - in a word, more 'bottom-up'. In abstract terms this means taking the visitor's competence

and abilities seriously, and creating opportunities for the visitor to actively shape their experience in the museum.

But let me give a final concrete example to illustrate the notion of interactivity and engagement. In my office is a vitrine, specially designed for the Richard Meier monument of which I am steward. In the vitrine is a selection of beautiful glasses, from a 16th century Venetian masterpiece to a set of Boris Sipek glasses. I often use the vitrine to test new text panels – after all; we are not an interactive science centre! I have one text panel with the title 'Glasses through the century'. It is amusing, informative, and written in a popular style. Visitors to my office often stop to read it, and chuckle at the humour. I also have another text panel, with another title. This title reads 'One of these glasses is a fake'. The difference in behaviour is striking – often visitors stand for ages closely inspecting the glasses. Nor is the question trivial – after all, what is a fake glass anyway? All that has changed is the direction of the learning process – from top-down, to bottom-up. Of course our museums remain treasure houses of interesting and wonderful objects - objects that can be enjoyed, inspected, compared, and discussed. Texts can guide us through the history of our material culture, or help us look critically at the museum's objects - at provenance, style, composition, sources. Our eyes are sharpened by the process of looking. By honing our critical faculties the museum is indeed 'an institution for the prevention of blindness', as Nelson Goodman argued. And unlike the kind of top-down learning that one finds in most museums – which are sort of classrooms in disguise – the learning in mak.frankfurt will be increasingly bottom-up and learner-driven. This emphasis on the learning of new skills brings us back to the origins of the applied arts museum, and to the heart of its unique role in the museum world.

In the museum we must continue the tradition of our 19th century forerunners by being a centre for the acquisition of new skills. What are the skills needed in the next century? Just museums of the 19th century hoped to hone the judgement of consumers and producers alike, the museum of the 21st century must prepare its users to understand - and actively help create - the world they live in. In the museum that the visitor can develop the means of seeing better, choosing better, communicating better. It is in the museum that we explore the ways in which we discover, understand, and appropriate our culture, and in so doing, understand the debt we owe to cultures other than our own. Now more than ever, on the threshold of the next century - we must prepare the next generation to participate fully – as critical and informed citizens – in a culture that is becoming increasing European - and increasingly global.

[1] published Going Public: Science museums, debate and democracy, Planning Science Museums for a New Europe, UNESCO; Paris: 1993

[2] Wake, D.A. and Mitchell, J. An informal study of visitor behaviour at two exhibits, unpublished research paper, Toronto: Ontario Science Centre; 1987

[3] Cziksentmihalyi, M. Flow New York: Harpers; 1990

[4] Drew Ann Wake and the author worked on interpretive projects together since 1976. From 1989 until 1994 they worked together as the Wake/Bradburne Partnership, and realised several projects internationally, including those described in this paper. In 1994, Drew Ann Wake founded her own consultancy, LiveWires Design, based in Vancouver, Canada, and the author took up the position of Head of Design at newMetropolis, in Amsterdam. Drew Ann Wake is currently working on a computer game to sensitise teenagers to the dangers of Internet predators

[5] Drew Ann Wake worked in Calgary with the Science Alberta Foundation from 1989 until 1992. The following papers by Drew Ann Wake and the author give greater detail about the Science Alberta Foundation and its projects:

- La transhumance de la science:Le developpment d'un reseau des expositions itinerantes Conference Proceedings, PRELUDE, 1990, Namur
- Au-dela de l'oeil nu, Alliage No. 15, Nice, 1992
- Science des villes, science des champs, AMCSTI/Infos printemps 1993
- Priming the Pump: Building a Science Network in Alberta, in La Science en Scène, PENS, Paris 1996

[8] The economy of British Columbia is based largely on the resource industries - fishing, mining, and forestry, and the province has had a history of conflict over the development of these resources. In the case of Clayoquot Sound, environmentalists protested the logging of first-growth forest in an ecologically sensitive area of the Queen Charlotte Islands, and the provincial government's decision to allow selective logging of the area provoked strong criticism from environmental groups worldwide. The same provincial government cancelled plans for the development of what would have been the world's largest open pit copper mine in the Tatsenshini River basin in the far north of the province, by turning the entire area into protected area. This decision, which circumvented the normal planning process for new mining development, angered the mining community, who threatened to stop investing in British Columbia and turn their attention to other countries such as Chile.

[7] An excellent illustration of this exhibition approach can be found in the Earth Galleries of the Natural History Museum in London, which opened in the summer of 1996.

[8] An excellent example is that of the 'tuneblocks' exhibit, developed by one of the Exploratorium's Osher Fellows, Jean Baumberger, Professor of Music at MIT, and reported to Sally Duensing in a private communication in 1992. In the letter she describes the transition from random clicking to concentrated 'flow'-like activity once the user sees that she can use the exhibit to compose tunes

[9] Clawe, M.

[10] Notably in Falk, J. and Dierking, L. The Museum Experience, Washington: Whalesback Books; 1992

[11] This description of the Mine Games exhibition has been excerpted from the article Mine Games, which appeared in La Revue of the Arts et Métiers Museum in French, No. 10, March 1995

[12] for a complete description, see La problematique d'une création - newMetropolis
in Vers les musées du XXIe siècle - La Révolution de la Muséologie des Sciences Nouvelles perspectives américaines, européennes et australiennes ed. Bernard Schiele Presses Universitaires de Lyon: Lyon; 1997